

Environmental Impact Assessment, SISALCO 4.000 ha Pilot Sisal Plantation Project in North-East, Haiti

HAITI

EIA REPORT

Delivered to:


Ministry of Agriculture, Haiti and InterAmerican Development Bank.

Julio Guzmán

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Contact person is

JULIO GUZMÁN

 (+506) 8379-2116

julioantonioguzman@gmail.com

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EIA REPORT

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LIST OF ABBREVIATIONS

3BNP	Three Bay National Park (3BNP)
ACP	African, Caribbean and Pacific Countries
An	Annual
ANAP	National Agency of Protected Areas
APN	National Port Authority
APP	Anchor Points Project
Av.	Average
°C	Celsius degrees
CASEC	Council for the Administrative Section
CFC	Chlorofluorocarbons
CIAT	Territorial Management Institute
CIDA	Canadian International Development Agency
CIP	Caracol Industrial Park or Professional Identity Card
CO ₂	Carbon dioxide
CONAT	National Commission on Land Development
CT	Labor Code
CW	Community welfare
DANRRD	Department of Agriculture, Natural Resources and Rural Development
DGI	General Tax Directorate
DINEPA/CAEPA	National Directorate for Potable Water and Sanitation/ Autonomous Metropolitan Administration of Potable Water
DISE	General Inspectorate for the Environment
EDH	Electricity of Haiti
EPA	United States Environmental Protection Agency
Eto	Evapotranspiration
EU	European Union
Eva	Evaporation
FAO	Food and Agriculture Organization of the United Nations
GAP	Good agricultural practices
GFDRR	Global Facility for Disaster Reduction and Recovery
GHG	Green House Gases

g/mi	grams per mile
GoH	Government of Haiti
GPP	Good processing practices
GREF	Groupe De Recherches D'etudes Environnementales Et
ha	Hectares
HC	Hydrocarbons
HDDV	Heavy duty diesel vehicle
HDGV	Heavy duty gasoline vehicle
HGC	Haitian Gourde Currency
HH&S	Human Health and Safety
HTG	Haitien Gourdes
IDB	Inter American Development Bank
ILO	International Labor Organization
INARA	National Institute for Agrarian Reform
Km	Kilometers
Km ²	Square kilometers
LAC	Latin American and Caribbean Countries
m	Meter
m ²	Square meter
m ³	Cubic meters
mm	Millimeters
MAE	Foreign Ministry and Religious Affairs
Max	Maximum
MARNDR	Ministry of Agriculture, Natural Resources and Rural Development
MAST	Ministry of Social Affairs and Labor
MCI	Ministry of Commerce
MDE	Ministry of the Environment
M&E	Monitoring and Evaluation
MEF	Ministry of Economy and Finance
MICT	Ministry of the Interior and Territorial Communities
min	Minimum
MJ	Megajoule

MPA	Marine Protected Area
MPCE	Ministry of Planning and External Cooperation
MSME	Medium, Small, and Micro Enterprises
MT	Metric Tonne
MTPTC	Ministry of Public Works, Transportation and Communications
NIF	Tax Registration Number
Nox	Nitrogen oxides
NRCS	The Natural Resources Conservation Service
NTU	Nephelometric Turbidity Units
OAS	Organization of American States
OFATMA	Office of occupational accident insurance, sickness and maternity
ONA	Retirement Insurance Office
OPRODEX	Development office for the promotion des of exportable commodities
OSH	Occupational safety and health
PAP	Project affected person
PM _{2.5} :	Particle matter under 2.5 microns diameter
PM ₁₀ :	Particle matter under 10 microns diameter
POP	Persistent organic pollutants
PPE	Personal protective equipment
ppm	Parts per million
RH	Relative humidity
sec	Seconds
SMRCS	Service Metropolitain de Collecte des Residus Solides
SWANNA	Solid Waste Association of North America
UN	United Nations
USACE	The United States Army Corps of Engineers
USDA	The United States Department of Agriculture
WHO	World Health Organization

1 EXECUTIVE SUMMARY

1.1 *Project Description*

Sisal production could be a major part of the agricultural emphasis for the North-East Region of Haiti. In fact, this sisal project is a low-environmental impact:

FACTOR	REASON FOR LOW IMPACT
Water	No water requirement, except a small quantity for two weeks at the nursery level and washing the fiber
	No use of agrochemicals
	Zero waste: all residues will be utilized
Soil	Low compaction: land preparation once every 10 years
	No use of agrochemicals
	Zero waste: all residues will be utilized
Air	No emissions from agrochemical use
	Emissions from transport vehicles and decortication machines, which could be compensated with native tree planting
Vegetation/Wildlife	Project developed in former sisal plantations' areas, even inside the 3BNP. Sensitive areas inside the 3BNP will be kept aside and preserve (<i>Map 16</i>)

Furthermore, this project presents the following advantages:

- Sisal is a traditional crop in the North-East Region, which is an ideal location for the Sisal Project, based on soil quality, topography, climatic conditions, and logistics. It tolerates heat and drought well, a predominant characteristic in this area.
- Its products are always biodegradable, while other synthetic fibers are not and can cause environmental damage.
- Its leaves produce a strong natural fiber for rope, rugs, wall paper, and many other useful items.
- Sisal produces leaves for about 10 years and is extremely reproducible and the decortication process produces organic byproducts, which are excellent animal feed, insecticide or fertilizer and/or use for many other uses, such as bioenergy (which is the long-term plan of SISALCO).
- There exists a growing worldwide demand for natural fibers and SISALCO cannot – nowadays – fulfill the US market and national demand.
- There is a need for anchor projects to activate the regional economy.

The first stage of the project (1,000 ha planted by SISALCO) will be located inside the 3BNP, in two areas approximately located as following described (*Map 2*):

- 500 ha from an around 2,500 ha area, toward north of Phaeton.
- 500 ha located in Dérac.

The second stage of the project has to do with out-growers or “*petit planteurs*¹” plantations dispersed throughout a wider area, which exact location is not yet determined and which would supplement production in about 3,000 ha area. These area would be partly located north of National Route 6, among the towns of Paulette, Phaeton, and Savane Carrie (*Photo 2*), at about 46 km from Cap Haitien.

SISALCO S.A. aims to take advantage of the worldwide growing demand for natural fiber products through the quality of Haitian Sisal, while contributing to the creation of viable jobs in the agribusiness sector. These jobs will be created without further degrading the environment or exhausting the available water supplies; on the contrary they would be enhanced by complying with the highest environmental standards. Its vision of sustainable job creation outside Port-au-Prince (PAP) will support the Government’s of Hatiti’s (GOH) policy for decentralization, and create economic opportunities in rural areas.

1.2 *Analysis of policy and legal framework*

In order to comply with *OP-703 Environment and Safeguards Compliance Policy* and the national legislation, the project needs to apply the regulations/policies regarding Natural Habitats and Cultural Sites, civil society participation, and access to information, among others. In accordance with both regulations, Inter American Development Bank (IDB) and national, the project needs to carry out the following procedures:

- Ensure legalization of all firm (developer) documents, as well as, obtain authorization for the establishment of a commercial agricultural enterprise by the Ministry of Agriculture, Natural Resources and Rural Development (MARNDR).
- With regard to the small farmers, taking into consideration Haitian land regulations, the project needs to obtain a land use authorization – for lands outside the Three Bay National Park (3BNP) - with a regional planning strategy from the Ministry of Planning and External Cooperation (MPCE) and Ministry of the Interior and Territorial Communities (MICT). In the case of the small farmers located inside 3BNP is necessary to obtain approval from the National Agency of Protected Areas (ANAP) of the ESIA - for land use - and the project must ensure the respect of the protected area according to the scientific demarcation

¹ The leaders of the “petit planteurs” consider that there exist approximately up to 3,000 members, but provided a list of only about 360.

(Kramer et al 2016). Furthermore, the project must apply for a tax registration number (NIF) before the General Tax Directorate (DGI) and obtain the License for Operation and Professional Identity Card (CIP) from the Ministry of Commerce (MCI).

- The project needs to ensure that the workers' contract and conditions are in compliance with the Labor Code, as well as notifying the Ministry of Social Affairs and Labor (MAST) about hiring of personnel, registered for an insurance coverage before Office of occupational accident insurance, sickness and maternity (OFATMA), and in compliance with occupational health measures.
- The project must ensure compliance with the water management plans National Directorate for Potable Water and Sanitation (DINEPA), Ministry of Environment (MDE) , MARNDR, Ministry of Public Works, Transportation and Communications (MTPTC) and obtain permits for drilling from the General Inspectorate for the Environment (DISE) -MDE -, if needed. The project needs to follow specific custom regulations for agriculture with the Central Committee of Standardization of the National Port Authority (APN)/ Ministry of Economy and Finance (MEF).

1.3 *Main Potential Environmental Impacts*

Paragraph 1.1 described that this sisal project is low-impact, not only because of the agroecological characteristics of the crop, but also for the technological package that is intended to be used in its cultivation and processing.

Nonetheless, in order to avoid unexpected situations and reduce the risk of an eventuality, potential impacts are identified and individually evaluated, and a management and monitoring plans designed (Chapter 6). A summary of these impacts are depicted in the following Chart.

Chart 1 Evaluation of identified potential environmental impacts

FACTOR	IMPACT
NURSERY ESTABLISHMENT AND OPERATION	
SOIL	Fuel and oil spills caused by the use of machinery
	Sedimentation and erosion caused by surface runoff during rains and/or wind erosion
	Erosion in the slopes and river/creeks banks caused by land clearance and building of elevated beds
	Soil compaction caused by the use of heavy machinery
SUPERFICIAL AND GROUND WATER	Contamination of superficial and/or ground water caused by fuel and oil spills
	Contamination caused by non-treated effluents and sewage

FACTOR	IMPACT
AIR	Dust produced by wind erosion caused by exposition of soil materials during land preparation
	Emissions of GHG to the atmosphere caused by the use of machinery and transport vehicles
VEGETATION	Undesirable ecological regime shifts by scattered trees loss
COMMUNITY WELFARE	Dust, noise and vibrations to adjacent communities caused by the use of heavy machinery
HUMAN HEALTH AND SAFETY	Workers' risks caused by overload of activities performed
CONSTRUCTION AND FARM ESTABLISHMENT	
SOIL	Fuel and oil spills caused by the use of machinery
	Sedimentation and erosion caused by surface runoff during rains
	Erosion in the slopes along river/creeks banks with slopes of 20 %-30 % caused by land clearance
	Soil compaction caused by the use of heavy machinery
SUPERFICIAL AND GROUND WATER	Contamination of superficial and/or ground water caused by fuel and oil spills
AIR	Dust produced by wind erosion due to exposition of soil materials during land preparation
	Emissions of GHG to the atmosphere caused by the use of machinery and transport vehicles
VEGETATION	Loss of biodiversity in DBEF Shrubland and coastal areas due to agricultural related activities
	Undesirable ecological regime shifts by scattered trees loss
COMMUNITY WELFARE	Dust, noise and vibrations to adjacent communities caused by the use of heavy machinery
HUMAN HEALTH AND SAFETY	Workers' risks caused by overload of activities performed
OPERATION	
SOIL	Soil erosion caused by water runoff
	Fuel and oil spills caused by the use of machinery
	Soil compaction caused by the use of machinery
	Soil contamination caused by agrochemicals
SUPERFICIAL AND GROUND WATER	Contamination of superficial and/or ground water caused by fuel and oil spills
	Contamination of superficial and groundwater caused by waste water from decortication and if any, agrochemicals runoff from in intercropping
	Contamination caused by not treated effluents and sewage

FACTOR	IMPACT
AIR	Emissions of GHG to the atmosphere caused by the use of machinery and transport vehicles
VEGETATION	Loss of biodiversity in DBEF Shrubland and coastal areas due to agricultural related activities
HUMAN HEALTH AND SAFETY	Workers' risks caused by overload of activities performed
TRANSFORMATION PROCESS	
AIR	Emissions of GHG to the atmosphere caused by the use of machinery and transport vehicles
HUMAN HEALTH AND SAFETY	Workers' risks caused by overload of activities performed

Note: IN= intensity EX= extension Sy= synergy
AC= accumulation EF= effect MO= momentum
PR= periodicity PE= persistence RE= recoverability
RV= reversibility

According to the evaluation carried out (for details see Annex 4), all impacts evaluated would require mitigation measures. However, the impacts related to agrochemical use and HH&S would be severe impacts that need close attention and especially detailed mitigation measures.

1.4 Conclusions summary

- ANAP and national authorities should ensure that developers follow some specific conditions for project implementation, by clarifying them in the agreement before project approval.
- In Haiti, and the North-East Region is not an exception, income is very low and land is not intensively used, because is mostly srubs/shrubs and current agriculture is low input, low mechanization. Furthermore, large landowners do not present dynamism.
- Plantation of sisal is suitable for the area of study, but inside the 3BNP DBEF Shrubland should be kept undisturbed. In all sisal plantations, the management and monitoring plans described in previous chapters should be followed.
- Sisal plantations will benefit in general the North-East Region environment.
- Poor maintenance of drainage channels provokes accumulation of piles of waste and sludge, which reduces drainage and are focus of diseases. Pollution destroys the spawning area of marine species and prevents migration of others, as well as, affects the coral reef and marine wildlife.

- Water availability for irrigation is necessary at the commercial sisal nursery, but the amount is insignificant comparing to its availability in the aquifer.
- No chemicals, hazardous materials, or explosives are stored in industrial quantities, but there could be some cases of small and disperse chemical contamination: small quantities of various chemical substances that could be mixed with demolition debris - from school laboratories and similar institutions.
- There is no risk of agrochemical contamination in the commercial sisal nursery and/or plantation.
- Warehouses are point sources of contamination.
- The sisal project will increase GHG emissions, because of the use of diesel generators to produce electricity and transport vehicles.
- The risk of pollution is very low if good practices of FAO and WHO are followed in dealing with fuel and oil.
- Environmental emergencies could come from anthropogenic actions and/or natural events.
- There exist several certifications that could provide a value added to the project and promote an even higher demand.
- Subcontractors do not follow the norms, because either they do not know the norms and/or it is not a requirement in their contracts.
- For all the environmental risks identified, mitigation measures have been proposed, according to international and IDB standards and policies.
- There are several requirements and procedures created by law that have not been developed within the mandated institutions.
- The definition of the protected lands that cannot be used for agro industrial production is a key factor for the project, as well as the previous approval of the management plan for the sisal project by the MOE.
- International conventions, environmental and labor laws regulate several aspects of the project implementation, day-to-day activities, and the powers of the authorities; however, local regulations have not been made available, nor do they appear to be related to the primary issues of intervention.

1.5 *Recommendations summary*

- The Project must follow the regulations provided by law in its activities. Additionally, the project must complete the requirements - created by law -, despite non-enforcement or non-response by the authorities.
- It is recommended that if the property falls on protected areas, measures should be taken.

- The Project must follow the regulations provided by the law in its activities. This is particularly true with regards to the creation of internal safety regulations, so as to ensure compliance whether or not a government institutional inspection is conducted.
- Conditions should be clearly stated in the agreement between government authorities (ANAP) and project developers.
- The project should maintain the vision about the importance of contributing to the development of the surrounding communities, keeping close communication with them, taking into account its financial benefit, and the improvement of the region as a whole, which in turn will contribute to improving the environment. Furthermore, the project should follow the management and monitoring plan and recommendations of this EIA.
- Inside the 3BNP restrictions on the use of land should be taken.
- Maintaining good agricultural practices (GAP) is essential in a sustainable agricultural production; therefore, its implementation would facilitate not only obtaining the certifications, but also the buyer's control. Furthermore, well informed and trained workers and managers provides complimentary monitoring and control functions, in coordination with ANAP, to ensure that the Fort Liberté peninsulas are not subject to illegal activities such as mining, charcoal production, and goat grazing, among other, not aligned with the conservation objectives of the 3BNP.
- The project should maintain the drainage systems clean. Therefore, it is important to establish a collaborative partnership with the Municipalities, as well as other community institutions and organizations since the beginning of the project, for this and other matters.
- Any building (offices and loading centers) should have septic tanks or treatment plants.
- Even though the aquifer could provide enough water to cover the requirements of the nursery, other alternative source could be explored, such as the development of a water retaining pond and the use of saline water.
- The project should secure store any chemical substance, according to FAO and WHO guidelines.
- If any, use only certified agrochemicals for the nursery and intercropping, preferably with no cloro (which is more persistent), of rapid degradation properties.
- The sisal nursery should only be located outside the 3BNP.
- Keep a close monitoring of water outlets, as well as, superficial and groundwater resources, every to six to twelve months.
- Use vegetative coverage in rows at the nursery to serve as retention of soil erosion and agrochemical runoff, diminish weed growth, among

other benefits. It is very important that the plant used (preferably a locally available) as coverage do not compete with the sisal and do not attract insects or favors any disease.

- Warehouses should be well located outside the 3BNP, for example, where there is no an aquifer below, upslope (not down slope), no houses, offices and/or cafeterias nearby, leaving an appropriate distance according to FAO standards.
- Provide - at least - contention measures, good ventilation, waterproof floors, retaining wall around (waterproof cement), protection equipments, and showers.
- Fertilizers, pesticides, and fuels should be stored in separate warehouses.
- The project should seek to be carbon neutral that means that emissions should be compensated, for example, by planting native trees, especially in the uphill to protect water production, but also in rows within the farm, as protective wind barriers, roads, and as buffer zones to aisle communities from the project.
- It is important to keep the necessary equipment to collect any possible spill of fuel and oil, especially in the service station and the storage place.
- Good monitoring of equipment and vehicles is necessary to put out of service any, which is not in good condition.
- Maintenance and repairing should only be carried out in the service station.
- The project should develop procedures to identify, prevent, respond, and mitigate environmental emergencies.
- The project should seek to use the best sisal variety to be adapted to the region.
- Some of the certifications that could be viable for this project are ISO 14000, Global Gap, Rain Forest Alliance, and Fair Trade, among others.
- All required, among others, environmental, H&S, and legal compliance norms should be part of the contracts of subcontractors.
- The proposed mitigation measures should be refined and adapted by the project. Therefore, in order to facilitate their implementation, an environmental management system should be put in place that includes several aspects such as energy and water quality and saving, integrated pest management system, and monitoring and evaluation, among others.

2 INTRODUCTION

The social and economic difficulties of Haiti are well documented over the last decades. Future priorities for Haiti in the economic sphere are in the sustainable growth of different local crops, which will improve living standards of its population.

The sisal project is a low risk and low impact project, because of the following reasons:

- Organic (no agrochemicals are used).
- Requires no irrigation.
- Zero waste (all residues/byproducts are utilized).
- Low compaction: land preparation once every 10 years.
- Tolerates heat and droughts, among other factors.

However, as part of it may take place in a recently pronounced protected area (the 3BNP, a former sisal plantation), IDB policies requires the project to be designated Category A². Environmental risks are low and manageable.

Sisal production could be a major part of the agricultural emphasis for the North-East Region of Haiti. Sisal is a plant that tolerates heat and drought well. Its leaves produce a strong natural fibre for rope, rugs, wall paper, and many other useful items.

Sisal produce leaves for about 10 years. All during the plants life it shoots out infants from its roots. At the end of the plants life, it produces a stalk about 15 feet tall with flowers and hundreds of infant plants, making it an extremely reproducible and abundant resource of fibre. The waste/byproducts that is produced from the decortication process is excellent animal feed, insecticide and/or fertilizer, among other uses such as bioenergy. Today, North Coast Development Corporation (NCDC) is using the waste produced to feed goats in the current drought being experienced in the northern region³ (NCDC 2015).

2.1 *Project Objectives and Scope*

The objectives of SISALCO S.A. are the following:

- Establish a SISALCO own plantation in 1,000 ha in the Hatian North-East Region.

² Any operation that is likely to cause significant negative environmental and associated social impacts, or have profound implications affecting natural resources, will be classified as **Category "A"**. These operations will require an environmental assessment (EA), normally an Environmental Impact Assessment (EIA) for investment operations, or other environmental assessments such as a Strategic Environmental Assessment (SEA) for programs and other financial operations that involve plans and policies. Category "A" operations are considered high safeguard risk. For some high safeguard risk operations that, in the Bank's opinion raise complex and sensitive environmental, social, or health and safety concerns, the borrower should normally establish an advisory panel of experts to provide guidance for the design and/or execution of the operation on issues relevant to the EA process, including health and safety.

Operations that are likely to cause mostly local and short-term negative environmental and associated social impacts and for which effective mitigation measures are readily available will be classified as **Category "B"**. These operations will normally require an environmental and/or social analysis, according to and focusing on, the specific issues identified in the screening process, and an environmental and social management plan (ESMP).

Operations that are likely to cause minimal or no negative environmental and associated social impacts will be classified as **Category "C."** These operations do not require an environmental or social analysis beyond the screening and scoping analysis for determining the classification. However, where relevant, these operations will establish safeguard, or monitoring requirements.

³ Personal interview with William Pitts, NCDC Director. It is a for-profit Haitian corporation with operations primarily located in Terrier Rouge Haiti, in the Northeast department. NCDC was conceived as a business development enterprise, engaging local citizens within the operations from management to daily labor. It focuses primarily on agribusiness related operations, but also has created non-agribusiness enterprises such as sewing and candle making during its existence.

- Develop 3,000 ha of sisal with outgrowers, which are mainly small and medium size farmers.
- Zero waste: all residues/byproducts will be utilized.
- Process all fiber in its industrial facility at Caracol Industrial Park (*Photo 1*).
- Partner with North Coast Development Corporation (NCDC) for nursery production and decortication process. The latter could be also carried out by local farmers' organizations.
- Establish strategic relationships with importers from USA, Dominican Republic, and Colombia.
- Increase gross margins.
- Build the capacity of 3,000 farmers and operators to 15,000 within the first three years and to 50,000 farmers and operators, within ten years.

Photo 1: **SISALCO facility plant in Caracol Industrial Park**



Source: *Eric Brusberg from Guzmán, Brusberg 2015.*

SISALCO's mission is to serve sisal products importers by exceeding minimum acceptable quality standards and by providing the highest quality products at the best possible price. It is working in both the sale side, by building relationships with customers through its outstanding service, and the supply side, by supporting farmers who are the key for its success. Most of these farmers are currently under the poverty line with very little opportunities. SISALCO's commitment to its customers and its country will be reflected through honest and responsible (sustainable development) business, and assist in the revitalization of this important and traditional agro-industry. Through this process it also seek to prevent further soil erosion by creating new plantations, where the sisal plants' root systems will have an anchor effect in the soil.

SISALCO is committed to supporting the conservation objectives of the Three Bay National Park (3BNP) and obtain international certifications that provided a value added to its final product.

2.2 *Project Location and related activities*

The North-East Region of Haiti has been determined to be an ideal location for the Sisal Project, based on soil quality, topography, climatic conditions, and logistics.

The first stage of the project (1,000 ha planted by SISALCO) will be located inside the newly established 3BNP (created in October 2013) (Map 1), where it has obtained a land concession, in an earlier sisal location, which nowadays is mostly covered by acacia - an invasive sp which will be explained later.

Map 1: **Location of 3 Bays National Park showing its landward and seaward extent, North-East Haiti**

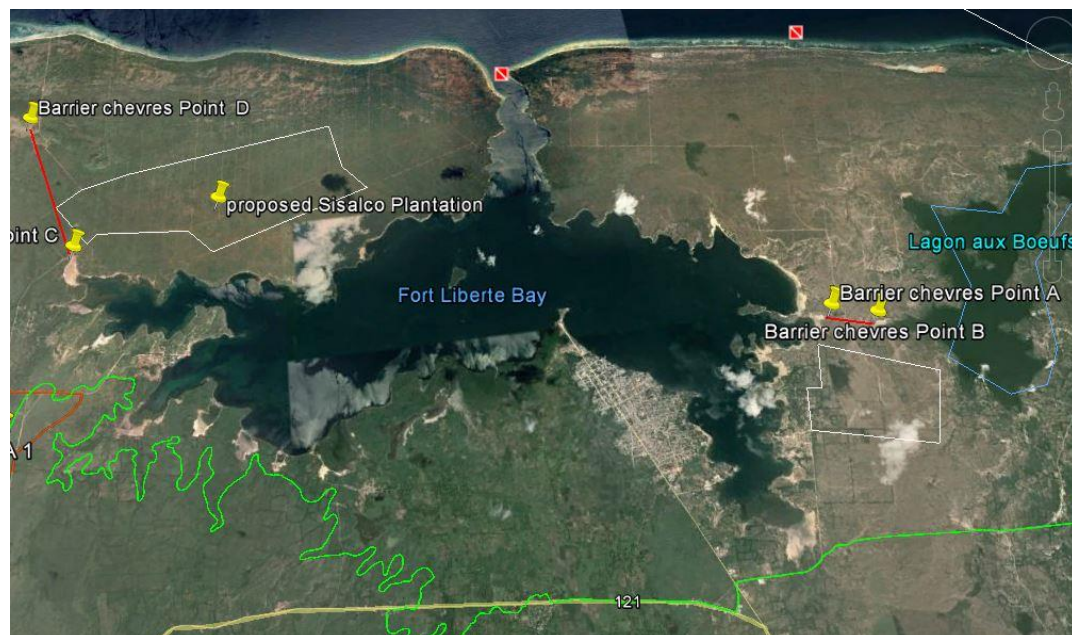


Source: *Kramer et al 2016.*

SISALCO's land concession is divided into two areas, approximately located as following described (Map 2):

- 500 ha towards north of Phaeton.
- 500 ha located in Dérac.

Map 2: **Approximate location of potential 1,000 ha SISALCO plantation**



Source: *Drumm 2016.*

Photo 2 shows a drone photograph of the area north of Phaeton (left side in *Map 2*), where we could see some dirty roads and intervened vegetation, with mostly invasive acacia.

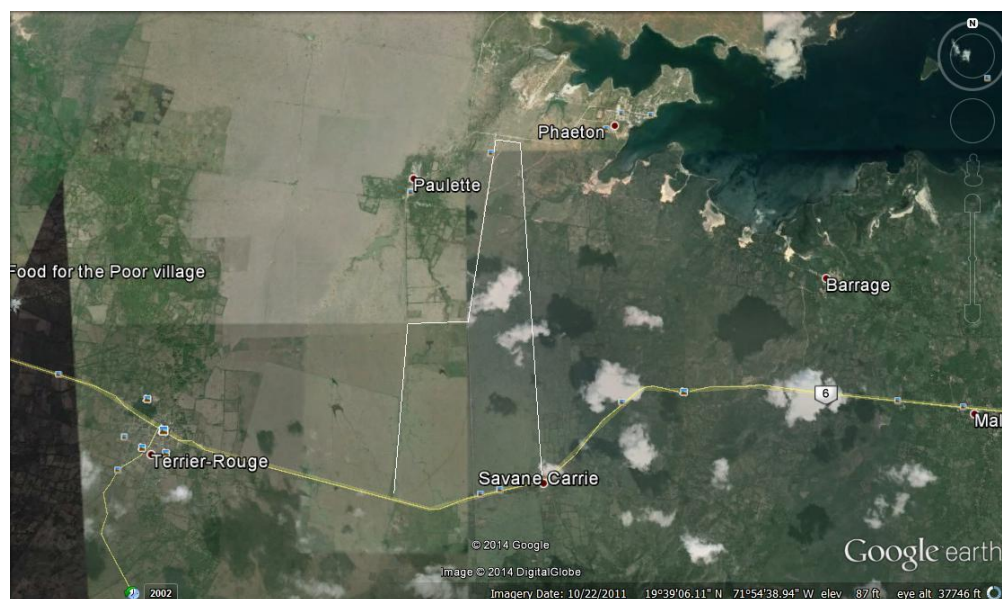
Photo 2 **Dron photograph of the SISALCO north-west area in Map 2**



Source: *Nicolas Clarens 2016.*

The second stage of the project has to do with out-growers, some of whom belong to the organization “petit planteurs” – and which plantations would be dispersed throughout a wider area, which exact location is not yet determined, but most probably outside the 3BNP. The idea is that they supplement production to SISALCO’s factory from about 3,000 ha area.

Map 3: **Approximate localization the outgrower’s area, North-East Haiti**



Source: *Google Earth 2015.*

In the surroundings of the outgrowers’ area, there are some main townships: Phaëton, Limonade, Trou-du-Nord, and Terrier Rouge, representing a first tier of settlements.

These townships are surrounded by countryside of medium sized farms, whose produce is generally sold or ex-changed at the township's market. In terms of land use, the townships are almost entirely configured as mixed use, with buildings serving as home as well as office, store, training center, phone booth, restaurant, among others. Hamlets are the second tier of settlements presented, and include places such as Caracol, Bor de Mer de Limonade, Phaëton, Paulette and Jacquезy. These are normally located along secondary or tertiary roads. A wide variety of farm types are found: from small farms alongside roads that house two to three generations, which are used for family subsistence and market exchanges of the surplus; to large estates exploited for sisal, plantain, citrus, sugarcane and other crops. The presence of small farmers along the internal roads is partly a result of the fact that they used (or continue) to be employed in the large plantations, whose owners have given them small parcels to settle. Other, medium parcels and farms are the result of subdivision of the large plantations over the years (IDB 2015) (*Photo 3*).

Photo 3: *Small producers' livelihood*



Source: *Sisalco business plan 2015.*

In general, this is an extensive rural area low-intensive land use; it is chiefly used for grazing livestock and harvesting of woody vegetation for charcoal. Outside the 3BNP, no natural forest exists; the landscape is characterized by brush and wild vegetation (*Photo 4*).

Photo 4: *Typical landscape in the proposed area of the project*



Source: *Eric Brusberg from Guzmán, Brusberg 2015.*

Caracol is the site of an industrial park, which is also inside the 3BNP (with a reliable electrical supply (*Photo 5*) and related services) and where SISALCO has already installed its processing factory.

Photo 5: **Thermal plant in the Caracol Industrial Park**



Source: *Eric Brusberg from Guzmán, Brusberg 2015.*

The North Coast Development Corporation (NCDC)⁴ has already established a nursery at Terrier Rouge (*Photo 6*). Interviews with the manager and staff indicated a considerable interest on the part of local farmers with larger holdings from five ha to 50 ha. The NCDC manager, William Pitts, believe that the optimal size for a small farmer would be on the order of three to five ha. Containerized export of finished products will be facilitated by way of the port at Cap-Haïtien.

Photo 6: **Sisal nursery from NCDC in Norther Haiti**



Source: *Eric Brusberg from Guzmán, Brusberg 2015.*

2.3 *The 3BNP (Kramer et al 2016)*⁵

The “Three Bays National Park (3BNP)” was declared in 2013, located in the northeast coast of Haiti, is part of a marine ecosystem of regional importance and high priority for biological resource conservation: elevated indices of biodiversity, around the bays of Caracol, Limonade, and Fort Liberté (*Map 1*).

⁴ The major goal of North Coast Development Corporation’s involvement in this project is to improve the lives of Haitian in the project area by giving them access to decent paying jobs, which can either come directly from involvement in the sisal industry, or can spring up from related intercropping opportunities.

⁵ All the information in this subsection is taken from Kramer et al 2016, not yet published. For more detail please consult the reference.

The Park boundaries are the following:

- *From the Western edge of Grande Rivière du Nord east for over 40 km to the border with the Dominican Republic.*
- *The seaward edge from the 12-mile territorial sea limit, inland up to the 10 m topographic contour line.*

The park presents the following characteristics:

- *One of the largest mangrove forests in Haiti, with about 4,274 ha (about 18 % of Haiti's remaining mangroves)*
- *The largest barrier coral reef on the north coast, stretching for over 20 km mainly along the seaward edge of Caracol Bay.*
- *A rich 20 km length of fringing reef on either side of the mouth of Fort Liberté Bay to the Haitian/Dominican border.*
- *The total coral reef complex (Holocene reef build-ups) is estimated at 1,100 ha (about 10% of the shallow - < 30 m - shelf area).*
- *The protected bays, mangroves, sea grass beds, and reefs are important spawning and nursery areas for fish, mollusks, and crustaceans; many of which serve as important source of protein for local communities.*
- *These habitats protect the northern shoreline from erosion, wave action, and storm surges.*
- *Provides an important habitat for endangered and rare species including turtles and manatees, and provides important inputs for offshore marine ecosystems because organic productivity is high. The main habitats of the Park include terrestrial, mangroves, inland fresh water, and marine environments.*

2.4 Project Description

SISALCO S.A. has been incorporated in February 2011, with the purposes of strengthening and expanding the production of natural fiber made of sisal to manufacture rope, twine and bags for the local market and export to the Dominican Republic, United States, Central, South America and the Caribbean.

SISALCO S.A. aims to take advantage of the worldwide growing demand for natural fiber products through the quality of Haitian Sisal, while contributing to the creation of viable jobs in the agribusiness sector throughout the country. These jobs will be created without further degrading the environment or exhausting the available water supplies. Its vision of sustainable job creation outside Port-au-Prince (PAP) will support the Government's of Hatiti's (GOH) policy for decentralization, and create economic opportunities in rural areas.

In 2012, it signed a Memorandum of Understanding (MOU) with "*Compañía de Empaques from Colombia*" (producers of natural fiber products out of Fique), for commercial and technical collaboration. They started buying Ropes and Fiber from Sisalco in the same year.

A 15 ha experimental Farm from NCDIC is the first objective to check sisal yield and other similar variables, before to immediately initiate with the planting of the first 1,000 ha of sisal. Production at the 1,000 ha scale is anticipated to yield some 2.5 to 3.0 tonnes/ha/year.

SISALCO's goal is to expand the plant production capacity from 3,000 Mt of twines and ropes per year to 10,000 Mt in five years and from 60,000 coffee bags per year to 200,000 also in five years. Further, its goal is to bring the Dauphin plantation back to a production of

30,000 tons per year in ten years. As articulated in the SISALCO business plan, an expanding and sustainable supply of raw material will hinge on building, “... *the capacity of 3,000 farmers, and operators to 15,000 within the first three years and to 50,000 farmers and operators, within ten years.*”

SISALCO business development plan envisions the establishment of a 1,000 ha pilot farm to provide a base level of production, a focal point for fibre processing, and a base for provision of extension and support services for some 2,000 to 3,000 ha of out-growers to be planted over the ensuing 5 to 10 years (*Photo 7*).

Photo 7: *In Fort Liberté talking to a representative of small farmers*



Source: Brusberg 2015.

Outgrower production would be owned and managed by cooperatives or groups of small agricultural producers. Small producers will ultimately provide the bulk of raw material to the company. SISALCO has signed an agreement (*Pré-Accord*) with the ministry of Agriculture, Natural Resources and Rural Development (*MARNDR*) to secure a lease for 1,000 ha of state land in an area of the former, and now abandoned, *Plantation Dauphin* (*Photo 8*). (Since its establishment in the early 1920's, the Dauphin Plantation planted extensive areas in sisal on Haiti's north-eastern littoral. The area grew to a size on the order of 20,000 ha; and at peak the plantation was exporting some 30,000 tonnes of fibre annually.)

Photo 8: *Current sisal plants in the area of the project*



Source: Sisalco business plan 2015.

For NCDC according to William Pitts' description, one of the goals of the sisal project is to put back into production enormous tracts of land that are almost completely useless today. The land has become overgrown with thorny and worthless shrub trees and grasses, and the only economic activities happening there at the moment are unorganized and inefficient cattle grazing and charcoal production.

The idea is also to create water reservoirs whenever possible to help the land and local people maximize the effects of rains, as well, reintroduce trees back into the areas along creek beds and other not suitable for agricultural purposes. Many of the trees to plant, such as mangoes, cashews, and almonds, grow very slowly, but have cash value that can be utilized by the local people in the future.

Then, the goal of this project is not simply to set up a sisal plantation, but rather to transform this area into a center of economic development and expansion, by empowering and giving local people the opportunity to make their own living, by participating in an organized and effective system.

2.5 Project Layout⁶

2.5.1 The nursery establishment and operation

The sisal nursery will consist of 25-50 hectares of very flat and well drained land outside the 3BNP, which has not been fully determined, with easy access to fresh water and totally cleared of any non-sisal plant life. The water could be from a manmade or natural preexisting retaining pond, and/or any creek or river that runs year round, or from wells of an adequate size and depth to pump multiple gallons of adequate water daily. The water is not required on a constant basis, but accessed when necessary; the requirement is 2,000 gallons per ha every two days for two weeks.

The operation of the nursery should require the employment of 50-100 people with varying and specified roles (2 person/ha/year). It should operate as its own system independent from the larger planting activities, but will need to be closely choreographed with the activities in the field to ensure a precise timing.

2.5.1.1 Land preparation

The nursery area will be divided into nursery subplots, 1.2 meters wide and as long as the land allows it. These plots will be constructed in advance - by the nursery crew - using a tractor, mechanical tiller, shovels, hoes, and rakes to create elevated beds of soil fortified by natural compost fertilizer. Prior to planting, these beds should be watered lightly to dampen the soil.

2.5.1.2 Bulbs harvesting and transplanting

The baby bulbs will either be the nuisance sucker shoots that grow from the root system of mature sisal plants, or will come from the tiny bulbs produced in the final stage of an old sisal plants life cycle. These sisal bulbs will be planted as tightly as possible depending on the size of the plants - being planted.

The bulbs will be taken from the field harvesters and transplanted immediately, trimmed of any unnecessary root material and then transplanted into their designated subplots. One of

⁶ This subchapter was developed in consultation with William Pitts from North Coast Development Corporation (NCDC) and, Marie Franco and Pierre Yves Gardere from SISALCO:

the major activities of the nursery operators will be to plant the sisal bulbs into their designated subplot, as they come in from the field.

The bulbs are planted using a simple system of poking the bed with a sharpened stick, to create a small hole for the bulb and then placing the bulb into this hole. After a bed has been filled with plants, the bed should be watered thoroughly to help alleviate the impact of the transplantation shock on the plants. They should be watered again every few days to prevent the ground from completely drying out until the bulbs can begin to produce new roots (2,000 gallons per ha every two days for two weeks). At that time, the plants should be able to obtain enough water from the soil without watering.

2.5.1.3 Agrochemical use

No agrochemical will be used in the nursery, neither fertilizers. It is been evaluated if natural compost will be used, when the nursery is expanded, but probably will not.

2.5.1.4 Bulbs harvesting and final planting

The final nursery activity is to harvest and prepare the bulbs to be planted on the field. The bulbs will be pulled from their beds and trimmed of any excess roots and then placed in large burlap or similar bags for transportation. These bags can be wetted with water to prevent the bulbs from drying out, if they have to be transported over long distances or are expected to spend large amounts of time in the sunlight.

2.5.2 Construction layout and farm establishment

The project will include the following most important infrastructure:

2.5.2.1 Roads and culverts

Roads and culverts are important for transporting the sisal from every harvesting plot to the decortication house and then to the industrial park. However, the design of the farm and in turn of roads and culverts is not ready yet, until the exact final location of the farm is authorized and acknowledged by the Government.

2.5.2.2 Drainage system

The majority of the area being prepared for and planted with sisal will not require any drainage system. The natural topography of the area will aid in preventing any damaging and prolonged flooding.

When necessary, drainage ditches could be built to drain water from the soil, in a perpendicular and irregular shape. They are classified according to their diameter and depth in primary, secondary, tertiary, and drawers. In their construction, heavy machinery is used, as dredgers and backhoes. The drainage system network could consists of two or three levels branch system of open canals completed with buried drains.

2.5.2.3 Flood protection

There really are no major rivers in the proposed sisal area (*Map 1*). The major task as far as flooding is concerned will be to build up roads that can be used during heavy rains. It is important that roads are rebuilt in a manner that does not interfere with natural water flow during heavy rains.

Apart from the main road (National Route 6) other public roads are most probably not suitable for the project (inside and outside the 3BNP); which means that some - few of them - will

be maintained and rehabilitated, but others newly constructed. The design could include, when necessary, concrete culverts for heavy traffic, and if necessary on main and primary drains crossing the roads; but not for secondary drains.

2.5.2.4 Buildings and facilities

Housing and facilities for the administration and management/supervisory staff, workers facilities, other operation and maintenance buildings will be constructed, which will be located in a central residential area for the whole plantation, most probably outside the 3BNP. Other buildings could be constructed in each farm and an office for operation management. Only the necessary buildings in town areas inside the 3BNP will be used; none of them will be constructed in agricultural and/or protective land inside the 3BNP.

Facilities for workers will include washrooms, toilets (included in every decortication house), and a dispensary (included in the main administrative building). Other buildings and facilities for operation and maintenance in the field may include: dangerous materials storage warehouse, materials warehouse, and an engineering shop (including tools and repair equipment), and a fuel station to serve farm vehicles and generators.

The dangerous storage warehouse deserves to be especially mentioned, because it is very important to decide where it will be located, taking into account the following aspects (FAO ____):

- Faraway from water courses, wells, and other supplies of water for domestic and stock animal use, because these could be contaminated by spillage and leaks from the store. Especially, not above a water well.
- Not to be in an area with high groundwater levels, which may be subject to seasonal flooding, nor should it be adjacent to a seasonal flood course.
- Not downslope, on the contrary upslope.
- Not near houses, cafeterias, and offices, among others. Not close to dwellings or to hospitals, schools, shops, food markets, animal feed depots, and general stores.
- There should be easy access for transport vehicles. Ideally, there should be access on at least three sides of the building for fire-fighting vehicles and equipment in case of emergency.

All buildings will have drinking water, electricity and sanitation. Housing will be provided only for management staff, including supervisors. Workers are living close to the farms in their own houses, and then it is not provided by the project.

2.5.2.5 Power and water supply

The project will supply the power necessary through diesel generators. The decortication houses, storage houses, engineering workshop, residential area, and offices will have separate power supply for water and electricity.

The water quality will meet the requirements of the Ministry of Health. In the event that the power station at Caracol industrial park is able to expand their range to include the sisal plantation area, electricity will be obtained that way rather than through generators. Furthermore, a long term SISALCO plan includes the development of biomass electricity generation.

Sisal do not need water during planting and/or maintenance.

2.5.2.6 Land clearing and preparation

Before sisal can be planted, the plantation lands must be cleared of the majority of the plant life already established in the area. This would include all mesquite trees, bushes, proposes juriflora and acacia farnesiana, or other plant species that grow to a height that could threaten the small sisal plants' ability to gather adequate sunlight and minerals; however opportunities will be explored to maintain IUCN redlisted cacti and gaiac.

The clearing waste should be pushed into piles to burn, or in some areas can be pushed into drainage areas to create small dams to help with water retention and reduce flooding risks. The mesquite trees can also be given to local people to produce charcoal. Larger trees can be left occasionally to provide temporary daily shade for the plants and to reduce the impacts of deforestation in the area. The land must also be cleared of any rocks large enough to damage tractor equipment. This will need to be accomplished with a bulldozer operated by a skilled and experienced driver.

After clearing the land, tractors will be used to prepare the soil for planting. First, a tractor will pull a deep digging plow across the land to break the soil and roughly turn it over. The plow will be followed by a heavy disc to further break the soil and create a more even surface for planting.

Depending on soil conditions, a good tractor operator should be able to prepare 3-5 hectares of land in a day.

Existing roads will be taken into account in the farm layout; which will include the cleaning of some dirty roads.

Typical land preparation could include the following:

- Land clearing if the area has not been cultivated for years.
- Land levelling and modelling for drainage purposes if necessary.
- Subsoiling the whole area to 90 cm depth for aeration, mixing and reduce the soil compaction.
- Horrowing the whole area.
- Construction of a drainage network.
- Construction of a road and culvert networks.
- Construction of buildings and facilities.

2.5.2.7 Transport, farm equipment

Transport systems for materials and personnel during construction and farm establishment will be performed with vehicles and trucks, while the farm equipment includes tractors with trailers.

2.5.2.8 Decortication house

The designed capacity of the decortication house has to meet the seasonal peak and will probably include a drier patio - for holding and initial evaluation -, processing area - where the sisal is washed, selected and hanged for drying -, storage room, dispatch platform – where the fiber is loaded into trucks.

Auxiliaries and facilities are needed in the decortication house: deep water well, generator, washrooms, toilets, and water supply and sewage system.

2.5.3 Operation layout

The project will include the following most important activities during the sisal production and transport to the decortication facility.

2.5.3.1 Planting

Planting should always be done a day or two after a good rain if possible, which will reduce the impact of transplantation shock on the small plants. These plants will come from the nursey and will already be prepared for transplantation by the nursey crew.

Rows will be mapped out using contractor's twine and ground stakes to ensure that the rows are straight and parallel to one another.

In areas where the soil is not conducive for intercropping, the rows should be planted in pairs two meters apart with a four meter gap between each pair (row < 2 meters > row < 4 meters > row).

In areas where intercropping is desired and feasible⁷, the rows should be paired one meter apart with a five meter gap between pairs. This will provide for a larger area between the row pairs for the cultivation of another crop plant. The plants in the row pairs will be staggered so that the rows would appear to follow a zigzag pattern if viewed from above.

Planting will be carried out by a team of 11 people (10 planters and a supervisor). One team of 11 people should plant at least one hectare of sisal in a day following this procedure.

There really should not be a need to treat the bulbs with any chemicals. Sisal is very resistant to most threats naturally.

2.5.3.2 Energy

The energy to be used by the project - for cultivation, cleaning, decortication and transport - will be fuel and electricity to be produced with diesel generators. Or with energy from the power station at Caracol. However, a long term SISALCO strategy includes building a bio-energy plant to be feed by sisal waste.

2.5.3.3 Agrochemicals

No agrochemicals at all for sisal production will be used in this project. Furthermore, for intercropping there will be not much need for agrochemicals. Depending on what is intercropped in the land outside of the sisal plantation, natural fertilizer may be used, but this will introduce no chemicals into the environment. Fungicides may be sprayed on some crop plants if needed. Weed control will be made with machete and low impact machine, no herbicides will be used.

2.5.3.4 Plantation maintenance

Maintaining the sisal plantation involves two major activities:

- *Keeping weeds and advancing shrubbery from choking out the sisal.*

⁷ There are a number of plant species that appear to be good candidates for intercropping, but the crops to be developed and where will be determined depending on the conditions of the area. The target region for this project is very hot and very dry. Traditional crops like corn or tomatoes would not fare well in this area without extensive irrigation systems. Other, hardier, plants like milo, sorghum, potentially peanuts, and potentially potatoes would be the best option for large scale intercropping. Smaller scale farming, including smaller family plots that would be offered to farmers tending to the sisal fields, may yield larger opportunities to grow more traditional crops depending on where the farm is located. Next to a creek or pond, they could potentially grow whatever they wanted to as water would not be an issue.

- *Removing the sisal bulbs as they begin to grow around the sisal plants.*

In areas where the plantation has been tailored for intercropping, keeping the land between the rows weed and shrub free will simply be a byproduct of it. This land will have to be tended for the crop to be productive, so this will prevent any plants from threatening the sisal between the rows.

In areas where there is no intercropping, the land between the rows will need to be cleared periodically, either by hand with a machete or similar tool, or with a tractor and a bush hog depending on the accessibility of the area.

The farmer will need to remove the sisal bulbs from around the plants at least once a year. These plants will be purchased by the nursery operation as both: an incentive for the farmer to make sure to stay on top of this duty and a means of keeping the nursery stocked with plants for future planting. The harvesting of the baby plants should be coordinated with the nursery to ensure that nursery beds have been prepared and are available for the new plants.

One farmer should be able to maintain at least 2 hectares of land. A group of farmers may find that they can collectively handle more than 2 hectares per individual.

2.5.3.5 Sisal harvesting

Harvesting the sisal is as simple as cutting leaves off of the plant. Each plant should be harvested two times annually, with only the leaves that protrude from the plant at a 45 degree (or smaller) angle relative to the ground. The leaves can be cut using any blade sharp enough to cleanly sever the base of the leaf from the central core of the plant.

2.5.3.6 Field transport

Once the leaves have been cut, they should be transported from the field to the decortication center in trucks or trailers pulled behind tractors to a leaf collection facility within one day, to ensure that the leaves can be weighed and processed before they begin to deteriorate.

Other transport systems for materials and personnel during operation and maintenance will be performed with vehicles, while the farm equipment includes tractors with trailers

As of now, the farmers will be paid US\$ 1.00 for every 100 kg of raw leaves. This equates to roughly US\$ 0.30 per kilogram of fiber, once it has been decorticated and dried. As the plants mature, the leaf to fiber weight ration improves, so this payment will have to be adjusted to make sure the farmer's production is paid fairly.

2.5.3.7 Decortication

Once the leaves arrive at the collection center, they will be transported to a decortication facility where they are further processed. The decortication center will consist of a large number of mechanized decortication machines that are all manned by a small crew of workers to keep fiber output as high as possible.

Each machine will have two workers who feed the sisal into the machine, and each five machines will share a worker who collects, washes, and hangs the fiber as it is produced. In three hours enough leaves could be decorticated to produce 35 kg of fiber.

The washed fiber will dry on what amount clotheslines build to support the weight of hundreds of kilograms of wet fiber. Here, the fiber will dry at least one day. After it is thoroughly dried, it will be collected and transported in trucks or trailers pulled behind tractors to the secondary processing plant where it is spun into whatever its final product will be.

The fiber will be rinsed in a trough of water that is continually refreshed by a well/cistern system. This water will be collected and used to produce insecticides, animal feed or fertilizer, among others.

2.5.3.8 Waste biomass

Some 95 % of sisal biomass is considered waste material. Only around 5 % of the leaf's mass is fiber, while the rest of the mass is water and leaf pulp. Some of the fiber obtained from each leaf will be of insufficient length to be used for twine production. This fiber can be used as an additive in particle board production, or can be used as stuffing for mattresses. The leaf pulp will be dried and used as an additive for animal feed or composted for use as fertilizer.

2.5.4 Transformation process

When the fibers arrived to the transformation facility, they undergo a complex process with many machines, to prepare the fibers to be transformed into the final product. The most relevant impacts are described below.

2.5.4.1 Further transportation

After the decortication, washing, and drying of the sisal fibers take place, this intermediate product will be transported in tracks to the final transformation facility at the Caracol Industrial Park (CIP), process after which the final product will be exported.

The transport from the CIP to the port will be also carried out in trucks.

2.5.4.2 Use of chemicals in the fibers

No chemicals are used to process the fibers/products. Only vegetal oil and water are used to hydrate the fiber, which are then brushed.

2.5.4.3 Use of chemicals, lubricants in the machinery

Only engine oil is used to lubricate the machine gears, but there is no residuals to be disposed afterwards.

2.5.4.4 Energy for the machinery

All the machinery work with electricity, obtained from the Caracol Industrial Park plant, which is a thermal plant, feed with fossil fuels.

2.5.4.5 Solid waste from transforming the fibers

During and after the process the following two kind of solid wastes are produced:

- Fiber from the brushing, which is sold to mattress manufactures.
- Sisal dust, which is collected and storage, while a process for its transformation is put into place, to be converted into a new product (briquette).

3 ENVIRONMENTAL AND LEGAL SETTING OF THE PROJECT

The data presented in the following chapter is the environmental and legal baseline of the project. The former, the state of the environment in the area of the Project (North-East Region of Haiti), specifically within the area proposed to develop the 4,000 ha sisal project, which includes SISALCO's 1,000 ha and outgrowers' 3,000 ha.

3.1 Environmental setting of the project⁸

3.1.1 Climate

According to *Map 5*, the Northeast Department has four climate zones (arid, semiarid, humid and montane altitude); the SISALCO project may be located in the arid climate zone, which sisal tolerates. The arid zone has 600-1,200 mm of annual precipitation with five to seven dry months and average temperatures between 25 °C and 27 °C (CIAT 2013).

The semiarid zone, where part of the outgrowers' project may be located, is characterized by an annual rainfall between 1,100 and 1,600 mm, with four or five dry months and average temperatures between 22 °C and 25 °C (CIAT 2013).

Sisal tolerates temperatures between 0 °C to 40 °C (Cabi 2016). In the area of the project, the average annual temperature is 26.6 °C, maximum annual 31.6 °C and 21.5°C minimum, accordingly to records of the P. Salcedo Station. Climate-data.org (2015) reports an average annual temperature of 25.8 °C, maximum annual 30.7 °C and 21.0 °C minimum. Both sources of data show a similar trend throughout the year. The highest temperature is found between June and September and January the coolest month (*Chart 12*).

Sisal tolerates till six consecutive months with average rainfall of less than 40 mm, and an annual average between 500 mm and 800 mm (Cabi 2016). *Map 6* shows the annual rainfall distribution of the North and Northeast region. The north and north-east region are divided in four different zones according the rainfall distribution. The driest area has less than 1,000 mm annually. The project will be located in this area in the 3BNP and closest to the Phaéton Town. The second driest zone has an annual precipitation of 1,000-1,500 mm. The other two areas show 1,500-2,000 mm annually and 2,000-2,500 mm, according to the climate zones in this area.

3.1.2 Hydrology

The sisal plantation does not require much water, except once at the nursery stage (2,000 gallons per ha every two days for two weeks) and in the decortication centers for washing the fibers (20-25 gallons per machine per day).

Haiti is divided in seven hydrographic regions. The Sisal project will be located in the North hydrographic region, which shows an average flow of 920 mm³ per year and covers an area of 2,490 km².

There are four main watersheds that drain into the Park: Grande Rivière du Nord, Rivière Trou du Nord, Rivière Marion, and Rivière Jassa (*Map 8*). The Grande Rivière du Nord accounts for almost two-thirds of the total freshwater discharge in the region and is large enough to flow year round, including during the dry season. The other watersheds are

⁸ The detailed environmental setting of the Project is in Annex 9.1, page 132.

smaller and without precipitation during extended periods of time, which may cause to run completely dry in their lower reaches. The steep deforested slopes of the upper portions of all the watersheds provoke very rapid and high flow discharges following storm events, which during high rainfall events may cause hazardous flash floodings and movement of large volumes of sediments. In the lower reaches of the watersheds that cross the Northern Plain, the riverbeds and river mouths may shift around from year to year building deltas, which may enter into the bays (Kramer et al 2016) (Chart 16).

Northern Haiti has a large aquifer that provides 250,000,000 m³ of water per year and is believed to be unconfined (ENVIRON 2011). This is a highly valuable resource given the freshwater constraints faced by many islands. In the coastal plain, from Cap-Haïtien to the Massacre River, aquifers are mostly less than 0.5 to 2.0 meters below the surface, and are rarely more than 20 or 30 meters below the surface. Given the alluvial and sandy soils of most of the plain, the coastal aquifer is highly porous and easily contaminated, particularly from latrines, unsanitary landfills, gas stations, and transport hubs. The growing impermeability in Cap-Haïtien is preventing aquifer recharge (Smucker et al. 2007).

In the communities of Caracol, Fort-Liberté and Ferrier, the water table are semi-confined, and the aquifer is semi-permeable. In the coastal plain of Phaeton and Dauphin, aquifers are conformed by cracks and porous limestone, and are permeable. In parts of plains of Caracol, Trou-du-Nord, Terrier Rouge, Fort-Liberté, Ferrier, Ouanaminthe and Carice alluvial aquifers are unconfined.

Inside the 3BNP the project will be located over two different types of aquifers (Map 10):

- *The location north of Phaeton will be over an aquifer with carbonate fissures and porous very permeable (yellow color north of Phaeton).*
- *In Dérac will be over an alluvial slick aquifer partly captive semi permeable (purple color in Dérac).*

The implications of an agricultural project on the aquifers would be that the most porous and permeable implies that agrochemicals – and/or any other type of contamination, for example non-treated sewage - could penetrate easier, polluting the aquifer; however, the sisal project will not use any type of agrochemicals, nor the associated intercropping that is proposed to be organic.

Permeability also affects the recharge timing of the aquifer, more permeability implies that the aquifer recharges more easily, but also that could be easily contaminated with saline water if the extraction rate is higher than the recharging rate. However, this project will not use any irrigation and will only use a minimum quantity of water for irrigation in the nursery and for washing the fibers at the decortication centers (as explained at the beginning of the current subsection).

3.1.3 Soils

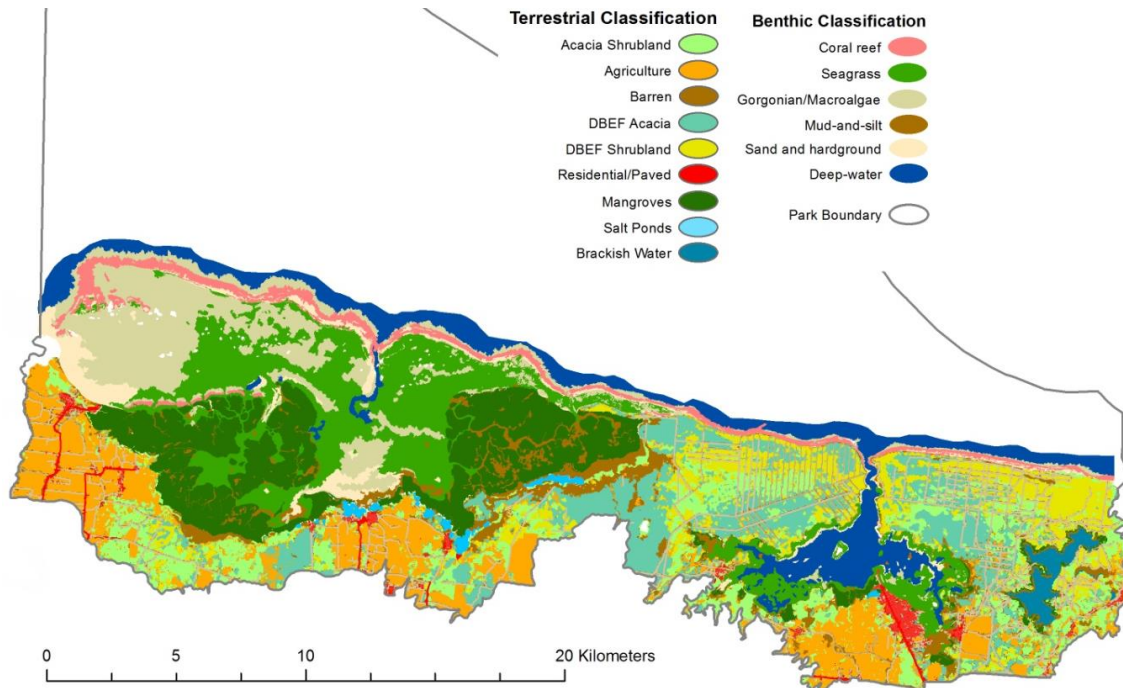
Sisal tolerates well soils with the following characteristics: reaction acid to neutral, texture light to medium, and type saline to shallow (Cabi 2016). The majority of the northeast region is compound by Ultisols and Entisols, with pockets of Inceptisols; with udic (the soil moisture control section is not dry in any part for as long 90 cumulative days) or ustic (there is at least one rainy season of 3 months or more) soil moisture regimes and Alfisols (Grunwald 2015; Hylkema 2011) (Map 11).

Inside the 3BNP and according to the land use potential, the SISALCO project will be located in lands that are classified from very good to mediocre for agricultural purposes (Map 12):

- North of Phaeton: classified as average (opaque green color).

- Dérac: one part classified as very good (light green color) and other part (northern) as mediocre (brown color).

Map 4 **Map of terrestrial land cover and simplified shallow water benthic habitat classes of the Three Bays National Park**



Source: *Kramer et al 2016.*

3.1.4 Terrestrial setting of the 3BNP⁹

Since the SISALCO's project is located inside a protected area, highly biodiversity areas should be kept aside, in this case DBEF Shrubland, as explained below.

The terrestrial part of the park is formed by natural and human altered environments including settlements, farms, roads, and fish ponds, among others. The coastal terrestrial habitat consists of 16,677 ha, supporting a variety of animals and plants. Since 500 years ago, the native terrestrial habitats have undergone significant conversion and use, ranging from small and medium scale agriculture to ranching.

The terrestrial vegetation associated with the three main land use classes: Human Altered, *Acacia farnesiana* Shrubland, and Dry Broadleaf Evergreen Formation are following described (Map 4).

1. **Human Altered (HA):** includes active agriculture, fallow fields, roads, and buildings and was ~7,300 ha (~44% of the terrestrial portion of the park).

These lands are dispersed throughout the entire park, on both soil and rock depending on the usage of the land. The largest area of HA is agricultural with a variety of crops being grown. The HA class areas have low plant diversity that is primarily filled by

⁹ All the information in this subsection was taken and adapted from Kramer et al 2016, not yet published. For more detail please consult the reference.

weedy, widely distributed native and non-native species including a number of invasives. While some areas are monoculture, the vast majority are a mix of a variety of crops including annuals (rice, corn), perennials (sugar cane, beans), and fruit trees (primarily Mango).

All riverine habitat was grouped within the HA habitat type, which present very little intact native vegetation. Agriculture and roads occur directly adjacent to the rivers. In some cases, a few areas with native aquatic plants are present and noted.

2. **Acacia farnesiana Shrubland (AFS)**: the dominant vegetation type, particularly in the drier eastern sides of the park, which have had been cultivated in previous years, with approximately 3,400 ha (~20 % of the park). In areas that have been left fallow and for grazing it occurs as a monoculture, often growing in iron rich clay alluvial deposits. The vegetation is 2-3 m in height and forms a canopy over time. Very few species are able to co-exist within an AFS area. It is unsuitable as feedstock for grazers as it has an extensive system of 2-4 cm thorns along the stems.
3. **Dry Broadleaf Evergreen Formation (DBEF) Shrubland**: habitat that occurs as two distinct types - DBEF-shrubland (DBEF-S), which contains predominantly undisturbed native vegetation and DBEF-Acacia (DBEF-A), which is partially invaded with *A. farnesiana*. The total spatial area of DBEF (both shrubland and Acacia) is approximately 5,700ha (~33% of the park). DBEF is 1-4 m in height occurring in areas with mixed clay and limestone substrate.

DBEF-A are areas that could be used for agricultural activities, due to its low biodiversity value.

DBEF-S is a high diversity vegetation type with many native species, which occurs as a band approximately 2 km wide and is fairly common along the two peninsulas north of Fort Liberté that forms Fort Liberté Bay.

All areas of the DBEF-S surveyed appeared to have been disturbed at some point in the past and had *A. farnesiana*. In areas with a rock substrate there was less *A. farnesiana* as well as *Coccoloba uvifera*.

The SISALCO's potential 1,000 ha area of the project was in the past, for the major part, planted with sisal as for *Map 17* (contour outline with red), by comparison to *Map 2*.

3.1.5 Air quality

The sisal project will increase the traffic of cars and trucks, which means higher air pollution and emissions. Vehicles such as heavy-duty trucks will be used for transport the sisal leaves, fibers, and final products. Heavy-duty trucks are vehicles greater than 8,500 lb gross weight, equipped with heavy-duty engines.

3.1.6 Droughts risk

Sisal is resistant to droughts. A natural risk in the area of the project is droughts, which in most parts result in food insecurity and famine. During the 20th century, historical documents cite episodes in 1923-24, 1946-47, 1958-59, 1966-68, 1974-77, 1981-85. *Map 28*, shows that most susceptible areas for droughts are located in the northwestern, some areas on the southern coast, and part of the northeast region. Droughts normally occur between November and January, and from March to May (Thieme & Jacobs 2012; Government of Haiti 2010).

3.2 Institutional and legal framework

The project, in order to comply with OP-703 Environment and Safeguards Compliance Policy (Annex 9.12, page 131) and the national legislation, needs to apply the regulations/policies regarding Natural Habitats and Cultural Sites, civil society participation, and access to information, among others. Therefore, it should follow the procedures explained below, which are based on a meticulous study of the local legislation and the steps to be taken before different offices (Annex 9.13, page 135). Additionally, information related to the prerequisites/steps is explained in the matrix, in order to facilitate its fulfillment.

3.2.1 Previous to Project implementation¹⁰

The Project must ensure legal validation of all international firm's documents before the Ministry of Foreign and Religious Affairs (MAE), as well as to obtain MARNDR's¹¹ authorization for the establishment of a commercial agricultural enterprise.

With regards to the small farmers, the developer needs to promote the legal formalization of their associations in the Ministry of Social Affairs and Labor – MAST. At the same time, the project must start working on the establishment of the framework for the agricultural concession within the PA.

The project concession framework needs to accomplish gender equality in development (IDB policies). With that purpose, the project must strive to create - as far as possible - the same conditions and opportunities for women and men, such as negotiation and contracting. Decision making and land concessions must be directed to women as much as possible.

Taking into consideration Haitian land regulations, the project needs to obtain the authorization of compliance for land use as follows:

- When located outside the 3BNP: with the regional planning strategy from the MPCE/MICT.
- When located inside 3BNP, is necessary to obtain ANAP's approval of the ESIA for the use of the land.

In the case of the plantations inside the 3BNP, once the small farmers are legally formalized, and the ESIA is approved by ANAP, the project needs to formalize the Memorandum of Understanding between DGI and the small farmer's associations for the land use authorization, as well as ANAP/MdE. In parallel, the project must elaborate the draft and agree on the terms of the concession between the investor and MARDNR.

Special attention must be paid to comply with IDB regulations regarding to the small projects/farmers' location. Haitian decrees create different levels of protected areas within the 3BNP. Scientific studies have been carried out to define valuable ecological zones and demarcations inside the park. If the project includes small farmers located within the 3BNP, it must ensure respect for the scientific demarcation.

After formalization of the firm's legal documents, the authorization of MARNDR for the establishment of a commercial agricultural enterprise is required, as well as, the land use authorization from MPCE/MICT. Then, the project must apply for a tax registration number in NIF/DGI, and make an initial capital deposit in the National Bank of Credit. After obtaining the NIF, the developer should obtain the Quitus Fiscal for Franchise from DGI. Once all

¹⁰ Legislation detail in Annex 9.14, page 139.

¹¹ <http://www.doingbusiness.org/data/exploreeconomies/haiti/starting-a-business/> consulted on July 20th 2016.

these requirements are accomplished, the project must obtain the License for Operation and Professional Identity Card in CIP/MCI.

3.2.2 Project Implementation

The developer needs to ensure that workers' contracts and conditions are in compliance with the Labor Code, as well as notify the Labor Direction of MAST, within 8 days. In parallel, the project should obtain a workers' insurance coverage (OFATMA) and comply with the occupational health measures. Best practices will be taken into account to enrich the firm's Occupational Safety and Health (OSH) management plan (Annex 9.14. page 140 and Annex 9.17, page 146).

During the operation, it is important to comply with the water management plans before DINEPA/MDE/MARNDR/MTPTC and obtain permits for drilling with MDE-DISE.

For exporting, the developer must follow the guidelines of the Central Committee of Standardization (MEF-APN) regarding the specific customs' regulations for agriculture.

The following matrix summarizes the legal procedures already explained - that need to be accomplished before the Project implementation and during the production cycle.

Chart 2: Legal procedures

	Action	Preceding Steps
Previous Project implementation		
1	Ensure legalization of all firm's international documents MAE	Simultaneous
1.1	Promote legal formalization of small farmer's associations in the Ministry of Social Affairs and Labor - MAST	
2	Obtain authorization for the establishment of a commercial agricultural enterprise by (MARNDR)	
2.1	Establish a framework for agricultural concessions within the PA	
3	Authorization of compliance for land use outside the 3BNP with a regional planning strategy from the MPCE/MICT	
3.1	Obtain ANAP's approval of the ESIA for the use of land inside 3BNP	1.1 3.1
3.2	Formalization of MOU between DGI and small farmer's associations for the land use authorization and if inside the Park with ANAP/MdE	
3.3	Draft and agree on the TERMS OF CONCESSION between the developer and MARDNR.	
4	Apply for a tax registration number - NIF (DGI)	1,2,3
5	Ensure an initial deposit with the National Bank of Credit (BNC)	1,2,3
6	Obtain a Quitus Fiscal for franchise (DGI)	1,2,3,4

	Action	Preceding Steps
7	License for operation and Professional Identity Card - CIP in MCI	1,2,3,4,5,6
Project Implementation		
8	Determine land classification status when located inside project area in DGI and with local notary)	3
9	Ensure that workers' contracts and conditions are in compliance with the Labor Code of MAST	Simultaneous
10	Register for an insurance coverage for workers (OFATMA)	
11	Register for a retirement coverage for workers (ONA)	
12	Comply with water management plans in DINEPA/MDE/MARNDR/MTPTC	Simultaneous
13	Obtain permits for drilling in MDE-DISE	
14	When exporting, follow specific customs' regulations for agriculture with the Central Committee of Standardization (MEF-APN)	

4 PARTICIPATORY PROCESS AND SURVEY ANALYSIS

The participatory process is three-fold:

1. Participatory workshop held in the CIAT office in Port-au-Prince and participatory workshops about the draft ESIA.
2. Participatory general workshop about the final ESIA.
3. Questionnaire/survey analysis about the potential beneficiaries (164 interviews) and institutions (13 interviews) working in the north-east region.

4.1 Participatory workshops to inform about the draft ESIA

4.1.1 Participatory workshop held in CIAT office in Port-au-Prince

A participatory workshop was held at the CIAT office in Port-au-Prince on Monday, June 20th, with the participation of CIAT's high authorities, SISALCO, and IDB personnel (Annex 9.12, page 131).

4.1.2 Participatory workshop held in Terrier Rouge

A participatory workshop was held in Terrier Rouge on Tuesday, June 21st, with the participation of potential small farmers' beneficiaries, national institutions (MARNDP, INARA), and interested organizations (Petit Planteurs Association, North Coast Development Corporation, and SISALCO) (Annex 9.19, page 153). During the workshop the draft results of the ESIA were presented.

A summary of the relevant environmental interventions during this workshop, prepared by Al Thermil, Environmental Expert of the Ancre Program (MARNDP), is presented below:

The need for information about the project is noted. The concept of the 3BNP appeared as new for the representatives of the small farmers. They said that they do not know where are the limits of this national park, while they are in the area. Sharing information on the project is fundamental to avoid misinformation. Further, a participant noted that Sisalco products lacked to mention their origin.

Participants suggested to think about planting fruit trees to improve the already degraded environment. Small planters will ensure the respect of environmental standards by the actors and Sisalco. They reported that during the factory tour to Caracol, some operators were not wearing a mask nose while working in dusty areas. In the case of the sisal project, they will ensure the implementation of the recommendations in the field. Zoning is needed to know what to do and where to do it.

The Sisalco provided information on security concepts and protective equipment available, which are mandatory for factory workers. Sisalco ensures compliance with safety standards. Sisalco interventions will be on land that have beneficial properties to grow sisal. The lands

that have a more interesting potential for farm income that growing sisal will not be converted. Fruit trees will be supported, where they have a real chance of survival. Sisalco will have a good realistic management plan for the proper operation of the sites, particularly those of small growers.

4.1.3 Participatory general workshop about the final ESIA

A participatory general workshop was held on Tuesday 19th of July in Terrier Rouge, with the participation of potential small farmers' beneficiaries, national institutions (MARNDR, INARA), and interested organizations (Petit Planteurs Association, North Coast Development Corporation, SISALCO, and CA 17 International) (Annex 9.20, page 158).

4.2 Survey to community members

4.2.1 Interviewee's information

Sixteen percent of the people interviewed were women and 84 % men, regrettably a low proportion of women. From the total with an average age of 50 years, 37 % have at least two occupations, 20 % farmers, 13 % fishermen, 10 % domestic unpaid work, 5 % coal producer, 4 % with no occupation and the rest of variety of occupations. In reference to their education level 55 % have obtained primary school, 20 % high school, 3 % university, 18 % no education, and the rest other type of training.

4.2.2 Household information

About family members, in average there are 6 adults and 2 minors, and 74 % have wife/husband. More than 57 % of minors in the household attend to school.

In regard to houses, 61 % are owners of their home, 21 % lived in free houses from their employers, 12 % rent, and the rest other types of occupations. Houses have the following characteristics:

- 55 % are concrete, 30 % CMU/iron sheet, 2 % mud/straw, and the rest other types.
- 3 rooms in average.
- Only 45 % have toilets.

4.2.3 Land

Forty six percent do not own land, only 16 % own property land, 21 % are squatters, 10 % are sharecroppers, 4 % rent, and the rest others. Seventy five percent had planted sisal in the past, but 97 % do not produce currently, although 93 % are interested in producing sisal now.

The total average size of their land is 1.41 ha. In general, 31 % produce "pwaneg", 19 % corn, 11 % coal, 6% peanuts, 6 % manioc, 5 % sweet potatoes, and the rest others. About animals 26 % breed goats, 9 % horses, 7 % poultry, 1 % cows, and the rest others. In average, they have lived in this land for 40 years.

4.2.4 Community services

About services of the community, all are classified as very bad, except connectivity and education establishments (*Chart 3*). Most respondents 33 % answered that they obtain water from a well, 12 % buy from watertrucks, 10 % from a water tank, and the rest by other means. Sixty five percent answered that the water was drinkable.

Chart 3: *Opinion about community services*

SERVICE	VERY GOOD	GOOD	REGULAR	VERY BAD
Drinking Water	0%	9%	23%	68%
Energy	35%	13%	11%	41%
Connectivity	28%	61%	5%	5%
Health	1%	13%	46%	41%
Roads	7%	28%	27%	38%
Education Establishments	17%	72%	5%	5%
Sewage	0%	4%	6%	90%
Storm Drain	1%	1%	8%	90%
Irrigation	0%	1%	5%	94%

4.2.5 Environment and natural resources

The questionnaire asked the interviewees about the environmental and/or other problems they are facing, and only floodings and droughts obtained a significant percentage of answers considering them very strong events.

Chart 4: *Main environmental risk and/or other problems in the community, only opinions consider very strong*

FLOODING	DROUGHT	RAIN	HURRICANES	EARTHQUAKE	OTHERS
36	35	5	4	0	20

Beneficiaries were also asked about the current state of the natural resources in the community they live in, and their opinion is, for most of them, that river (93 %) and forest (80 %) are in a very bad (poor) condition, and soils (70 %) and air (93 %) are in a very good or good condition.

Chart 5: *Current state of natural resources in the community*

ESTIMATION	RIVER	FOREST	SOILS	AIR
Very good	0%	0%	40%	45%
Good	2%	2%	30%	48%
Regular	5%	18%	26%	7%
Very bad	93%	80%	3%	1%

Ninety five percent of the respondents answer that the project would bring a positive effect on the communities, and 91 % think it would not bring any negative effect, because it would allow them to work, have a source of income, and use abandon land. In order to make a

synergy with the positive effects they recommend taken them into account in all decisions and give drinking water to the communities, among others. Furthermore, 94 % think that the community will be in favor of the project and 99 % are in favor of it.

4.3 Survey to institutions/organizations

Thirteen interviews were made to institutions/organización, all of them working in the North-East Region: AREDE, JEOVA, RCAD/TR, Organizasyon Peyizan Nan Fon Blan, CASECDE, ASEC, MOPADEP, ASPLAD, Cooperative des Pecheurs de Derac, ADAF (ASEC), AEN (Association des Entrepreneurs du Nord-Est), CPPNE, and Kat Kooperativ Agrikol Terye Rouj.

4.3.1 Opinions about the community

Most of the respondents think that the following services are very bad: drinking water, sewage, irrigation, and storm drainage; regular: connectivity and roads; good: education establishments (Chart 6).

Chart 6: Opinion about community services

ESTIMATION	DRINKING WATER	CONNECTIVITY	ROADS	SEWAGE	IRRIGATION	ENERGY	HEALTH SERVICES	EDUCATION ESTABLISHMENT	STORM DRAINAGE
Very good	0%	8%	15%	0%	0%	54%	0%	8%	0%
Good	0%	23%	8%	0%	0%	0%	0%	31%	0%
Regular	15%	38%	38%	8%	8%	15%	69%	46%	8%
Very bad	62%	15%	23%	69%	69%	15%	15%	0%	69%

Sixty nine percent think malaria is a strong problem among community members, as well as 38 hypertension, 31 % diabetes, and 23 % vision problems.

4.3.2 Environment and natural resources

In relation to environmental risks and/or problems, 62 % think drought is a very strong probability risk event and 23 % flooding.

About the current state of natural resources, 69 % think rivers are in very bad condition 61 % that soils are regular to good, 61 % air and trees are regular to very bad.

Chart 7: Estimation about the current state of natural resources

ESTIMATION	RIVERS	SOILS	AIR	TREES
Very good	0%	8%	15%	15%
Good	0%	23%	8%	8%
Regular	15%	38%	38%	38%
Very bad	62%	15%	23%	23%

5 ENVIRONMENTAL IMPACTS

The proposed 1,000 ha plantation will tentatively be located within 2,500 ha allocated by “Direction Generale des Impots¹²” (DGI) to SISALCO inside the 3BNP. Because of the fact that this land is in a protected area, it requires an authorization from the Ministry of the Environment (MdE) prior to proceeding. Furthermore, as part of this land contains important biodiversity, its protection should be ensured.

It is expected that the loss of natural vegetation due to the project will be minimal, because it will be located in a former sisal plantation and this crop is low impact. However, taking a preventive approach, potential environmental impacts were identified in order to minimize risk and have contingency measures in case of their eventual appearance.

Thereby, some of the potential environmental impacts on the factors described in the previous chapter, and especially associated with access, land clearing, removal of vegetation and building of infrastructure, as well as, the normal operation of the sisal project, are described below.

The Sisal Project presents four stages: nursery establishment and operation, construction & farm establishment, operation, and transformation process. The factors that could be impacted during these stages are the following:

- *Soil*
- *Superficial and ground water*
- *Air*
- *Vegetation & wildlife (flora & fauna)*

Furthermore, human health and safety (HHS) and community welfare (CW) will be taken into account.

5.1 Major potential environmental impacts

The identification of environmental impacts is explained under the current section, according to the activities described in the project layout in the introduction (2.5).

5.1.1 Description of major potential environmental impacts during nursery establishment and operation

5.1.1.1 Soil

- i) Fuel and oil spills caused by the use of machinery (*Gilles and Kaufman 2010*).
- ii) Sedimentation and erosion caused by surface water runoff during rains and/or wind erosion (*Perlman 2016, Meyer 2016*).
- iii) Erosion in the slopes, if any, along river/creeks banks with slopes of 20 %-30 % caused by land clearance. To avoid it a strip of land seven meters width from the watercourse will be left undisturbed, to stabilize river/creek banks and avoid soil erosion from surface run-off. Also, erosion in the slopes caused by land clearance and building of elevated beds.
- iv) Soil compaction caused by the use of heavy machinery during land clearance and soil preparation (*Botta et al 2012, ADB 1998, Alegre 1990*).

¹² Directorate General of Taxes.

5.1.1.2 Superficial and ground water

- i) Contamination of superficial and/or groundwater caused by fuel and oil spills. (Grey 2016, DeMoranville 1996).
- ii) Contamination caused by non-treated effluents and sewage (Clendenon and Atkins 2016, Cushman and Carlson 2016, Pendersen 1997).

5.1.1.3 Air

- i) Dust produced by wind erosion caused by exposition of soil materials during land preparation (DustWatch Australia 2016, Grossman 2006).
- ii) Emissions of GHG to the atmosphere caused by the use of machinery and transport vehicles (Vimont 2015, EPA 2008).

5.1.1.4 Vegetation

- i) Undesirable ecological regime shifts by scattered trees loss, which fulfill unique functional roles in a wide range of scattered tree ecosystems, including negative effects on animals and birds (Pérez Burgher 2011, Manning 2005). That is if all scattered trees are cut during land clearing and preparation.

5.1.1.5 Community welfare

- i) Dust, noise and vibrations to adjacent communities caused by the use of heavy machinery (USDL 2016, Evans 2004, Staying Healthy ____).

5.1.1.6 Human health and safety

During construction and land preparation, workers are exposed to risks from various sources, which could affect their health and safety. The most important risks are the ones associated to the use of mechanical hand tools, agricultural machinery, and equipment. These activities affect workers with a workload, increased by other risk factors: especially dynamic physical load, irregular topography, presence of trenches and pits, adverse weather conditions, biological hazards, and mental load, without neglecting poor hygienic/sanitary conditions and risks from environment and the ecosystem, which most important are following detailed (USDL 2016; Sas et al 2011; Chinchilla, Rojas, Forastieri 2004):

- i) Changes in the health of workers due to exposition to varied work and weather conditions, being the more relevant the following:
 - a. Increased physical workload
 - b. Increase in body temperature, which could generate thirst, mental confusion, and headache.
 - c. Heat stroke from an extended exposition to the sun leading to potential disorientation, unconsciousness, and skin burns and lesions cause by ultraviolet radiation.
 - d. Dermal problems such as fungi and dermatitis by water contact, due to exposition to high relative moisture (caused by rain), and increased physical load.
 - e. Breathing problems and contact dermatitis caused by exhaust gases from internal combustion equipment.

- f. Allergies, stings, bites, skin lesions and zoonosis, death or serious injuries, caused by animal attacks, animal contact, plants and infectious agents (worms, ants, wasps, snakes, rodents, domestic animals, viruses and bacteria).
- ii) Slips, falls and fatigue in workers due to irregular topography, trenches and pits
- iii) Injury, rollover, shock, outrage, amputations, and even death caused by the use of chainsaws, machetes, shovels, scythes, tractors and their attachments (mechanical shovel peaks, mowers and carts).
- iv) Collisions, rollovers, and outrages during travel in different means (trucks, cars, tractors, buses, bicycles), because of mechanical damage and/or bad conditions of road and access to plantations.
- v) Electrical shock to workers by power machinery and equipment.
- vi) Risk of accident when in contact with farm buildings such as warehouses, workshops, and processing plants, among others (inadequate floors and walls, overcrowded, uncased electrical system, poor lighting and ventilation, lack of emergency exits and evacuation routes, poor conditions of order and cleanliness, no firefighting equipment, and poor distribution).
- vii) Muscle-skeletal injuries, physical fatigue, and/or repetitive strain injury due to bending, and squatting as well as horizontal and vertical displacements (inappropriate and awkward postures).
- viii) Mental health problems (such as stress, depression, irritability, anxiety, and fatigue) because of tasks performed with little enrichment, monotonous, and prolonged working hours.
- ix) General work risks associated to the lack of prevention policies, allocation of responsibilities, administrative organization of prevention (Commissions Health and Safety), Department of Risk Prevention, lack of procedures, lack of auditing and training systems on risks and preventive-corrective measures.
- x) Health problems caused by noise and vibrations produced by heavy machinery.

5.1.2 Description of major potential environmental impacts during construction and farm establishment

5.1.2.1 Soil

- i) Fuel and oil spills caused by the use of machinery (*Gilles and Kaufman 2010*).
- ii) Sedimentation and erosion caused by surface runoff during rains and/or wind erosion (*Perlman 2016, Meyer 2016*).
- iii) Erosion in the slopes, if any, along river/creeks banks with slopes of 20 %-30 % caused by land clearance. To avoid it a strip of land seven meters width from the watercourse will be left undisturbed, to stabilize river/creek banks and avoid soil erosion from surface run-off.
- iv) Soil compaction caused by the use of heavy machinery during land clearance and soil preparation (*Botta et al 2012, ADB 1998, Alegre 1990*).
 - Sub-soiling should be necessary, due to soil compaction for the presence of machinery in the sisal plantation; then a crawler tractor with ripper tires in both

directions could be used. The use of heavy equipment will be limited to land preparation. Sub-soiling together with better drainage and recycling of organic matter will greatly improve the physical structure of the upper soil profile.

5.1.2.2 Superficial and ground water

- i) Contamination of superficial and/or groundwater caused by fuel and oil spills. (Grey 2016, DeMoranville 1996).

5.1.2.3 Air

- i) Dust produced by wind erosion caused by exposition of soil materials during land preparation (DustWatch Australia 2016, Grossman 2006).
- ii) Emissions of GHG to the atmosphere caused by the use of machinery and transport vehicles (Vimont 2015, EPA 2008).

5.1.2.4 Vegetation

- i) Loss of biodiversity in DBEF Shrubland and coastal areas due to agricultural related activities:
- ii) Undesirable ecological regime shifts by scattered trees loss, which fulfill unique functional roles in a wide range of scattered tree ecosystems, including negative effects on animals and birds (Pérez Burgher 2011, Manning 2005).

5.1.2.5 Community welfare

- i) Dust, noise and vibrations to adjacent communities caused by the use of heavy machinery (USDL 2016, Evans 2004, Staying Healthy ____).

Dust, noise, and vibrations could be important during land preparation, but these will take place in agricultural land, which make it more difficult to affect people. However, some standard measures will be implemented, such as periodic watering down the building area, installing and maintaining mufflers on equipment, and restrict noisy construction activities to daytime hours.

5.1.2.6 HHS

During construction and land preparation, workers are exposed to risks from various sources, which could affect their health and safety. The most important risks are the ones associated to the use of mechanical hand tools, agricultural machinery, and equipment. These activities affect workers with a workload, increased by other risk factors: especially dynamic physical load, irregular topography, presence of trenches and pits, adverse weather conditions, biological hazards, and mental load, without neglecting poor hygienic/sanitary conditions and risks from environment and the ecosystem, which most important are following detailed (USDL 2016; Sas et al 2011; Chinchilla, Rojas, Forastieri 2004):

- i) Changes in the health of workers due to exposition to varied work and weather conditions, being the more relevant the following:
 - a. Increased physical workload
 - b. Increase in body temperature, which could generate thirst, mental confusion, and headache.

- c. Heat stroke from an extended exposition to the sun leading to potential disorientation, unconsciousness, and skin burns and lesions caused by ultraviolet radiation.
- d. Dermal problems such as fungi and dermatitis by water contact, due to exposition to high relative moisture (caused by rain and irrigation), and increased physical load.
- e. Breathing problems and contact dermatitis caused by exhaust gases from internal combustion equipment.
- f. Allergies, stings, bites, skin lesions and zoonosis, death or serious injuries, caused by animal attacks, animal contact, plants and infectious agents (worms, ants, wasps, snakes, rodents, domestic animals, viruses and bacteria).
- ii) Slips, falls and fatigue in workers due to irregular topography, trenches and pits
- iii) Injury, rollover, shock, outrage, amputations, and even death caused by the use of chainsaws, machetes, shovels, scythes, tractors and their attachments (mechanical shovel peaks, mowers and carts).
- iv) Collisions, rollovers, and outrages during travel in different means (trucks, cars, tractors, buses, bicycles), because of mechanical damage and/or bad conditions of road and access to plantations.
- v) Electrical shock to workers by power machinery and equipment.
- vi) Risk of accident when in contact with farm buildings such as warehouses, workshops, and processing plants, among others (inadequate floors and walls, overcrowded, uncased electrical system, poor lighting and ventilation, lack of emergency exits and evacuation routes, poor conditions of order and cleanliness, no firefighting equipment, and poor distribution).
- vii) Muscle-skeletal injuries, physical fatigue, and/or repetitive strain injury due to bending, and squatting as well as horizontal and vertical displacements (inappropriate and awkward postures).
- viii) Mental health problems (such as stress, depression, irritability, anxiety, and fatigue) because of tasks performed with little enrichment, monotonous, and prolonged working hours.
- ix) General work risks associated to the lack of prevention policies, allocation of responsibilities, administrative organization of prevention (Commissions Health and Safety), Department of Risk Prevention, lack of procedures, lack of auditing and training systems on risks and preventive-corrective measures.
- x) Health problems caused by noise and vibrations produced by heavy machinery.

5.1.3 Description of major potential environmental impacts during project operation

5.1.3.1 Soil

- i) Soil erosion caused by water runoff (Perlman 2016, Meyer 2016):
 - If rains occur, the high population of plants and organic mulch mass in the farms will contribute to minimize wash and loss of surface soil particles.

- Erosion in the slopes, if any, along river/creeks banks with slopes of 20 %-30 % caused by land clearance. To avoid it a strip of land seven meters width from the watercourse will be left undisturbed, to stabilize river/creek banks and avoid soil erosion from surface run-off.
- ii) Fuel and oil spills caused by the use of machinery (*Gilles and Kaufman 2010*).
- iii) Soil compaction caused by the use of machinery.
 - Sub-soiling is necessary, due to soil compaction for the presence of machinery in the sisal plantation; then a crawler tractor with ripper tires in both directions will be used. The use of heavy equipment will be limited to land preparation. Sub-soiling together with better drainage and recycling of organic matter will greatly improve the physical structure of the upper soil profile.
- iv) Soil contamination caused by agrochemicals and waste residues (including liquid waste) from decortication (FAO 2016, Yhdego 2015, Terrapon-Pfaff 2012, Muhibbullah, et al 2005; Brandon 1949, Varca ____).
 - The Sisal plantation will use no agrochemicals, therefore there will be no agrochemical threat. However, with intercropping there could be application of agrochemicals although minimal.
 - Weed control will be performed with machete or a similar mechanical tool.
 - The decortication waste (sisal juice, particles of crushed parenchymatose tissue and fragments of leaves and fibres) could be used as fertilizer, animal feed and/or biodigestion fuel. The juice of the plant could be also used to prepare pharmaceuticals like hecogenin and inulin, among others.

5.1.3.2 Superficial and ground water

- i) Contamination of superficial and/or groundwater caused by fuel and oil spills. (Grey 2016, DeMoranville 1996).
- ii) Contamination of superficial and groundwater caused by waste water from decortication and if any, agrochemicals runoff from in intercropping.
 - Applications of agrochemicals in intercropping will be made upon necessities (low quantities and no applications in the presence of rain).
- iii) Contamination caused by non-treated effluents and sewage (Clendenon and Atkins 2016, Cushman and Carlson 2016, Pendersen 1997).

5.1.3.3 Air

- i) Emissions of GHG to the atmosphere caused by the use of machinery and transport vehicles (Vimont 2015, EPA 2008).

5.1.3.4 Vegetation

- i) Loss of biodiversity in DBEF Shrubland and coastal areas due to agricultural related activities.

No negative affection of existing vegetation is expected during this stage of the project.

5.1.3.5 HHS

The risk condition that affects the most the safety and health of employees, during field work (including the decortication process), is the dynamic and static postural physical load, because work is done standing and squatting (in normal kneeling and knees bent positions), with horizontal and vertical displacement movements. Additionally, workers have to lift and transport sisal leaves and fibers and/or other products and equipment.

These facts causes a workload increased by other risk factors: irregular topography and presence of trenches and pits, adverse weather conditions (heat and humidity), biological (insects and rodents), and mental workload (organization and content of work); without neglecting poor hygienic-sanitary conditions and natural disasters. Furthermore, during the decortication process the use of machinery could be a source of accidents' risk. The most important impacts are following detailed (Chinchilla, Rojas, Forastieri 2004):

- i) Changes in the health of workers due to exposition to varied work and weather conditions, being the more relevant the following:
 - a. Increased physical workload.
 - b. Decreased hearing, hearing loss and muscle-skeletal disorders, and psychological effects (sleep and attention), among others, caused by noise and vibrations generated by the tractor and its attachments, used to transport materials, cuttings, and sisal bulbs to plant.
 - c. Increase in body temperature, which could generate thirst, mental confusion, and headache.
 - d. Heat stroke from an extended exposition to the sun leading to potential disorientation, unconsciousness, and skin burns and lesions cause by ultraviolet radiation.
 - e. Dermal problems such as fungi and dermatitis by water contact, due to exposition to high relative moisture (caused by rain), and increased physical load.
 - f. Breathing problems, contact dermatitis, eye irritation, acute poisoning, chronic effects (cumulative effects on the central nervous system, liver, kidneys, blood, lungs, and reproductive harm) and, even death caused by exhaust gases from internal combustion equipment and agricultural machinery in the field.
 - g. Allergies, stings, bites, skin lesions and zoonosis, death or serious injuries, caused by animal attacks, animal contact, plants and infectious agents (worms, ants, wasps, snakes, rodents, domestic animals, viruses and bacteria).
- ii) Slips, falls and fatigue in workers due to irregular topography, trenches and pits.
- iii) Injury, rollover, shock, outrage, amputations, and even death caused by the use of chainsaws, machetes, shovels, scythes, tractors and their attachments (mechanical shovel peaks, mowers and carts).
- iv) Collisions, rollovers, and outrages during travel in different means (trucks, cars, tractors, buses, bicycles), because of mechanical damage and/or bad conditions of road and access to plantations.
- v) Electrical shock to workers by power machinery and equipment. Including decortication machines and risk of accidents with the decortication blades.

- vi) Risk of accident when in contact with farm buildings such as warehouses, workshops, and processing plants, among others (inadequate floors and walls, overcrowded, uncased electrical system, poor lighting and ventilation, lack of emergency exits and evacuation routes, poor conditions of order and cleanliness, no firefighting equipment, and poor distribution).
- vii) Muscle-skeletal injuries, physical fatigue, and/or repetitive strain injury due to bending, and squatting as well as horizontal and vertical displacements (inappropriate and awkward postures).
- viii) Mental health problems (such as stress, depression, irritability, anxiety, and fatigue), as a result of tasks performed with little enrichment, monotonous, and prolonged working hours.
- ix) General work risks associated to the lack of prevention policies, allocation of responsibilities, administrative organization of prevention (Commissions Health and Safety), Department of Risk Prevention, lack of procedures, lack of auditing and training systems on risks and preventive-corrective measures.

5.1.4 Description of major potential environmental impacts during the transformation process

5.1.4.1 Air

- i) Emissions of GHG to the atmosphere caused by the use of electricity by the Caracol Industrial Park chinery and transport vehicles (Vimont 2015, EPA 2008).

5.1.4.2 HHS

The risk condition that affects the most the safety and health of employees, during processing work, is the dynamic and static postural physical load, because work is done standing and squatting (in normal kneeling and knees bent positions), with horizontal and vertical displacement movements. Additionally, workers have to lift and transport materials, and/or other products and equipment. These facts causes a workload increased by other risk factors, such as mental workload (organization and content of work); without neglecting poor hygienic-sanitary conditions. The most important impacts are following detailed (Chinchilla, Rojas, Forastieri 2004):

- i) Slips, falls and fatigue in workers.
- ii) Injury, rollover, shock, outrage, amputations, and even death caused by the use of machinery.
- iii) Collisions, rollovers, and outrages during travel in different means (trucks, cars, tractors, buses, bicycles), because of mechanical damage and/or bad conditions of road and access to the transportation facility.
- iv) Electrical shock to workers by power machinery and equipment.
- v) Risk of accident: inadequate floors and walls, overcrowded, uncased electrical system, poor lighting and ventilation, lack of emergency exits and evacuation routes, poor conditions of order and cleanliness, no firefighting equipment, and poor distribution.
- vi) Muscle-skeletal injuries, physical fatigue, and/or repetitive strain injury due to bending, and squatting as well as horizontal and vertical displacements (inappropriate and awkward postures).

- vii) Mental health problems (such as stress, depression, irritability, anxiety, and fatigue), as a result of tasks performed with little enrichment, monotonous, and prolonged working hours.
- viii) General work risks associated to the lack of prevention policies, allocation of responsibilities, administrative organization of prevention (Commissions Health and Safety), Department of Risk Prevention, lack of procedures, lack of auditing and training systems on risks and preventive-corrective measures.

5.2 *Evaluation of environmental impacts*

5.2.1 Methodology for the evaluation of environmental impacts

The evaluation of the environmental impacts is conducted by using the methodology described below (Campos et al 2015; Olympic Peru Inc., Equas S.A. 2013). The variables to be evaluated are presented in the following chart and the qualitative valuation of the impacts in the next chart.

Chart 8 *Variables to evaluate the importance (I) or significance of the impacts for the 4,000 sisal project in North-East Haiti*

IMPACT	SIGN/ VALUE	IMPACT	VALUE
Nature impact (sign)	+ / -	Synergy (SI) No synergy Synergistic High synergy	1 2 4
Intensity (IN) Low Medium High Very high	1 2 4 8	Accumulation (AC) Simple Accumulative	1 4
Extension (EX) Punctual Partial Extensive Total Critical	1 2 4 8 +4	Effect (EF) Indirect (secondary) Direct	1 4
Momentum (MO) Long term Medium term Immediate Critical	1 2 4 +4	Periodicity (PR) Irregular, or sporadic, aperiodic and discontinuous Periodic Continue	1 2 4
Persistence (PE) Fleeting Temporary Permanent	1 2 4	Recoverability (RE) Immediate Medium term Partially recoverable, mitigated and/or compensable Irrecoverable	1 2 4 8

IMPACT	SIGN/ VALUE	IMPACT	VALUE
Reversibility (RV) Short term Medium term Irreversible	1 2 4	$I = 3IN + 2EX + MO + PE + RV + SI + AC + EF + PR + R$ E	

Source: Campos et al 2015; Olympic Peru Inc., Equas S.A. 2013.

Chart 9 Scale of evaluation of the importance (I) of the impacts

IMPORTANCE VALUE (I)	QUALITATIVE VALUATION	MEASURES
$I < 25$	Irrelevant	Do not require mitigation measures
$25 < I < 50$	Moderate	Require mitigation measures
$50 < I < 75$	Severe	Require mitigation measures
$I < 75$	Critical	Require mitigation measures

Source: Campos et al 2015; Olympic Peru Inc., Equas S.A. 2013.

5.2.2 Evaluation of identified potential environmental impacts

The potential impacts identified in 6.1 will be evaluated in this section for the four stages: nursery establishment and operation, construction and farm development, project operation, and operation (see Annex 5 for an individual evaluation of every impact).

Chart 10 Evaluation of identified potential environmental impacts

FACTOR	IMPACT	VALUE OF VARIABLE											IMPO RTAN CE	QUALITATIV E VALUATION
		I N	E X	S Y	A C	E F	M O	P R	P E	R E	R V			
NURSERY ESTABLISHMENT AND OPERATION														
SOIL	Fuel and oil spills caused by the use of machinery	1	1	1	4	4	1	4	4	4	4	-31	MODERATE	
	Sedimentation and erosion caused by surface runoff during rains and/or wind erosion	4	4	1	4	4	2	4	4	2	2	-43	MODERATE	
	Erosion in the slopes and river/creeks banks caused by land clearance and building of elevated beds	3	2	1	1	4	2	4	1	1	2	-29	MODERATE	
	Soil compaction caused by the use of machinery	3	5	2	4	4	2	4	1	1	4	- 41		
SUPERFICIAL AND GROUND WATER	Contamination of superficial and/or ground water caused by fuel and oil spills	3	4	1	4	4	2	1	4	4	4	-41	MODERATE	

FACTOR	IMPACT	VALUE OF VARIABLE										IMPORTANCE	QUALITATIVE VALUATION
		I N	E X	S Y	A C	E F	M O	P R	P E	R E	R V		
	Contamination caused by non-treated effluents and sewage	5	3	1	4	4	4	4	2	1	2	-43	MODERATE
AIR	Wind erosion caused by exposition of soil materials during land preparation	5	4	1	1	4	4	1	4	3	4	-46	MODERATE
	Emissions of GHG to the atmosphere caused by the use of machinery and transport vehicles	1	4	1	1	4	4	1	1	1	1	-25	MODERATE
VEGETATION	Undesirable ecological regime shifts by scattered trees loss	4	2	1	1	4	4	1	1	1	1	-30	MODERATE
COMMUNITY WELFARE	Noise and vibrations to adjacent communities caused by the use of heavy machinery	2	2	1	1	4	4	1	1	1	1	-24	IRRELEVANT
HUMAN HEALTH AND SAFETY	Workers' risks caused by overload of activities performed	8	2	4	4	4	4	4	2	2	2	-54	SEVERE
CONSTRUCTION AND FARM ESTABLISHMENT													
SOIL	Fuel and oil spills caused by the use of machinery	1	1	1	4	4	1	4	4	4	4	-31	MODERATE
	Sedimentation and erosion caused by surface runoff during rains	4	4	1	4	4	2	4	4	4	2	-45	MODERATE
	Erosion in the slopes caused by land clearance along river/creeks banks with slopes of 20 %-30 % caused by land clearance	1 .5	2	1	1	4	2	4	1	1	2	-24.5	IRRELEVANT
	Soil compaction caused by the use of machinery	1 .5	5	2	4	4	2	4	1	1	4	-36.5	MODERATE
SUPERFICIAL AND GROUND WATER	Contamination of superficial and/or ground water caused by fuel and oil spills	3	4	1	4	4	2	1	4	4	4	-41	MODERATE
AIR	Dust produced by wind erosion caused by exposition of soil materials during land preparation	2	4	1	1	4	4	1	4	4	4	-37	MODERATE
	Emissions of GHG to the atmosphere caused by	1	4	1	1	4	4	1	1	1	1	-25	MODERATE

FACTOR	IMPACT	VALUE OF VARIABLE											IMPO RTAN CE	QUALITATIV E VALUATION
		I N	E X	S Y	A C	E F	M O	P R	P E	R E	R V			
	the use of machinery and transport vehicles													
VEGETATI ON	Loss of biodiversity in DBEF Shrubland due to agricultural related activities	2	2	1	1	4	4	1	4	1	1	-27	MODERATE	
	Undesirable ecological regime shifts by scattered trees loss	3	2	1	1	4	4	1	1	1	1	-27	MODERATE	
COMMUNI TY WELFARE	Noise and vibrations to adjacent communities caused by the use of heavy machinery	2	2	1	1	4	4	1	1	1	1	-24	MODERATE	
HUMAN HEALTH AND SAFETY	Workers' risks caused by overload of activities performed	8	2	4	4	4	4	4	2	2	2	-54	SEVERE	
PROJECT OPERATION														
SOIL	Soil erosion caused by water runoff	1	4	1	4	4	2	4	4	4	2	-36	MODERATE	
	Fuel and oil spills caused by the use of machinery	1	1	1	4	4	1	4	4	4	4	-31	MODERATE	
	Soil compaction caused by the use of machinery	1	4	1	4	4	2	4	1	1	4	-32	MODERATE	
	Soil contamination caused by agrochemicals and waste water from di-cortication	4	4	2	4	4	2	4	4	4	4	-51	SEVERE	
SUPERFIC IAL AND GROUND WATER	Contamination of superfi- cial and/or groundwater caused by fuel and oil spills	3	4	1	4	4	2	1	4	4	4	-41	MODERATE	
	Contamination of superfi- cial and groundwater caused by waste water from decortication and if any, agrochemicals run- off from in intercropping	5	4	2	4	4	2	4	4	4	4	-51	SEVERE	
	Contamination caused by not treated effluents and sewage	5	3	1	4	4	4	4	2	1	2	-43	MODERATE	
AIR	Emissions of GHG to the atmosphere caused by the use of machinery and transport vehicles	1	4	1	1	4	4	1	1	1	1	-25	MODERATE	

FACTOR	IMPACT	VALUE OF VARIABLE										IMPOR TANCE	QUALITATIVE VALUATION
		I N	E X	S Y	A C	E F	M O	P R	P E	R E	R V		
VEGETATION	Loss of biodiversity in DBEF Shrubland due to agricultural related activities	2	2	1	1	4	4	1	4	1	1	-27	MODERATE
HUMAN HEALTH AND SAFETY	Workers' risks caused by overload of activities performed	8	2	4	4	4	4	4	2	2	2	-54	SEVERE
TRANSFORMATION PROCESS													
AIR	Emissions of GHG to the atmosphere caused by the use of machinery and transport vehicles	1	4	1	1	4	4	1	1	1	1	-25	MODERATE
HUMAN HEALTH AND SAFETY	Workers' risks caused by overload of activities performed	8	2	4	4	4	4	4	2	2	2	-54	SEVERE

Note: IN= intensity
AC= accumulation
PR= periodicity
RV= reversibility
EX= extension
EF= effect
PE= persistence
Sy= synergy
MO= momentum
RE= recoverability

According to the evaluation carried out (for details see Annex 4), all impacts evaluated would require mitigation measures. However, the impacts related to agrochemical use and HH&S would be severe impacts that need close attention and especially detailed mitigation measures.

5.3 Cumulative impact assessment

The U.S. Council on Environmental Quality's (CEQ) regulations (40 CFR 1500-1508) implementing the procedural provisions of the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321 et seq.), defines cumulative effects as:

"The impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions"

According to the same -Council on Environmental Quality (1997) - cumulative effects occur when:

- *Impacts on the environment take place so frequently in time or so densely in space that the effects of individual impacts cannot be assimilated; or*
- *The impacts of one activity combine with those of another in a synergistic manner.*

A Valued Ecosystem Component (VEC) can be defined as

"Any part of the environment that is considered important by the proponent, public, scientists and government involved in the assessment process."

Taking into account the above explanation, the cumulative impact was already conducted in the previous section taking into account the VEC's described as factors at the beginning of Chapter 6 (soil, air, water, vegetation and wildlife), with the particular evaluation of every of

the potential impacts identified (9.23 Annex 5). In fact, the methodology explained in 5.2.1 includes the evaluation of cumulative impacts, with the interaction of several variables such as persistence, reversibility, recoverability, synergy, and accumulation. As a result of the previous impact analysis, no major cumulative impacts are expected from the project.

However, according to that evaluation performed, the potential impacts that could present some minor cumulative effects - and for which the environmental management plan presented in Chapter 6 takes provisions - are listed and further explained in the current section.

The cumulative impact analysis shows the following facts:

1. *Contamination of soil and water bodies caused by accumulation of fuel and oil, as well as agrochemicals and decortication waste (Gilles and Kaufman 2010, Muhibbullah, et al 2005; Varca ____).*
2. *Sedimentation and erosion caused by water runoff with heavy rain.*
3. *Soil compaction due to the use of heavy machinery and years of cultivation.*
4. *Contamination caused by not treated effluents and sewage.*
5. *Imbalance due to overuse of underground water for irrigation (Zuubier ____).*
6. *Risk for overload work of workers (Chinchilla, Rojas, Forastieri 2004).*

5.3.1 Contamination of soil and water bodies caused by accumulation of fuel and oil, as well as agrochemicals

Oil-spilled impacted areas generally imply the following effects on agricultural soils:

- *Low fertility: with low agricultural productivity and reduce source of livelihood in the affected area. Moreover, they present higher electrical conductivity and higher salinity values. (Oyem 2013).*
- *Increase in soil pH and total carbon content, decrease in total nitrogen and available nitrate and in general it has a highly significant effect of reducing some mineral element composition (Agbogidi 2007).*

Materials in the soil's surface that move through the soil over time could contaminate ground-water: agrochemicals, used motor oil, untreated waste, and toxic chemicals from underground storage tanks and leaky landfills (The Groundwater Foundation 2015).

"Every oil spill is different, but the thread is a growing scientific awareness of the persistent damage that spills can do — and of just how long oil can linger in the environment, hidden in out-of-the-way spots (Gilles and Kaufman 2010).

Fertilizers, pesticides and contaminated sediments from plantations have caused massive deaths of fish in surrounding waters and the bleaching of coral reefs (Worobetz 2000).

From decortications of sisal leaves only 5 % is fiber; the remaining 95 % consists of solid waste (mucilage) and waste liquid (juice of the sisal) that are normally discarded by sisal farms. Sisal waste mainly contains plant tissue (lignin and cellulose), primary and secondary metabolites, and water, among others. This leaf extract at 5,000 ppm concentration have molluscicidal activity, which also destroys surrounding aquatic fauna and flora (Sharma, Varshney 2011; Kloos, Mecullough 1982).

5.3.2 Sedimentation and erosion caused by water runoff with heavy rain

Sedimentation and soil erosion caused by water runoff, especially during storms, is a major environmental threat to the sustainability and productive capacity of soil for agricultural purposes. It is well known that Haiti is prone to heavy rain and storms, and so North-East Haiti, the area of the project.

During the last, almost 33 % of the world's arable land has been lost by erosion, and this trend continues at a rate of more than 10 million hectares per year. In this case, in the area where the sisal project will be located in the North-East Haiti, erosion is caused by the energy transmitted from rainfall, in which raindrops hit exposed soil, launching soil particles into the air and/or water, which can be transported thousands of miles. Raindrop splash and sheet erosion are the most common ways of soil erosion; therefore living and dead plant biomass left on the field diminishes erosion and water runoff, by intercepting and dissipating raindrop and wind energy (Pimentel 2006; Pimentel, et.al. 1995).

This is a vicious cycle, since when erosion occurs, the amount of water runoff increases, and so the erosion associated to loss of productivity or nutrient reserves depleted in the plantation; furthermore, soil erosion may decrease the abundance and diversity of soil microorganisms. Soils with severe erosion reduce its yield in 15 % to 30 %. If the average soil erosion is of 17 TM/ha/year, the loss of nitrogen, phosphorus, and potassium could cause a long-term drop in crop yields. On the contrary, if soil erosion is one TM/ha/year or less, crop residues are left on the land, and lacking nutrients are added, soil quality and productivity would remain high and sustainable. Organic matter facilitates the formation of soil aggregate, increases soil porosity, and thereby improves soil structure, water infiltration, productivity, cation exchange, root growth, and the proliferation of soil biota. Fertile topsoils contain approximately 100 tons of organic matter per hectare (about 4 % of total weight) (Pimentel 2006; Pimentel, et.al. 1995).

Sedimentation due to soil erosion in rivers exacerbates flooding risk and disrupts and harms aquatic ecosystems by contaminating water with soil particles (Pimentel 2006).

5.3.3 Pollution caused by plastic bags, among other solid waste

If plastic bags are used in any way in the sisal production, it could be dangerous if end up in streams or the ocean, threatening aquatic wildlife (Vargas 1998). A number of endangered species are harmed by this pollution, for example the green sea turtle that suffocates on the bags, mistaken it for food (McCracken 1998).

Plastic bags and twine could be recycled or returned to the manufacturer to be recycled into other products, such as plastic pots, because they are not hazardous after eight weeks when the pesticides is already degraded (Russo and Hernandez, 1995). It is also a good idea to install solid waste traps in the decortication facilities to reduce river contamination (McCracken, 1998).

5.3.4 Soil compaction due to the use of heavy machinery and years of cultivation

Soil compaction is a process of densification, in which porosity and permeability are reduced and could happen, because of the overuse of machinery, intensive cropping, short crop rotations, intensive grazing, and inappropriate soil management, which occurs in a wide range of soils and climates. Low soil organic matter content and use of tillage or grazing at high soil moisture content favors it.

Soil compaction decreases soil fertility, due to a decreasing storage and supply of water and nutrients, which in turns leads to additional fertilizer requirement and increasing production cost. Therefore, a detrimental cycle occurs of reduced plant growth and lower inputs of organic matter to the soil, reduced nutrient recycling and mineralization, reduced activities of microorganisms, and increased wear and tear on cultivation machinery. Some techniques are used to avoid, delay or prevent soil compaction, for example the following (Hamza; Anderson 2005):

- a. Reducing soil pressure by decreasing axle load and/or increasing the contact area of wheels with the soil.
- b. Working soil and allowing grazing at optimal soil moisture.
- c. Reducing the number of passes by farm machinery and the intensity and frequency of grazing.
- d. Confining traffic to certain areas of the field (controlled traffic).
- e. Increasing soil organic matter through retention of organic residues.
- f. Removing soil compaction by deep ripping in the presence of an aggregating agent.
- g. Crop rotations that include plants with deep, strong taproots.
- h. Maintenance of an appropriate base saturation ratio and complete nutrition to meet crop requirements to help the soil/crop system to resist harmful external stresses.

A study of compaction of agricultural land by Oussible, M.; et al 1991 resulted in a decrease in yield (from 12 % to 23 %) in grain and a decrease in straw yield (from 9 % to 20 %). Root growth and distribution were greatly changed, because of subsurface compaction. Wheat plants in compacted plots had a denser, finer, and shallower root system. The decrease in shoot number might be attributed to a limitation in the amount of available soil N to the roots.

5.3.5 Contamination caused by not treated effluents and sewage

Wrong sewage disposal causes deteriorating surface water quality, furthermore, the lack of alternative water sources often provokes partially diluted and untreated wastewater to be used for irrigation, especially by the poor. Wastewater always finds its outlet, then fresh (clean) water bodies, which are already been used for domestic and/or agricultural purposes, or coastal water that supports biodiversity, may be contaminated (Raschid-Sally, et al 2005).

5.3.6 Imbalance due to overuse of underground water for irrigation

Freshwater supply, especially in coastal areas, is at stake due to salinization, increasing droughts, and/or increasing freshwater demands. Seasonal aquifer storage and recovery (ASR) of any surplus of freshwater (rain, surface, or treated water) is an adequate way to bridge periods of surplus and drought (Zuubier ____).

Rates of groundwater turnover vary from short term to long term (years), depending on aquifer location, type, depth, properties, and connectivity. Excessive pumping could lead to its depletion, when the extraction rate is higher than the replenishment rate. If the use of groundwater is not regulated, a "Tragedy of the Commons¹³" will eventually appear, where all the users loss (Ponce 2006).

¹³ An economic problem in which every individual tries to reap the greatest benefit from a given resource. As the demand for the resource overwhelms the supply, every individual who consumes an additional unit directly harms others who can no longer enjoy the benefits. Generally, the resource of interest is easily available to all individuals (Investopedia 2015).

Studies must prove that the hydrological, ecological, and other impacts of groundwater use do not affect the sustainability of the aquifer, from both the quantity and quality point of view. The effects depletion could be significant on surface and unsaturated subsurface (vadose) waters, and the terrestrial, riparian, and other ecosystems, which depend on these waters. The impacts of groundwater depletion are pervasive and, in most cases significant enough to justify a detailed evaluation. The loss of base flow can trigger a chain reaction of negative impacts to several of those components of the landscape, among others the following (Ponce 2006).

Direct (primary) impacts

- Increased magnitude and frequency of floods.
- Loss of wetland and riparian vegetation.
- Loss of phreatophytes and aquatic-terrestrial transition zones.
- Changes in channel morphology.
- Accelerated erosion and gully development.
- Increased severity and frequency of droughts.
- Loss of wildlife habitat and reduction in biodiversity.

Other impacts

- Drying up of wells.
- Increased cost of pumping and well infrastructure.
- Land subsidence.
- Salt-water intrusion.
- Changes in surface albedo and related climate change.

5.3.7 Risk for overload work of workers

The harmfulness of the risks of sisal workers depends on the following variables that include activities of land preparation sowing, crop maintenance, harvest, and packing, among others (Chinchilla, et al 2004):

- Its concentration or level in the environment.
- Time, frequency and duration of exposure.
- Features of the workplace.
- The route of exposure.
- The physical and / or chemical properties.
- The pathogenetic ability of the agent (biological, etc.).

6 ENVIRONMENTAL MANAGEMENT PLAN AND MITIGATION MEASURES

Although a sisal plantation is low (environmental) impact, it could have significant ones if it is not operated in an environmental and socially appropriate/responsible way. For all potential impacts, mitigation measures are following proposed.

6.1 Environmental management plan during nursery establishment and operation

6.1.1 Soil

i) Fuel and oil spills caused by the use of machinery

- a. All the machinery and transport vehicles used in the project will have an adequate preventive maintenance to optimize performance and minimize impacts by emissions or oil/fuel spills. Maintenance will be only carried out in authorized workshops or a service area belonging to the project outside the 3BNP.
- b. There should be a special area for service of vehicles and machinery outside the 3BNP. No machinery or vehicle will be allowed to be repaired (change or addition of oils and fuels) in any other part of the area of the project.
- c. As a preventive measure, an absorbent membrane to retain any minor spill will be part of the equipment in any working vehicle or machinery. In the event of a spill, that exceeds the capacity of the membrane, contaminated material should be collected in close-labeled containers and put in the yard of materials for its adequate disposal. Collection materials for oil or lubricant spills will remain in a special place within the service area.

ii) Sedimentation and erosion caused by surface runoff during rains

- a. Program construction and land preparation during day/months that have less rainfall.
- b. Minimize extent and duration of exposed soil areas, with no vegetative cover.
- c. Implement reliable and proven soil conservation technologies, including ridge-planting, no-till cultivation, strip cropping, grass strips, mulches, living mulches, agroforestry, terracing, contour planting, cover crops and windbreaks using native species.

All conservation methods reduce erosion by keeping a vegetative cover on the soil and a reduction of plowing. The conservation methods could be used in parallel with other erosion control techniques, for which is important to consider soil type, specific crop or pasture, slope, and climate (rainfall and wind intensity, and the socioeconomic situation of the people living in a particular site (Pimentel et al 1995).

iii) Erosion in the slopes and river/creeks banks caused by land clearance and building of elevated beds

- Leave some vegetation and/or grass in the slopes of elevated beds to avoid erosion.
- In case of river/creek, leave undisturbed with vegetative coverage, a seven meters width strip land from the watercourse, to stabilize river/creek banks and avoid soil erosion from surface run-off.

iv) Soil compaction caused by the use of machinery

- Sub-soiling is necessary in this case, then a backhoe with a special instrument, to move the soil without modifying the soil profile. Sub-soiling together with better drainage and recycling of organic matter will greatly improve the physical structure of the upper soil profile.

6.1.2 Superficial and ground water

i) Contamination of superficial and/or groundwater caused by fuel and oil spills

- Idem 6.1.1 i).

ii) Contamination caused by not treated effluents and sewage

- Every building with toilets should have the discharge to a septic tank or treatment plant in case of concentration of buildings. Any building should be constructed in protected and/or agricultural land, only in current towns such as Phaëton and Fort Liberté, and best outside the 3BNP.

6.1.3 Air

i) Dust produced by wind erosion caused by exposition of soil materials during land preparation

- Minimizing extent and duration of exposed areas during land preparation.
- If ground surfaces are visible during the dry season, and especially if they generate dust, mitigation measures, such as soil watering should be applied.

ii) Emissions of GHG to the atmosphere caused by the use of machinery and transport vehicles

- Idem 6.1.1 i).
- A compensation program, through reforestation of park areas, highlands – and/or along waterways and roads -, which in turn protects sources of water and promotes infiltration into the aquifers.

6.1.4 Vegetation

i) Undesirable ecological regime shifts by scattered trees loss

- Idem 6.1.3 ii) b.
- The required permissions to cut trees should be processed by SISALCO and/or the project developer in ANAP and/or any corresponding national authority, according to the description of the legal and institutional analysis.
- Only the strictly necessary trees are cut, according to the conditions establish in the current EIA.

6.1.5 Community welfare

i) Dust, noise and vibrations to adjacent communities caused by the use of heavy machinery

- Dust, noise, and vibrations could be important during land preparation, but these will take place in agricultural land. However, some standard measures will be implemented, such as periodic watering down the building area, installing and maintaining mufflers on equipment, and restrict noisy construction activities to daytime hours.

6.1.6 HHS

During construction and land preparation, workers are exposed to risks from various sources, which could affect their health and safety. The most important risks are the ones associated to the use of mechanical hand tools, agricultural machinery, and equipment. These activities affect workers with a workload, increased by other risk factors: especially dynamic physical load, irregular topography, presence of trenches and pits, adverse weather conditions, biological hazards, and mental load, without neglecting poor hygienic/sanitary conditions and risks from environment and the ecosystem, which most important are following detailed (Chinchilla, Rojas, Forastieri 2004):

- a. Working hours during the construction and nursery/farm establishment's phase should be daytime, from 6 am to 6 pm.
- b. Social security/insurance policy and occupational health and safety aspects should be of mandatory compliance by the developer and included in the respective contract. Employees should have the appropriate safety equipment and its use should be mandatory.
- c. There should be a permanent team of Occupational Safety in the project, which should be trained in first aid assistance and have access to a vehicle and driver to transfer injured people to the nearest clinics or hospitals.
- d. Prioritize the surrounding communities for recruitment of the project's staff and temporary workers (such as Phaëton, Dérac, Paulette, Barrage, and Fort Liberté, among others). Hiring of foreigners should be guaranteed by documents that prove that their immigration status is in order.
- e. An induction/training at the beginning of and during the project should be provided to all employees explaining environmental aspects such as conservation objectives of the 3BNP, proper waste disposal, measures to detect and clean oil spills, and equipment maintenance. Additionally, it should include prohibition of activities related to drugs and prostitution in the area of the project, and induce a healthy behavior, raising awareness about the consequences of misconduct, both at the personal and working levels.
- f. The company should provide medical care for workers and their families. A dispensary should be located in the mail building of the farm.
- g. Regular exams to workers and their families should be schedule to prevent any disease or health problem.
- h. Potable water should be provided to workers inside the project area.
- i. Clear procedures for workers should be designed – along with proper training -, following the FAO guidelines.

6.2 Environmental management plan during construction and farm establishment

6.2.1 Soil

i) Fuel and oil spills caused by the use of machinery

Idem 6.1.1 i)

ii) Sedimentation and erosion caused by surface runoff during rains

Idem 6.1.1 ii).

iii) Erosion, if any, in the slopes along river/creeks banks with slopes of 20 %-30 % caused by land clearance.

In case of river/creek, leave undisturbed with vegetative coverage, a seven meters width strip land from the watercourse, to stabilize river/creek banks and avoid soil erosion from surface run-off.

6.2.2 Superficial and ground water

i) Contamination of superficial and/or groundwater caused by fuel and oil spills

- Idem 6.1.1 i).

6.2.3 Air

iii) Dust produced by wind erosion caused by exposition of soil materials during land preparation

- Idem 6.1.3 i).

iv) Emissions of GHG to the atmosphere caused by the use of machinery and transport vehicles

- Idem 6.1.3 ii).

6.2.4 Vegetation

i) Loss of biodiversity in DBEF Shrubland and coastal areas due to agricultural related activities

- a. Leave an undisturbed seven meter width vegetation cover along the limits of DBEF Shrubland with regeneration, enriched with native species (*Map 16*).
- b. Only plant sisal and limit impacts to land classified as Acacia Shrubland and/or agricultural land (and/or DBEF Acacia far from the coast) (Kramer et al 2016).
- c. Inside the 3BNP only organic intercropping is to be cultivated.
- d. Outside the 3BNP and especially in its surroundings, if intercropping perform only low chemical¹⁴ or organic agriculture: application of agrochemicals will be minimal, for example: weed control will be performed with machete or mechanical lawn mower. No weed control should be performed with herbicides. It is recommended the use of a vegetative coverage. If minimal agrochemicals are to be used the below recommendations should be followed:
 - Manufacturers should certify that agrochemicals used in the plantation have safe degradation properties, both in the atmosphere and soil.
 - Non-chlorine based products are to be used.
 - Only backpack spray pumps are to be used in the limits and/or corners of the plantation to avoid risks of losing quantities of product.
 - Drainage layouts in the plantation should consider provisions to prevent contamination of drained water with harmful pesticides.
 - An integrated pest management program should be established.
 - Agrochemicals should be in a safe and secure storage place: the FAO guidelines should be followed in this regard. Fertilizers are in a separated storage room.
- e. Only the strictly necessary trees are cut, according to the conditions established in the current EIA.

¹⁴ The use of strictly necessary agrochemicals according to proper agronomic studies. Use only certified biodegradable non-chlorine products.

ii) Undesirable ecological regime shifts by scattered trees loss

- Idem 6.1.4 i).

6.2.5 Community welfare

i) Dust, noise and vibrations to adjacent communities caused by the use of heavy machinery

- Idem 6.1.5 i).

6.2.6 HHS

- Idem 6.1.6.

6.3 Environmental management plan during project operation

6.3.1 Soil

i) Soil erosion caused by water runoff

- a. It is recommended the use of a vegetative coverage within the plantation and in water outlets and waterways.
- b. Idem 6.2.1 iii).

ii) Fuel and oil spills caused by the use of machinery

- Idem 6.2.1 i).

iii) Soil compaction caused by the use of machinery

- Idem 6.1.1 iv).

iv) Soil contamination caused by agrochemicals and waste water from decortication

- Idem 6.2.4 i).
- Water quality should be monitored in farm's outlets, if any, and aquifer periodically.

6.3.2 Superficial and ground water

i) Contamination of superficial and/or groundwater caused by fuel and oil spills

- Idem 6.1.1 i).

ii) Contamination of superficial and groundwater caused by waste water from decortication and if any, agrochemicals runoff from in intercropping

- Idem 6.3.1 iv).
- The decortication facilities must be zero waste, especially inside the 3BNP.
- Zero waste means that the byproducts from decortication are to be processed to convert them to any of the following and/or a combination of two or more: insecticide, compost, animal feed, biofuel production, and/or cosmetics, among others.

iii) Contamination caused by not treated effluents and sewage

- 6.1.2 iii).

6.3.3 Air

i) Emissions of GHG to the atmosphere caused by the use of machinery and transport vehicles.

- a. Idem 6.1.3 ii).
- b. There will be tractors and transport vehicles.
- c. The sisal fiber will be transported from the decortication house to the processing factory in transport vehicles.
- d. There will be diesel generators to produce electricity for the decortication machines, which should not be located far from residential areas or office buildings.

6.3.4 Vegetation

i) Loss of biodiversity in DBEF Shrubland and coastal areas due to agricultural related activities

- Idem 6.2.4.

6.3.5 HHS

- Idem 6.1.6.

6.4 Environmental monitoring

For every impact identified by factor in previous sections, indicators to monitor the mitigation measures are established. These indicators are presented in the following chart.

If intercropping is not organic outside the 3BNP, agrochemicals should be controlled and monitored according to good international practices. Even if quantities of agrochemicals are much less than fertilizers, because of the risk of contamination of the surface water through watercourses and underground water, a monitor program for water quality should be established, especially for presence of pesticides. Soil and water analysis should be periodically carried out.

Every 3 months a routine inspection of the drainage system should take place, which is clear of obstruction and the vegetative growth is cut back, the drains are dug.

Best practices will be tested and recommended concerning, for example, land preparation, planting, cleaning and waste material, and drainage and irrigation, among others.

Chart 11 **Indicators to be monitored for identified impacts**

FACTOR	IMPACT	INDICATORS
NURSERY ESTABLISHMENT AND OPERATION		
SOIL	Fuel and oil spills caused by the use of machinery	<ul style="list-style-type: none"> • All machinery and vehicles have adequate preventive maintenance • No damaged vehicles are working • The service area have all necessary materials for an extreme case
	Sedimentation and erosion caused by surface runoff during rains and/or wind erosion	<ul style="list-style-type: none"> • Construction is carried out during the dry season • Minimum duration of soil exposition
	Erosion in the slopes and river/creeks banks caused by land clearance and building of elevated beds	<ul style="list-style-type: none"> • An indisturbed strip of land 7 m width from water course is in place • Vegetation and/or grass in the slopes of elevated beds
	Soil compaction caused by the use of heavy machinery	<ul style="list-style-type: none"> • A backhoe with a special instrument, to move the soil without modifying the soil profile • Better drainage and recycling of organic matter
SUPERFICIAL AND GROUND WATER	Contamination of superficial and/or ground water caused by fuel and oil spills	<ul style="list-style-type: none"> • All machinery and vehicles have adequate preventive maintenance • No damaged vehicles are working • The service area have all necessary materials for an extreme case
	Contamination caused by non-treated effluents and sewage	<ul style="list-style-type: none"> • Every building has septic tank or treatment plant
AIR	Dust produced by wind erosion caused by exposition of soil materials during land preparation	<ul style="list-style-type: none"> • Soil watering to prevent dust • Duration of soil exposition is minimal
	Emissions of GHG to the atmosphere caused by the use of machinery and transport vehicles	<ul style="list-style-type: none"> • All machinery and vehicles have adequate preventive maintenance • No damaged vehicles are working • A compensation program through reforestation of native species and/or fruit trees is in place
VEGETATION	Undesirable ecological regime shifts by scattered trees loss	<ul style="list-style-type: none"> • Cutting permit is duly performed with ANAP and/or any corresponding national authority to cut only the strictly necessary trees according to the conditions establish in the current EIA • A compensation program through reforestation of native species and/or fruit trees is in place
COMMUNITY WELFARE	Dust, noise and vibrations to adjacent communities caused by the use of heavy machinery	<ul style="list-style-type: none"> • Soil watering to prevent dust • Operation is only carried out during daytime hours

FACTOR	IMPACT	INDICATORS
HUMAN HEALTH AND SAFETY	Workers' risks caused by overload of activities performed	<ul style="list-style-type: none"> Nursery establishment is carried out only during daytime hours Social security/insurance policy and occupational health and safety measures are part of contracts and contractors comply with standards An occupational safety team is established and working % of workers from surrounding communities Drinking water is provided to workers Induction/training course is carried out at the beginning of and during the project to all workers
CONSTRUCTION AND FARM ESTABLISHMENT		
SOIL	Fuel and oil spills caused by the use of machinery	<ul style="list-style-type: none"> All machinery and vehicles have adequate preventive maintenance No damaged vehicles are working The service area have all necessary materials in case necessary
	Sedimentation and erosion caused by surface runoff during rains	<ul style="list-style-type: none"> Construction is carried out during the dry season Minimum duration of soil exposition
	Erosion in the slopes along river/creeks banks with slopes of 20 %-30 % caused by land clearance	<ul style="list-style-type: none"> An indisturbed strip of land 7 m width from water course is in place
	Soil compaction caused by the use of heavy machinery	<ul style="list-style-type: none"> A backhoe with a special instrument, to move the soil without modifying the soil profile Better drainage and recycling of organic matter
SUPERFICIAL AND GROUND WATER	Contamination of superficial and/or ground water caused by fuel and oil spills	<ul style="list-style-type: none"> All machinery and vehicles have adequate preventive maintenance No damaged vehicles are working The service area has all necessary materials in case necessary
AIR	Dust produced by wind erosion due to exposition of soil materials during land preparation	<ul style="list-style-type: none"> Soil watering to prevent dust Duration of soil exposition is minimal
	Emissions of GHG to the atmosphere caused by the use of machinery and transport vehicles	<ul style="list-style-type: none"> All machinery and vehicles have adequate preventive maintenance No damaged vehicles are working A compensation program through reforestation of native species and/or fruit trees is in place

FACTOR	IMPACT	INDICATORS
VEGETATION	Loss of biodiversity in DBEF Shrubland and coastal areas due to agricultural related activities	<ul style="list-style-type: none"> • In place, undisturbed 7 m width vegetation cover along the limits of DBEF Shrubland with regeneration, enriched with native species • Inside the 3BNP intercropping is organic • Outside the 3BNP intercropping is low chemical or organic • If minimal chemicals are used, only certified by manufacturers to have safe degradation properties in atmosphere and soil • In the limits and corners of the plantation no Martiniani equipment is used, only backpack spray pumps • Drainage layouts have provisions to prevent contamination with harmful pesticides • Integrated pest management program is in place • Agrochemical storage follow FAO protocols • Only strictly necessary trees are cut • A compensation program through reforestation of native species and/or fruit trees is in place
	Undesirable ecological regime shifts by scattered trees loss	<ul style="list-style-type: none"> • Cutting permit is duly performed and only the strictly necessary trees are cut according to design • A compensation program through reforestation of native species and/or fruit trees is in place
COMMUNITY WELFARE	Dust, noise and vibrations to adjacent communities caused by the use of heavy machinery	<ul style="list-style-type: none"> • Soil watering to prevent dust • Operation carried out only during daytime hours
HUMAN HEALTH AND SAFETY	Workers' risks caused by overload of activities performed	<ul style="list-style-type: none"> • Construction operation is carried out only during daytime hours • Social security/insurance policy and occupational health and safety measures are part of contracts and contractors comply with standards • An occupational safety team is established and working • Drinking water is provided to workers • % of workers from surrounding communities • Induction/training course is carried out at the beginning of and during the project to all workers
OPERATION		
SOIL	Soil erosion caused by water runoff	<ul style="list-style-type: none"> • Minimum duration of soil exposition • High population of sisal plants and organic mulch mass in the farms

FACTOR	IMPACT	INDICATORS
		<ul style="list-style-type: none"> • Vegetative cover in plantation and waterways and outlets is installed • No sisal plants in watershed areas
	Fuel and oil spills caused by the use of machinery	<ul style="list-style-type: none"> • All machinery and vehicles have adequate preventive maintenance • No damaged vehicles are working • The service area has all necessary materials in a necessary case
	Soil compaction caused by the use of machinery	<ul style="list-style-type: none"> • A backhoe with a special instrument, to move the soil without modifying the soil profile
	Soil contamination caused by agrochemicals	<ul style="list-style-type: none"> • Inside the 3BNP only organic intercropping is in place • Outside the 3BNP "Low chemical" or organic approach is in place • An integrated pest management program is established • Only certified agrochemical with safe degradation properties are used • Agrochemical are applied only with backpack spray pumps • Drainages have provisions to trapped to prevent agrochemicals' contamination • Agrochemical are in a safe and secure storage place under the FAO guidelines • Fertilizers, if any, are separated from the rest of agrochemicals
SUPERFICIAL AND GROUND WATER	Contamination of superficial and/or ground water caused by fuel and oil spills	<ul style="list-style-type: none"> • All machinery and vehicles have adequate preventive maintenance • No damaged vehicles are working • The service area has all necessary materials for an extreme case
	Contamination of superficial and groundwater caused by waste water from decortication and if any, agrochemicals runoff from in intercropping	<ul style="list-style-type: none"> • Zero waste: all residues/byproducts from decortication are processed in any of the following and/or a combination: insecticide, compost, biofuel production, and cosmetics, among others. • Inside the 3BNP only organic intercropping is in place • Outside the 3BNP "Low chemical" or organic approach is in place • An integrated pest management program is established • Only certified agrochemical with safe degradation properties are used • Agrochemical are only applied with backpack spray pumps • Drainages have provisions to trapped to prevent agrochemicals' contamination • Agrochemical are in a safe and secure storage place under the FAO guidelines • Fertilizers are stored separately

FACTOR	IMPACT	INDICATORS
	Contamination caused by not treated effluents and sewage	<ul style="list-style-type: none"> • Every building has septic tank or treatment plant • At the packinghouse organic matter mechanical traps and filters are working well
AIR	Emissions of GHG to the atmosphere caused by the use of machinery and transport vehicles	<ul style="list-style-type: none"> • All machinery and vehicles have adequate preventive maintenance • No damaged vehicles are working • A compensation program through reforestation of native species and/or fruit trees is in place • For decortication, diesel generators are located far away from residential areas and office buildings
VEGETATION	Loss of biodiversity in DBEF Shrubland and coastal areas due to agricultural related activities	<ul style="list-style-type: none"> • In place, undisturbed 7 m width vegetation cover along the limits of DBEF Shrubland with regeneration, enriched with native species • Intercropping is organic inside the 3BNP and organic or low chemical outside the 3BNP • Outside the 3BNP, if minimal chemicals are used, only certified by manufacturers to have safe degradation properties in atmosphere and soil • For low chemical use, only backpack spray pumps are used in the corner/limits of the plantations • Drainage layouts have provisions to prevent contamination with harmful pesticides • Integrated pest management program is in place • Agrochemical storage follow FAO protocols • Only strictly necessary trees are cut inside the 3BNP • Compensation program through reforestation is in place
HUMAN HEALTH AND SAFETY	Workers' risks caused by overload of activities performed	<ul style="list-style-type: none"> • Social security/insurance policy and occupational health and safety measures are part of contracts and contractors comply with standards • Occupational safety team is established and working • Workers use protection equipment • % of workers from surrounding communities • Medical care is provided to workers and their families and regular exams carried out • Drinking water is provided to workers

FACTOR	IMPACT	INDICATORS
		<ul style="list-style-type: none"> • Clear procedures are in place and proper training to workers, following the FAO guidelines • Monitoring of any illness case linked to the project operation, especially in dispensaries, medical centers and Hospitals in the North-East Region
TRANSFORMATION PROCESS		
AIR	Emissions of GHG to the atmosphere caused by the use of machinery and transport vehicles	<ul style="list-style-type: none"> • All machinery and vehicles have adequate preventive maintenance • No damaged vehicles are working • A compensation program through reforestation of native species and/or fruit trees is in place
HUMAN HEALTH AND SAFETY	Workers' risks caused by overload of activities performed	<ul style="list-style-type: none"> • Social security/insurance policy and occupational health and safety measures are part of contracts and contractors comply with standards • Occupational safety team is established and working • Workers use protection equipment • % of workers from surrounding communities • Medical care is provided to workers and their families and regular exams carried out • Drinking water is provided to workers • Clear procedures are in place and proper training to workers, following the FAO guidelines • Monitoring of any illness case linked to the project operation, especially in dispensaries, medical centers and Hospitals in the North-East Region

7 FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This chapter is subdivided into two main subjects of the Environmental Impact Assessment: legal-institutional framework and environmental aspects. The construction of this section is based on findings, conclusions related to them, and proposed recommendations.

7.1 *Environmental aspects*

1) **Conditions of ANAP and national authorities to project developers**

- Finding: There exists some proposed conditions that project developers (SISALCO and farmers organizations) should follow in order to receive the approval from ANAP and any other national authority.
- Conclusion: ANAP and national authorities should ensure that developers follow some specific conditions for project implementation, by clarifying them in the agreement before project approval.
- Recommendation: Some of the conditions that should be clearly stated in the agreement are the following:
 - Priority should be given to the recruitment of local staff and temporary workers from the surrounding communities (for example Phaeton, Dérac, Paullette, Barrage, and Fort Liberté).
 - Biomass obtained from land clearing in the SISALCO area in the 3BNP should be distributed among the surrounding community members/potential beneficiaries (for charcoal production).
 - DBEF Shrubland should be kept undisturbed.
 - Decortication centers should be away from water sources.
 - Inside the 3BNP only organic intercropping will be allowed.
 - The decortication centers are zero waste: all residues/byproducts are duly utilized.
 - Natural barriers (mostly with native species) will be developed, according to an appropriate design, to avoid animal intrusion inside the 3BNP.
 - Obtain international environmental certifications (such as ISO 14000 and Rain Forest Alliance).
 - The management and monitoring plan and recommendations of this EIA should be refined and follow by project developers.

2) **Development opportunity**

- Finding: The 4,000 ha sisal project is a unique development opportunity for the North-East Region and the country and it is low-impact.
- Conclusion: In Haiti, and the North-East Region is not an exception, income is very low and land is not intensively used, because is mostly shrubs and current agriculture is low input, low mechanization. Furthermore, large landowners do not present dynamism.

This project is low impact basically because of no water requirements (only little for two weeks at the nursery stage), no use of agrochemicals, no residues, and the fact that the project will be developed in former sisal plantation areas,

- **Recommendation:** The project should maintain the vision about the importance of contributing to the development of the surrounding communities, keeping close communication with them, taking into account its financial benefit, and the improvement of the region as a whole, which in turn will contribute to improving the environment. Furthermore, the project should follow the management and monitoring plan and recommendations of this EIA.

3) **Conditions of North-East Region for sisal production**

- **Finding:** The general conditions of the North-East Region - and even inside the 3BNP - are suitable for sisal production (*Map 16*). Most of the area inside and outside the 3BNP once was cultivated with sisal (*Map 17*).
- **Conclusion:** Plantation of sisal is suitable for the area of study, but inside the 3BNP DBEF Shrubland should be kept undisturbed. In all sisal plantations, the management and monitoring plans described in previous chapters should be followed.
- **Recommendation:** Inside the 3BNP restrictions on the use of land should be taken:
 - Leave undisturbed land classified as DBEF Shrubland.
 - Only plant sisal in land classified as Acacia Shrubland and/or agricultural land (including DBEF Acacia not adjacent to the coast).

4) **Environmental and economic benefits of sisal production**

- **Finding:** Sisal plants have the following benefits (Albrecht 2015):
 - Protect soil from erosion due to its roots' system.
 - Positive impact on watershed management, because of soil retention (erosion avoidance) and infiltration improvement.
 - Economic benefits: sisal is a valuable, rare, important natural fiber and has begun to become popular in the market, increasing profits for growers. Sisal has a low production cost.
 - Growing Sisal Fiber Sisal has many environmental benefits; it does not cost the well being of the environment, assuming good agricultural practices are fulfilled and monitored.
 - Its products are always biodegradable, while other synthetic fibers are not and can cause environmental damage.
 - When it is processed, it produces organic byproducts that have many different uses, such as fertilizer, bioenergy, insecticide, cosmetics, and/or animal feed, among others
- **Conclusion:** Sisal plantations will benefit in general the North-East Region environment.

- Recommendation: Maintaining good agricultural practices (GAP) is essential in a sustainable agricultural production; therefore, its implementation would facilitate not only obtaining the certifications, but also the buyer's control.

Furthermore, well informed and trained workers and managers provides complementary monitoring and control functions, in coordination with ANAP, to ensure that the Fort Liberté peninsulas are not subject to illegal activities such as mining, charcoal production, and goat grazing, among other, not aligned with the conservation objectives of the 3BNP.

5) **Current sources of discharge pollution in the North-East Region**

- Finding: In the region, waste and sludge are discharge directly to the land, rivers, and the ocean.
- Conclusion: Poor maintenance of drainage channels provokes accumulation of piles of waste and sludge, which reduces drainage and are focus of diseases. Pollution destroys the spawning area of marine species and prevents migration of others, as well as, affects the coral reef and marine wildlife.
- Recommendation:
 - The project should maintain the drainage systems clean. Therefore, it is important to establish a collaborative partnership with the Municipalities, as well as other community institutions and organizations since the beginning of the project, for this and other matters.
 - Any building (offices and loading centers) should have septic tanks or treatment plants.

6) **Water resources**

- Finding: There exist valuable water resources in the region. In the area of the project there is at least one aquifer that could potentially provide 250 million m³ of water per year, according to secondary information. The sisal plantation does not require water, except once at the nursery stage (2,000 gallons per ha every two days for two weeks) and in the decortication centers for washing the fibers (20-25 gallons per machine per day).
- Conclusion: Water availability for irrigation is necessary at the commercial sisal nursery, but the amount is insignificant comparing to its availability in the aquifer.
- Recommendation: Even tough the aquifer could provide enough water to cover the requirements of the nursery and the decortication centers, other alternative sources could be explored, such as the development of a water retaining pond and the use of saline water.

7) **Chemical contamination in the North-East Region**

- Finding: There exists no major cases of chemical contamination from industries in the North-East Region.
- Conclusion: No chemicals, hazardous materials, or explosives are stored in industrial quantities, but there could be some cases of small and disperse chemical contamination: small quantities of various chemical substances that could be mixed with demolition debris - from school laboratories and similar institutions.

- Recommendation: The project should secure store any chemical substance, according to FAO and WHO guidelines.

8) **Agrochemical contamination**

- Finding: The sisal industry do not uses any significant amount of agrochemicals for commercial production at the nursery stage.
- Conclusion: There is no risk of agrochemical contamination in the commercial sisal nursery and/or plantation.
- Recommendation:
 - If any, use only certified agrochemicals for the nursery, preferably with no cloro (which is more persistent), of rapid degradation properties.
 - The sisal nursery should only be located outside the 3BNP.
 - Keep a close monitoring of water outlets, as well as, superficial and ground-water resources, every to six to twelve months.
 - Use vegetative coverage in rows at the nursery to serve as retention of soil erosion and agrochemical runoff, diminish weed growth, among other benefits. It is very important that the plant used (preferably a locally available) as coverage do not compite with the sisal and do not attract insects or favors any disease.

9) **Warehouses**

- Finding: Warehouses contain dangerous substances such as agrochemicals, fertilizers, fuels, and cleaning chemicals, among others.
- Conclusion: Warehouses are point sources of contamination.
- Recommendation:
 - Warehouses should be well located outside the 3BNP, for example, where there is no an aquifer below, upslope (not down slope), no houses, offices and/or cafeterias nearby, leaving an appropriate distance according to FAO standards.
 - Provide - at least - contention measures, good ventilation, waterproof floors, retaining wall around (waterproof cement), protection equipments, and showers.
 - Fertilizers, pesticides, and fuels should be stored in separate warehouses.

10) **Increase in GHG emissions**

- Finding: An increase in GHG emissions is expected by the project.
- Conclusion: The sisal project will increase CFC emissions, because of the use of diesel generators to produce electricity and transport vehicles.
- Recommendation: The project should seek to be carbon neutral that means that emissions should be compensated, for example, by planting native trees, especially in the uphill to protect water production, but also in rows within the farm, as protective wind barriers, roads, and as buffer zones to aisle communities from the project.

11) **Fuel and oil contamination**

- *Finding:* There is a risk of fuel and oil leaking from heavy equipment in the field, transport vehicles, service station, and storage places.
- *Conclusion:* The risk of pollution is very low if good practices of FAO and WHO are followed in dealing with fuel and oil.
- *Recommendation:*
 - It is important to keep the necessary equipment to collect any possible spill of fuel and oil, especially in the service station and the storage place.
 - Good monitoring of equipment and vehicles is necessary to put out of service any, which is not in good condition.
 - Maintenance and repairing should only be carried out in the service station outside the 3BNP.

12) **Environmental emergencies**

- *Finding:* Haiti is prone to natural disasters such as earthquakes, storms, flooding, and droughts, among others.
- *Conclusion:* Environmental emergencies could come from anthropogenic actions and/or natural events.
- *Recommendation:*
 - The project should develop procedures to identify, prevent, respond, and mitigate environmental emergencies, related for example to the following subjects:
 - Regulations for occupational health and safety.
 - Emergencies caused by natural disasters.
 - Fire caused in project buildings.
 - Emergencies caused by any chemical contamination.
 - Emergencies during fumigation.
 - Transport, storage, and utilization of compressed gas cylinders.
 - Emergencies caused by africanized bees.
 - The project should seek to use the best sisal variety to be adapted to the region.

13) **Certifications**

- *Finding:* Certifications would facilitate management procedures for the sisal business project.
- *Conclusion:* There exists several certifications that could provide a value added to the project and promote an even higher demand.
- *Recommendation:* Some of the certifications that could be viable for this project are ISO 14000, Global Gap, Rain Forest Alliance, and Fair Trade, among others.

14) **Subcontractors**

- *Finding:* A common mistake in a commercial agricultural plantation is that subcontractors do not follow the environmental, health and safety, and legal compliance norms.

- Conclusion: Subcontractors do not follow the norms, because either they do not know the norms and/or it is not a requirement in their contracts.
- Recommendation: All required, among others, environmental, H&S, and legal compliance norms should be part of the contracts of subcontractors.

15) Environmental Management System (EMS)

- Finding: A good monitoring and control of environmental risks is a complex task.
- Conclusion: For all the environmental risks identified, mitigation measures have been proposed, according to international and IDB standards and policies.
- Recommendation: The proposed mitigation measures should be refined and adapted by the project. Therefore, in order to facilitate their implementation, an environmental management system should be put in place that includes several aspects such as energy and water quality and saving, integrated pest management system, and monitoring and evaluation, among others.

7.2 *Legal and institutional*

Within the Haitian legal system, there exists a basic (legal) framework that addresses most of the elements and phases of the project. Furthermore, there are several public institutions (Ministry of Agriculture, Ministry of Social Affairs and Labor, Ministry of the Environment and the Ministry of Planning and Foreign Cooperation), which have the authority and the mandate to approve the project, in order to comply with existing laws and regulations, through the enforcement of permit requirements, regulatory inspections, and state registration requirements.

As a result, the national system is disjointed and cannot be relied upon to ensure that the proper international and institutional standards of the Inter-American Bank are followed.

16) Legal framework and institutional capacity:

- Finding: In certain cases, the national laws create procedures and requirements, for which the corresponding competent offices do not have the required personnel.
- Conclusion: There are several requirements and procedures created by law that have not been developed within the mandated institutions.
 - Whereas there are some permits required by the project in order to execute the commercial sisal cultivation activities, the corresponding offices do not appear to either exist or to be applying the requirements.
 - In many offices there are not official sources of information related to procedures, requirements, and permits.
- Recommendations: The Project must follow the regulations provided by law in its activities. Additionally, the project must complete the requirements - created by law -, despite the lack of enforcement or non-response by the authorities. It is further recommended to proceed as follows in order to demonstrate proofs of the intention to follow the law:
 - Whereas there are some permits or management plans that require the approval or the inspection of government authorities, the project has to generate the conditions to fulfill these requirements, or either, find out the way to collaborate with the authorities to facilitate the process.

- Governmental (inter) agencies' coordination guarantees no duplication in general regulations and land use definitions.
- MOE inspection system may not have the required personnel to ensure compliance with the management and monitoring plans (presented in the last chapter); therefore, adequate personnel should be assigned specifically for this matter.

17) Land use, protected areas and institutional capability:

- *Finding: Since the Project will operate in protected land (SISALCO in the 3BNP, Map 2) as well as not protected one (Petit Planteurs and/or other farmer's organizations, Map 3), the location of the production parcels will require extra diligence to ensure that the production areas respect the land categories and management plans.*
- *Conclusion: The definition of the protected lands that cannot be used for agro industrial production is a key factor for the project, as well as the previous approval of the management plan for the sisal project by the MoE.*
- *Recommendations: It is recommended that if the property falls on protected areas, the following measures should be taken:*
 - Definition of the non-usable areas in consideration of ecological reasons according to the 3BNP baseline study (Kramer et al 2016).
 - Ensure of the previous approval of the management plan for the production parcels within protected areas by the MOE.
 - Promote the formalization of the small producers' associations.
 - Ensure the formalization of the MOU for the protected land use by the small producers.

18) Environmental and labor laws, and OSHA requirements:

- *Finding: Several difficulties have been identified related to the accomplishment and the implementation of the law within the work place.*
- *Conclusion: International conventions and environmental and labor laws regulate several aspects of the project implementation, day-to-day activities, and the powers of the authorities; however, local regulations have not been made available, nor do they appear to be related to the primary issues of intervention.*
- *Recommendations: The Project must follow the regulations provided by law in the implementation all workers' related activities. This is particularly true with regards to the creation of internal safety regulations to ensure compliance, whether or not a governmental institutional inspection is conducted. The following measures should be taken:*
 - Use internal and external evaluations to demonstrate that the project is in compliance with the legal framework.
 - Engage authorities in all project related activities.
 - Be aware and implement best practices held by the sector in other countries.

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9 ANNEXES

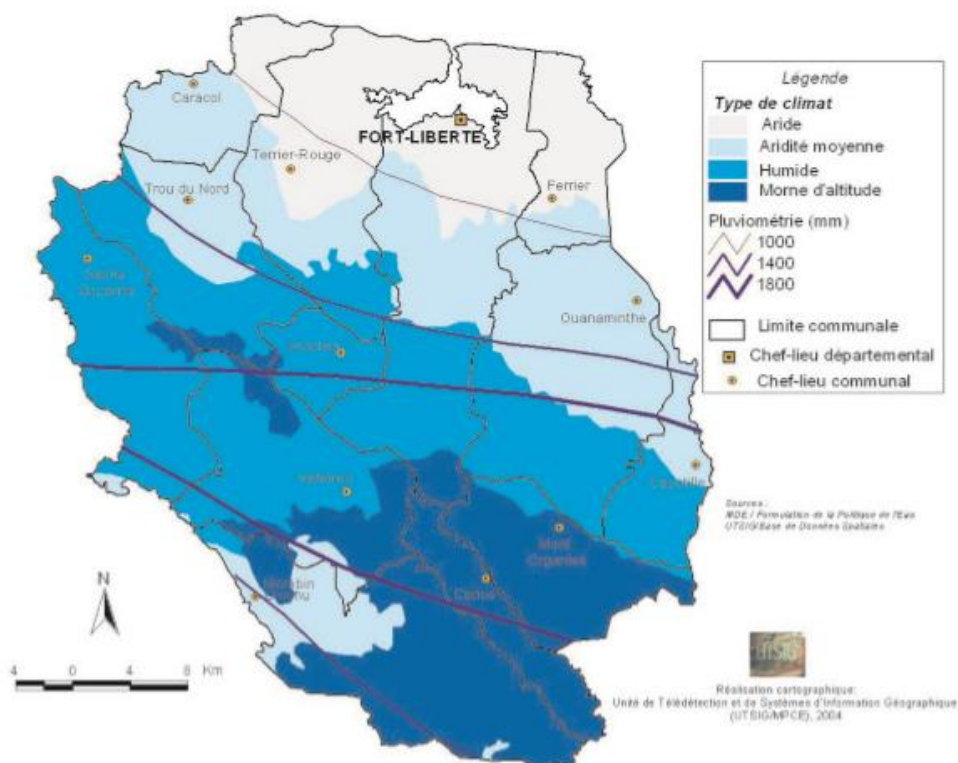
9.1 *Annex 1:*

Detailed environmental setting of the project

9.2 Climate

Haiti is located in the Low Subtropical Region (18°-20° north latitude and 72-75° west longitude). The climate has temperate conditions and moderately hot temperatures. It is free of fog at low altitudes and has a wide range of atmospheric temperatures compared with actual tropics. The climate of the plains and the lower montane regions are primarily tropical monsoonal, while that of the montane area is sub-tropical. The climate of Haiti is the result of its position in the Caribbean and the mountainous physiography. Also, geographical features of the country expound the climatic contrasts, founded only a few kilometers apart. (CIAT 2013, Swartley and Toussaint 2006).

Map 5: Haiti Northeast Department Climate Zoning



Note: Légende= legend Type Climate= Climate type aride= arid
 aridité moyenne= semiarid humide= humid mm= millimeters
 morne d'altitude= dreary altitude chief-lieu départemental= capital department
 Chief-lieu communal= Capital community pluviométrie = precipitation
 limites communale= community boundaries

Source: Céran ____.

According to Map 5, the Northeast Department has four climate zones (arid, semiarid, humid and montane altitude); the SISALCO project may be located in the arid climate zone, which sisal tolerates. The arid zone has 600-1,200 mm of annual precipitation with five to seven dry months and average temperatures between 25 °C and 27 °C (CIAT 2013).

The semiarid zone, where part of the outgrowers' project may be located, is characterized by an annual rainfall between 1,100 and 1,600 mm, with four or five dry months and average temperatures between 22 °C and 25 °C. The humid zone has 1,500-2,200 mm/annual with

For climate specifications, the data collected by Climate-data.org (2015) is used. This web page provides data on temperature and precipitation collected for 20 years, until 2000, which describes the climate of Terrier Rouge Town. Furthermore, temperature data recorded from 1961 to 1990 by P. Salcedo Station; located 20.4 km from Phaéton Town is presented below (NK 2015). Evapotranspiration humidity and evaporation data reported by LGL Ltd (2012) is also used.

Sisal tolerates temperatures between 0 °C to 40 °C (Cabi 2016). In the area of the project, the average annual temperature is 26.6 °C, maximum annual 31.6 °C and 21.5°C minimum, accordingly to records of the P. Salcedo Station. Climate-data.org (2015) reports an average annual temperature of 25.8 °C, maximum annual 30.7 °C and 21.0 °C minimum. Both sources of data show a similar trend throughout the year. The highest temperature is found between June and September and January the coolest month (*Chart 12*).

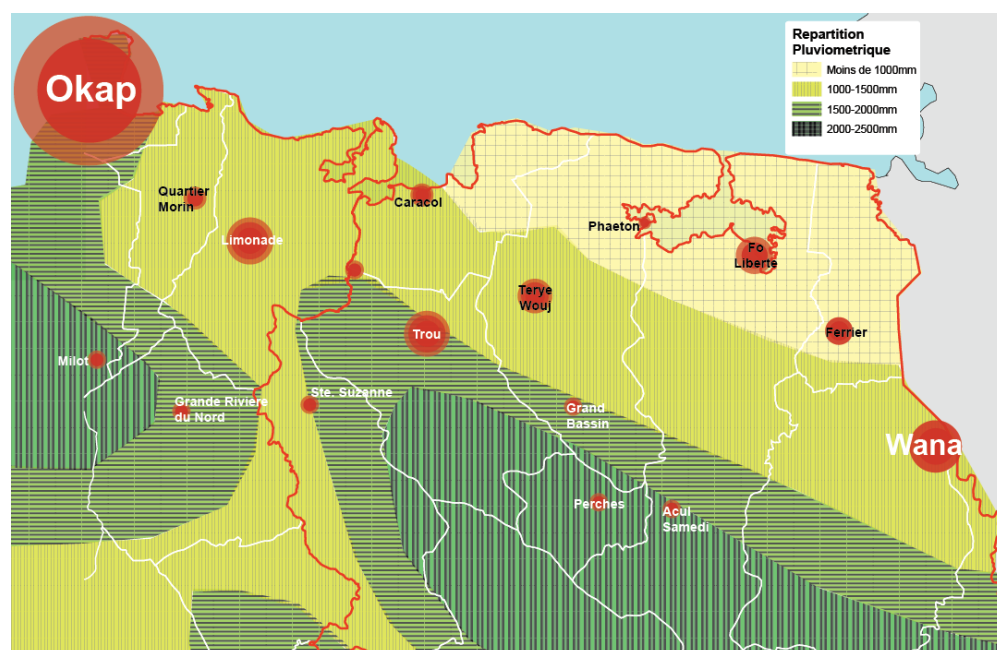
MONTH	TERRIER ROUGE TOWN			P. SALCEDO STATION		
	MAX	MIN	AV.	MAX	MIN	AV.
January	28.7	18.7	23.7	29.4	19.3	24.4
February	29.1	18.8	23.9	29.7	19.5	24.6
March	29.9	19.6	24.7	30.6	20.5	25.6
April	30.4	21.0	25.7	31.0	21.3	25.2
May	30.9	21.9	26.4	31.7	22.3	27.0
June	31.7	22.4	27.0	33.0	22.9	28.0
July	32.2	22.3	27.2	34.1	23.2	28.7
August	32.6	22.6	27.6	34.1	23.1	28.6
September	32.3	22.3	27.3	33.2	22.7	28.0
October	31.5	22.0	26.7	32.2	22.4	27.3
November	30.22	20.9	25.5	30.8	21.1	26.0
December	28.8	19.3	24.0	29.4	19.7	24.6
Average	30.7	21.0	25.8	31.6	21.5	26.6

Source: NK 2015, Climate-data.org 2015.

Sisal tolerates till six consecutive months with average rainfall of less than 40 mm, and an annual average between 500 mm and 800 mm (Cabi 2016). Map 6 shows the annual rainfall

distribution of the North and Northeast region. The north and north-east region are divided in four different zones according the rainfall distribution. The driest area has less than 1,000 mm annually. The project will be located in this area in the 3BNP and closest to the Phaéton Town. The second driest zone has an annual precipitation of 1,000-1,500 mm. The other two areas show 1,500-2,000 mm annually and 2,000-2,500 mm, according to the climate zones in this area.

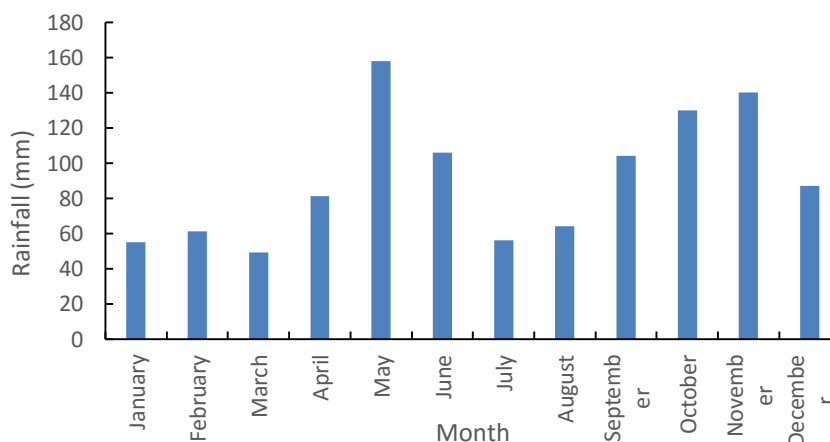
Map 6: Rainfall distribution in Nord/Nord-Est Region



Note: Repartition pluviometrique= Rainfall distribution, moins de= less than, mm= millimeters.

Source: Shi et al. 2012.

Figure 1: Monthly rainfall (mm)



Note: mm= millimeters.

Source: Climate-data.org 2015.

The northern region shows two rainy seasons: one that goes from April to June and another from September to June. The duration of the rainy season depends on the climate zone. In

the Northeast area, from Terrier Rouge to Ferrier, annual rainfall average is less than 1,000 mm.

Climate-data.org (2015) reports a precipitation annually of 1,091 mm. The driest month is March, and May is the month with more precipitation (Figure 1).

9.2.3 Evaporation and Evapotranspiration

High temperatures and solar radiation provokes the annual evaporation rate to be higher than the rainfall rate in Fort Liberté. *Chart 13* shows that July is the month with the highest evaporation and evapotranspiration rate and the month with the lowest ones is December (LGL Ltd 2012).

Chart 13: Monthly Evaporation (mm/day) and Evapotranspiration (mm/month)

MONTH	J	F	M	A	M	J	J	A	S	O	N	D
Evap	3.35	3.93	4.42	4.83	5.19	5.27	5.32	5.13	4.74	4.55	3.42	3.16
Eto	104	110	137	145	161	158	165	159	147	141	106	98

Note: Evap= evaporation. Eto= evapotranspiration, mm= millimeters.

Source: LGL Ltd 2012.

9.2.4 Relative humidity

The average relative humidity of Fort Liberté is presented on *Chart 14*. The relative humidity has a narrow range throughout the year with an average variation around 2.7 %. The month with the highest average relative humidity is October and with the lowest is March (LGL Ltd 2012).

Chart 14: Monthly Average Relative Humidity (Percentage)

MONTH	J	F	M	A	M	J	J	A	S	O	N	D
RH	58.4	55.4	53.7	60.0	62.1	58.8	54.3	57.5	64.1	65.9	62.5	60.0

Note: RH= Relative Humidity.

Source: LGL Ltd 2012.

9.3 Hydrology

Haiti is divided in seven hydrographic regions. The Sisal project will be located in the North hydrographic region, which shows an average flow of 920 mm³ per year and covers an area of 2,490 km².

The river runoff refers to all water that comes into a river water system from sources such as rainfall and groundwater. The most extensive regions show the highest run off, the center-north and south-west regions (*Chart 15*).

Chart 15: *Distribution of water resources by hydrographic regions*

HYDROGRAPHIC REGIONS	AREA (km ²)	TOTAL RUN OFF		RUN OFF RELATIVELY REGULAR Mm ³ /year
		Average flow Mm ³ /year	%	
I North	2,490	920	7.7	300-400
II North West	4,400	1,130	9.4	100-200
III Center North	7,200	3,465	28.9	700-1,000
IV Center South	3,630	1,100	9.2	300-350
V South East	1,810	775	6.4	50-1,200
VI South West	7,350	4,270	35.6	1,000-1,200
VII Satellite Islands	880	340	2.8	50
TOTAL	27,750	12,000	100.0	2,500-3,300

Note: Mm= millimeters an= annual.

Source: MoE 2001.

9.3.1 Surface water

Surface water is normally used for domestic purposes; including drinking and irrigation, and in less extent groundwater. Surface water is concentrated in a few number of rivers and wetlands (Swartley & Toussaint 2006). *Map 7* shows that the northern coast of the Departments of Le Nord and Nord-Est lies within the sub watersheds of Cap Haïtien (325 km²), Grande Riviere du Nord (640 km²) and Limonade/Ouanaminthe (1,085 km²). These watersheds are characterized by major rivers running from the mountains (Le Massif du Nord), which rise up to 1,210 meters above the sea level in Le Nord, down to the coastal plains (Livre du Nord, 1999). The first two watersheds are characterized by significant land area in the mountains and piedmont, while the Limonade/Ouanaminthe watershed is mostly coastal (Shie et al. 2012).

The main rivers in the northern departments are the Grande Riviere du Nord (serves Limonade and Quartier Morin), Riviere Trou du Nord serves Trou du Nord and Caracol), Rivières Malfety and Marion (serves Fort Liberté), and Riviere Massacre, Jassa and Lamatry (serves Ferrier). Terrier Rouge is served by a secondary river, the Ti Couline (Shie et al. 2012).

Map 7: Surface water resources in Haiti



SURFACE WATER RESOURCES

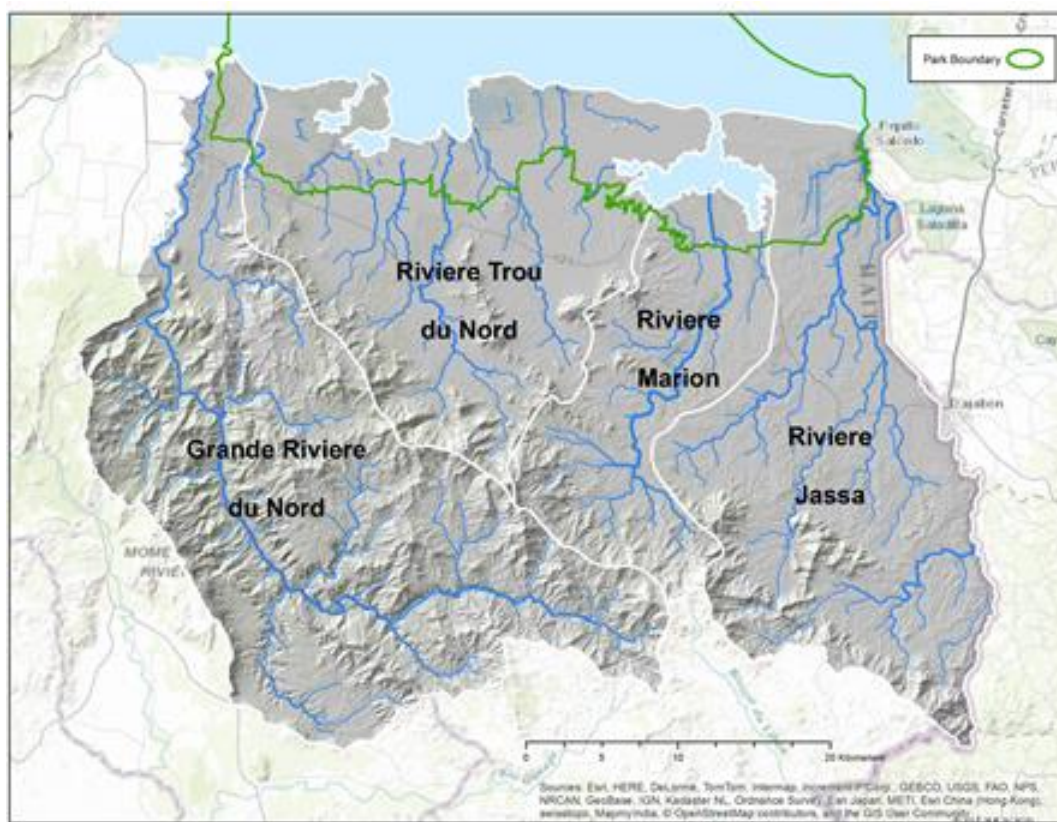
HYDROGRAPHIC BASINS AND ZONES:

- | | |
|---|--|
| I Mole St. Nicolas-Moustiques Zone | XVI Léogane-Carrefour Zone |
| II Bombardopolis-Gonaives Zone | XVII Grande Rivière de Jacmel Basin |
| III Trois Rivières Basin | XVIII Côtes de Fer-Bainet Zone |
| IV Port de Paix-Port Margot Zone | XIX Petit Rivière de Nippes-Grande |
| V La Quinte Basin | Gôave Zone |
| VI Limbé Basin | XX St. Louis du Sud-Aquin Zone |
| VII Cap-Haitien Zone | XXI Grande Rivière de Nippes Basin |
| VIII Grande Rivière du Nord Basin | XXII Cavaillon Basin |
| IX Limonade-Ouanaminthe Zone | XXIII Corail-Anse à Veau Zone |
| X Estère Basin | XXIV Cayes Zone |
| XI Artibonite Basin | XXV Roseaux-Voldroque Zone |
| XII Saint Marc-Duvalierville Zone | XXVI Grand Anse Basin |
| XIII Cul-de-Sac Zone | XXVII Jérémie-Les Irois Zone |
| XIV Fond Verrettes Zone | XXVIII Tiburon-St. Jean Zone |
| XV Cayes Jacmel-Anse à Pitres Zone | XXIX Tortue Island Zone |
| | XXX Gonâve Island Zone |

Source: Knowles et al. 1999.

There are four main watersheds that drain into the Park: Grande Rivière du Nord, Rivière Trou du Nord, Rivière Marion, and Rivière Jassa (Kramer et al 2016) (Map 8).

Map 8: Watershed boundary of four principle water drainage basins, including 3BNP



Source: *Kramer et al 2016.*

The Grande Rivière du Nord accounts for almost two-thirds of the total freshwater discharge in the region and is large enough to flow year round, including during the dry season. The other watersheds are smaller and without precipitation during extended periods of time, which may cause to run completely dry in their lower reaches. The steep deforested slopes of the upper portions of all the watersheds provoke very rapid and high flow discharges following storm events, which during high rainfall events may cause hazardous flash floodings and movement of large volumes of sediments. In the lower reaches of the watersheds that cross the Northern Plain, the riverbeds and river mouths may shift around from year to year building deltas, which may enter into the bays (Kramer et al 2016) (Chart 16).

Chart 16: Four principle watersheds of 3BNP and their characteristics

Watershed	Area (ha)	Mean Annual Precipitation (mm)	Average Discharge (m ³ /sec)*
Grande Rivière du Nord	62,746	1,743	17
Rivière Marion	21,803	1,361	5
Rivière Trou du Nord	42,830	1,217	8
Rivière Jassa	43,421	1,350	9

Note: *relative discharge calculated with a 0.5 fixed infiltration/evapotranspiration coefficient. Mm= millimeters.

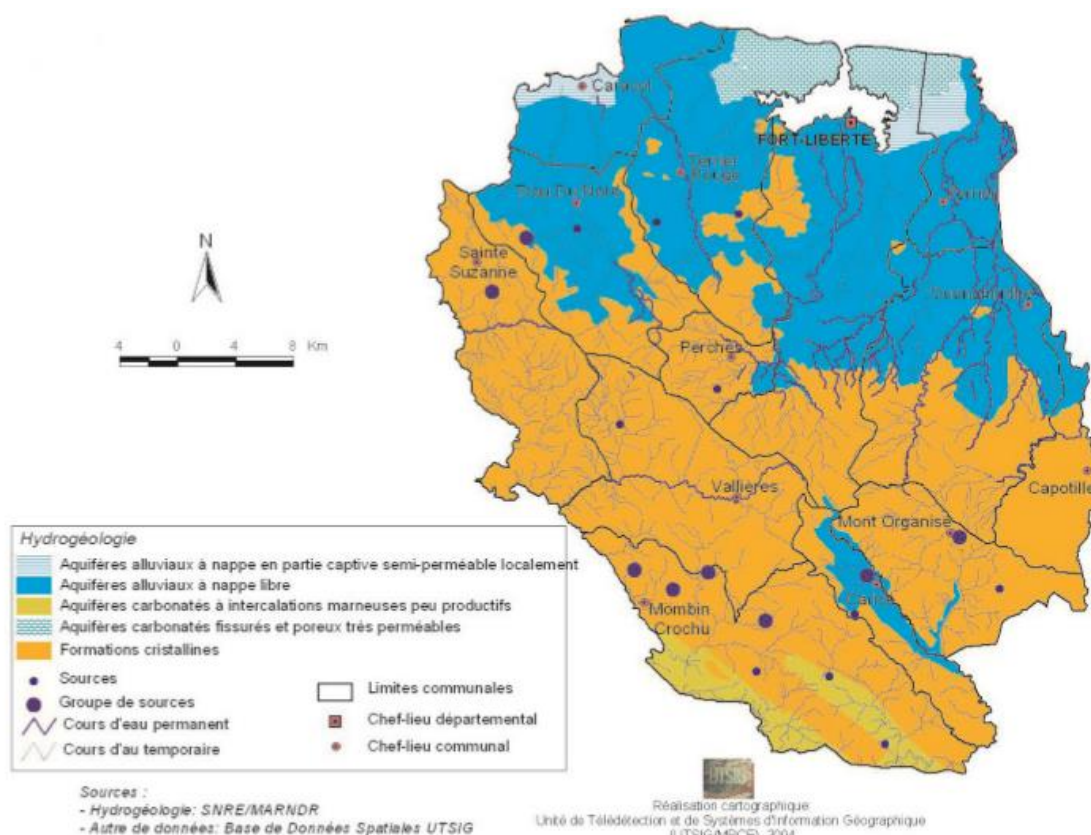
Source: *Kramer et al 2016.*

9.3.2 Ground water

Northern Haiti has a large aquifer that provides 250,000,000 m³ of water per year and is believed to be unconfined (ENVIRON 2011). This is a highly valuable resource given the freshwater constraints faced by many islands. In the coastal plain, from Cap-Haïtien to the Massacre River, aquifers are mostly less than 0.5 to 2.0 meters below the surface, and are rarely more than 20 or 30 meters below the surface. Given the alluvial and sandy soils of most of the plain, the coastal aquifer is highly porous and easily contaminated, particularly from latrines, unsanitary landfills, gas stations, and transport hubs. The growing impermeability in Cap-Haïtien is preventing aquifer recharge (Smucker et al. 2007).

According to Map 9, groundwater is grouped into five types of aquifers depending on the nature of the parental material. In the communities of Caracol, Fort-Liberté and Ferrier, the water table are semi-confined, and the aquifer is semi-permeable. In the coastal plain of Phaeton and Dauphin, aquifers are conformed by cracks and porous limestone, and are permeable. In parts of plains of Caracol, Trou-du-Nord, Terrier Rouge, Fort-Liberté, Ferrier, Ouanaminthe and Carice alluvial aquifers are unconfined. In mountainous areas, there are mainly crystalline formations.

Map 9: Ground water resources in the Northeast department of Haiti



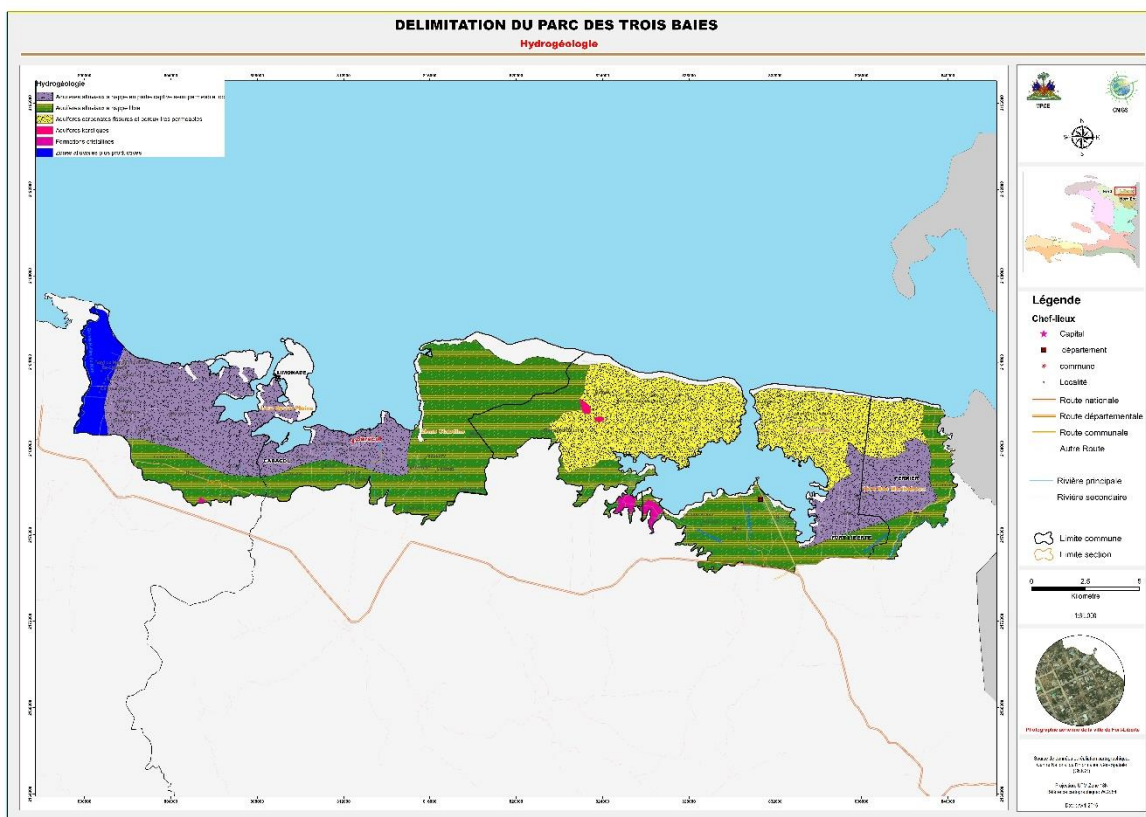
Note: Hydrogéologie= Hydrogeology Aquifères alluviaux à nappe en partie captive semi-perméable localement= Semi-permeable alluvial aquifer with semi-confined water table
 Aquifères alluviaux à nappe libre=, Unconfined alluvial aquifer
 Aquifères carbonates à intercalations marneuses peu productifs= Productive carbonate-rock aquifers with interbedded mal Aquifères carbonates fissures et poreux très perméables= Permeable and Porous carbonate-rock aquifers Sources= Sources
 Formations cristallines= Crystalline formations Limites communales= Community boundary
 Groupe de sources= Sources group
 Cours d'eau permanent= Permanent watercourse Cours d'eau temporaire= Temporary watercourse
 Chief-lieu départemental= capital department Chief-lieu communal= Capital community

Source: Cérans __.

Inside the 3BNP the project will be located over two different types of aquifers (Map 10):

- The location north of Phaeton will be over an aquifer with carbonate fissures and porous very permeable (yellow color north of Phaeton).
- In Dérac will be over an alluvial slick aquifer partly captive semi permeable (purple color in Dérac).

Map 10: Hydrology in the 3BNP



Note: Yellow= aquifer with carbonate fissures and porous very permeable
 Purple= alluvial slick aquifer partly captive semi permeable.

Source: CNIGS 2016.

The implications of an agricultural project on the aquifers would be that the most porous and permeable implies that agrochemicals – and/or any other type of contamination, for example non-treated sewage - could penetrate easier, polluting the aquifer; however, the sisal project will not use any type of agrochemicals, nor the associated intercropping that is proposed to

be organic. Permeability also affects the recharge timing of the aquifer, more permeability implies that the aquifer recharges more easily, but this project will not use any irrigation and will only use a minimum quantity of water for irrigation in the nursery and for washing the fibers at the decortication centers.

9.3.3 Drinking water

Demands for safe drinking water of the whole country reached in 1997 137 million m³: 52 million m³ for rural areas and 85 million m³ for urban areas, of which 33.5 million m³ only from Port-au-Prince (MoE 2001).

According to *Chart 17*, the proportion of population with access to improved potable water sources is low, especially in rural areas. Access to an improved water source refers to the percentage of the population with reasonable access to an adequate amount of water from an improved source, such as a household connection, public standpipe, borehole, protected well or spring, and rainwater collection (UN 2015).

The majority of the communities in the Northeast region are feed with potable water with hand pumps and several public water taps. Some people also use unprotected water sources for household water supply.

In the community of Terrier Rogue, the section of Grand Bassin is used as a water source, where the water is taken, stored in cisterns and dispensed by hand pumps, although this is a very precarious system and has water problems in terms of quantity and quality. Illnesses like typhoid, diarrhea, and intestinal parasites resulted from absorption of contaminated water are common. The community of Fort-Liberté has the same problems with the water supply. Wells equipped by hand pumps, public taps, and stored rain water in household cisterns are the main sources of the water. In this community exists a particular water supply service, by the payment of 1,500 gourdes (US\$ 25.64¹⁵), they provide a truck with 2.5 cubic meters of water for home delivery (USAID 2011; Céran ___).

Chart 17: Proportion of population with access to improved potable water sources (%)

ZONES	COVER RATE IN % PER YEAR				
	1995	2000	2005	2010	2015
Urban areas	88	82	76	70	65
Rural areas	50	49	49	48	48
Whole country	62	61	61	59	58

Source: UN 2015.

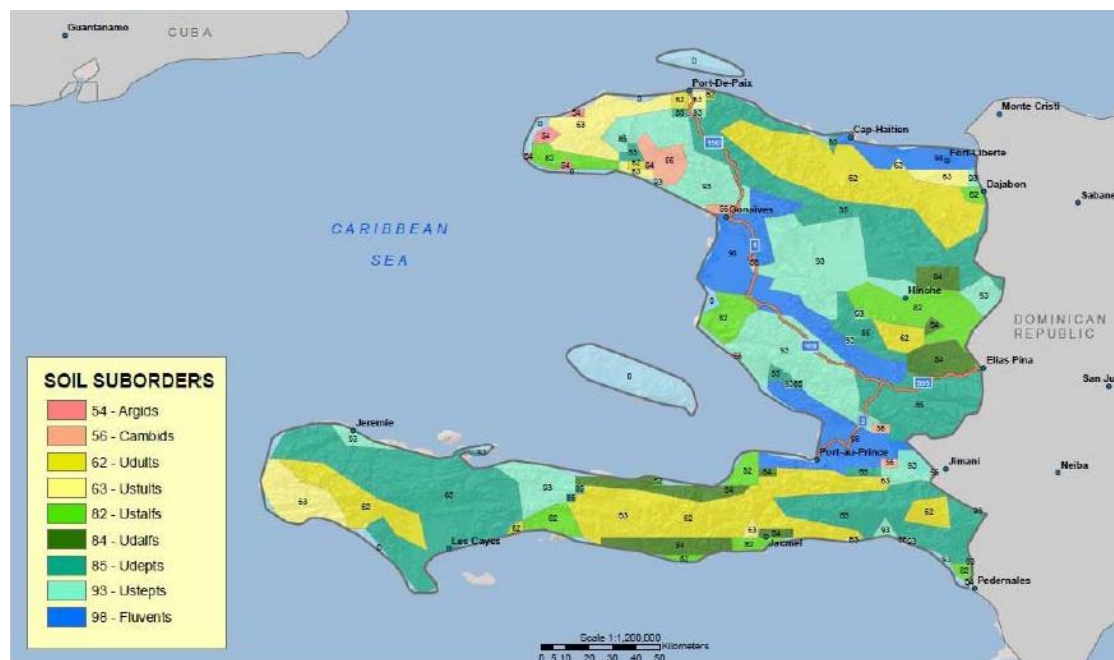
9.4 Soils

Sisal tolerates well soils with the following characteristics: reaction acid to neutral, texture light to medium, and type saline to shallow (Cabi 2016). The majority of the northeast region is compound by Ultisols and Entisols, with pockets of Inceptisols; with udic (the soil moisture control section is not dry in any part for as long 90 cumulative days) or ustic (there is at least one rainy season of 3 months or more) soil moisture regimes and Alfisols (Grunwald 2015; Hylkema 2011) (Map 11).

¹⁵ 1 US\$= 58.49 HTG.

Two distinct types of soils are founded in the Community of Terrier-Rouge: in the Grand Basin area, soils have sandy-clay texture, high contain of organic matter and a good agricultural potential. In the lower part, near Fond Blanc, soils have a loam-clay texture. These soils derived from the decomposition of diorite and basalt. In the Community of Fort-Liberté, the major part of the soils has calcareous origin and also present a volcanic origin (andesite and rhyodacites). In the part of the plain of Dauphin soils are protected by coastal limestone and in Madras the sandy-loam alluvium provides them a good agricultural potential. To the east side lies with slightly elevated plain and weak undulation where soils are richer, deeper, and a high agricultural potential. To the south foothills area, soils are deep (Céran ____).

Map 11 **Distribution of dominant soil suborders within Haiti**

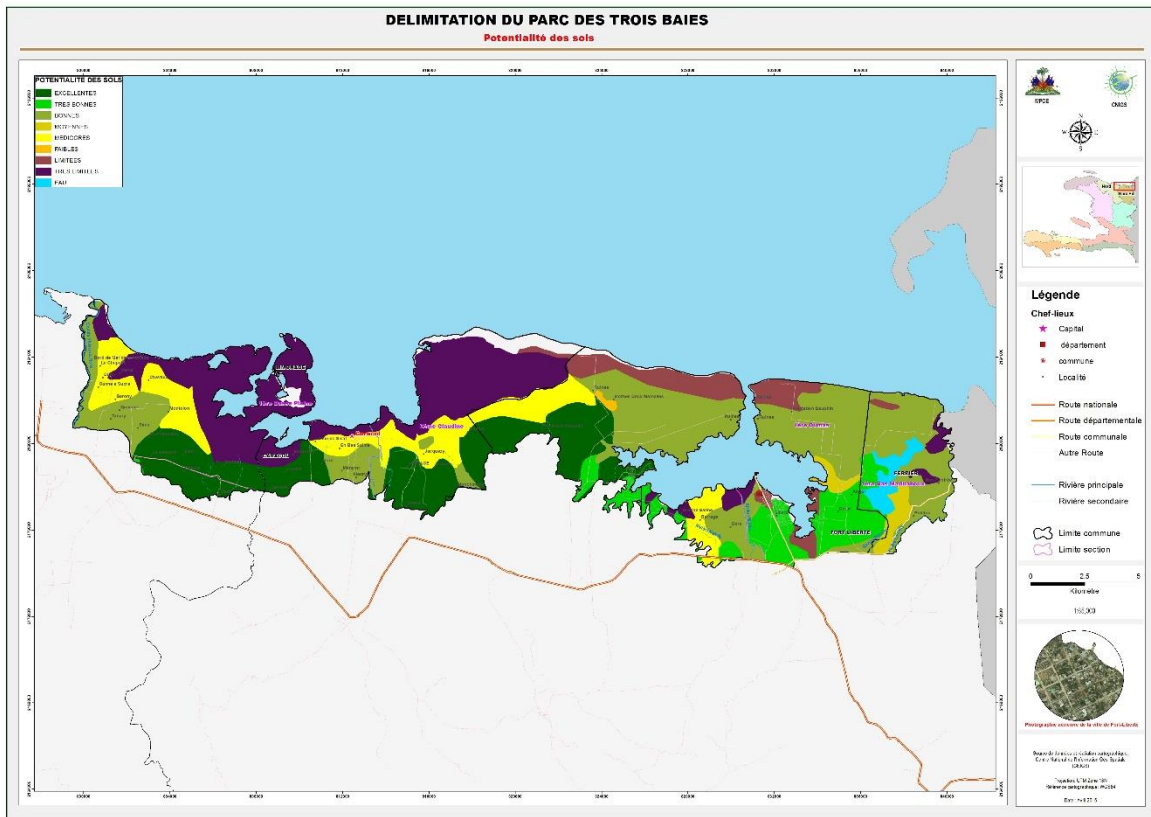


Source: USDA-NRCS 2010.

Inside the 3BNP and according to the land use potential, the SISALCO project will be located in lands that are classified from very good to mediocre for agricultural purposes (*Map 12*):

- North of Phaeton: classified as average (opaque green color).
- Dérac: one part classified as very good (light green color) and other part (northern) as mediocre (brown color).

Map 12 **Land use potential inside the 3BNP**



Note: Light green= Very good. Opaque green= Average.
Brown= Average.

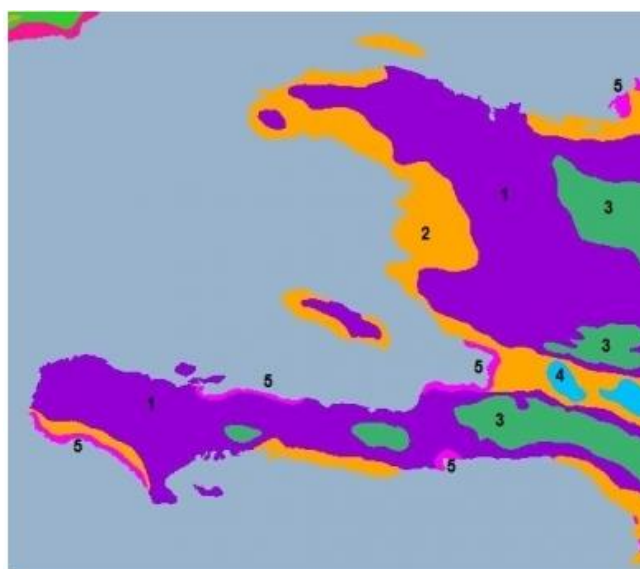
Source: CNIGS 2016.

9.5 Biodiversity

Map 13 shows the localization of the eco-regions in Haiti. The predominantly ecoregion is the Hispaniola moist forests that could be found between the slopes of the eastern range and along the northern range. In the northeast region includes Amanpa Mangroves, Hispaniola Moist Forest and Hispaniola dry forest, where is located the Sisal project (Swartley & Toussaint 2006).

Map 13

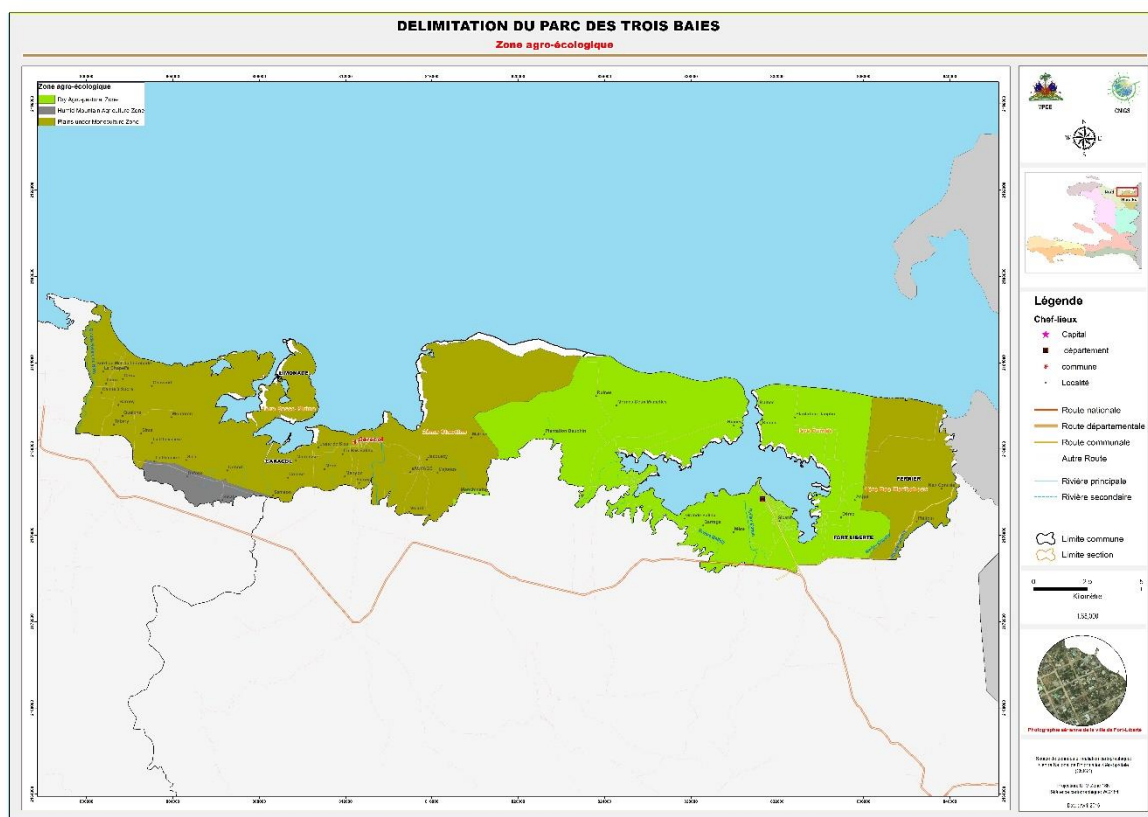
Ecoregions localization in Haiti



Note: 1. Hispaniola moist forests. 2. Hispaniola dry forest. 3. Hispaniolan pine forests.
4. Enriquillo wetlands. 5. Amanpa mangroves.

Source: World Wildlife Found 2010.

Map 14 **Agroecological zones in the 3BNP**



Note: Light green= dry agropastoral zone. Opaque green= Plains under monoculture zone.
Gray= Humid mountain agriculture zone.

Source: CNIGS 2016.

The project will be located in a dry agropastoral zone in both sides – north of Phaeton and Dérac, which could be easily tolerated by sisal (Map 14).

9.5.1 Flora

In the Northeast Department the plant cover is dominated by crops and tree regrowth. The major part of the plants is composed by seaweed, marine, and coastal plants and plants' characteristics of the subtropical dry forest, mountain rainforest, and lowland rainforest. Along the coast, the vegetation cover is composed by mangrove plants, dominated by red, white, black, and grey mangrove. In the arid zones, "Cadelon" and "Bayahonda" (*Prosopis juliflora*) are predominantly, followed by gum trees, cactus arborescent, cacti, and euphorbias. In Foothills and mountains, "the Colossus" (a thorn palm), mahogany, laurel, pine, and redwood trees are dominant. Some tree species grow on roadsides, such as mango and avocado, probably from seeds thrown by passersby. Generally natural areas of perennial woody plants were replaced by herbaceous or tubers crops, increasing the detriment of the environment and the economy of the department. Crops are introduced plants made through the history and includes avocado, corn, cassava, yam, potato, beans, achiote, pepper, cashews, sugar cane, bananas, rice, peanuts, congo peas, coffee, and mango (Céran ____).

Detailed information about the flora inside the 3BNP could be found in Kramer et al 2016, not yet published.

9.5.2 Fauna

Some of the fauna of the North East department consists of domestic animals introduced since the colony (dogs, cats, birds, horses, bovines, and goats) (Céran ____).

According to the base line ecological study carried out in the 3BNP, 6,411 birds of 95 species were recorded overall, including 24 non-breeding visitors or migrants. There are four amphibian species and 11 reptile species recorded. The low amphibian diversity is the result of the contamination and eutrophication of all the lagoons.

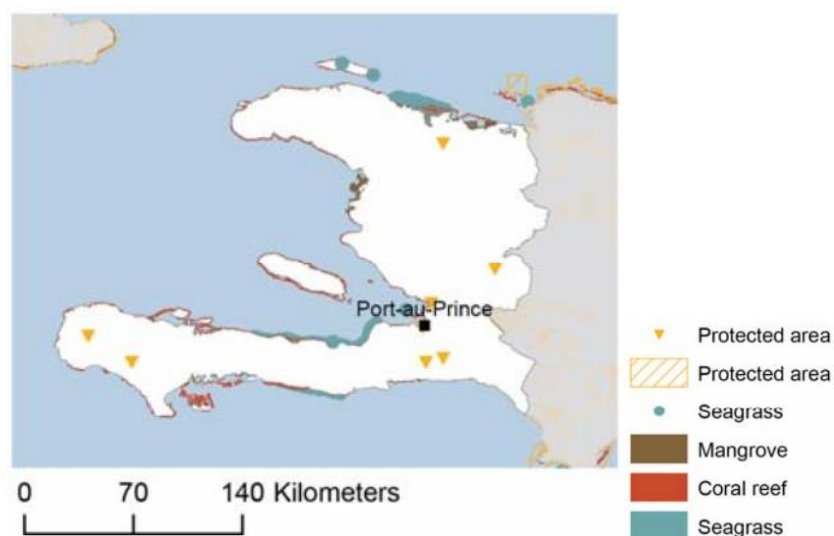
The principal larger mammals are two introduced predators- the Small Indian Mongoose (*Herpestes auropunctatus*) and the Feral Cat (*Felis catus*). Both of these predators are well established and widespread in the area. In relation to freshwater species diversity, a total of 59 animal taxa were collected or observed, which include 22 fish and 37 invertebrates. (Kramer et al 2016).

Detailed information on the fauna inside the 3BNP could be found in Kramer et al 2016, not yet published.

9.5.3 Coastal and marine ecosystem

Mangroves, sea grass, and coral reefs in the coastal areas are highly degraded. Sedimentation caused by erosion of the uppers parts of the watersheds, overexploitation of resources, land based pollution and sedimentation, and habitat encroachment have put these ecosystems under pressure. Consequently, reducing fishing catches and limiting the potential for aquaculture (United Nations Environment 2009).

Map 15 **Haiti Coastal Areas**



Source: Chatenoux and Wolf 2013.

Map 15 shows the location of the coastal areas. Seagrass beds occur along the North Coast. Coral reefs are distributed along important coastal zones and mangrove forests (180 km² in 1983), which relevant for this project are located on the North and North east Coast. Significant mangrove forests occur on the north coast between Baie de l'Acul and Fort-Liberté. The mangrove forest habitat holds a rich and diversified fauna, from which some representatives are permanent residents, while others are seasonal visitors. At least 13 species, considered either threatened or seriously in danger of extinction, have been identified as inhabitants of mangrove forests and lagoons in the country, among others the west Indian manatee (*Trichelus manatus*), the American crocodile (*Crocodylus acutus*), the Atlantic sea turtle (*Eretmochelys imbricata*), the Flamingo (*Phaenicopterus palmarum*) (MoE 2001).

One of the significant coastal habitats is located from Fort Liberté to St. Nicola. This coastal area is characterized by the presence of productive bays and coves, sandy beaches, extensive seagrass beds, and coral formations. There are significant mangroves between Baie de Fort Liberté, Baie des Caracoles, and Baie de l'Acul. Excellent shrimp habitat in Baie de l'Acul and good habitat for Manatee and green turtles (Swartley & Toussaint 2006).

In the coastline, there exist deltas, estuaries, coastal plains, and coastal lagoons. These wetlands provide diverse, renewable natural resources, which support mixed traditional economies based on capture fisheries and the use of forest products. Grasslands and mangrove forests support useful plants. Coastal lagoons and mangroves are the nursery grounds for many species, both benthic and pelagic (MoE 2001).

The Nature Conservancy (TNC) study¹⁶ suggested that 16 habitat classes captured most of the benthic habitat diversity of the Park. Coral reefs make about about 10 % of the benthic habitats and seagrass beds - found predominatly in Caracol Bay - cover over 25 % of the area (Kramer et al 2016 from Perkis 2015) (Map 1).

¹⁶ TNC acquired high resolution World View Satellite imagery of the area from 2014 and conducted groundtruthing via small boats using drop camera, fathometer, and a drone. TNC then contracted Dr. Sam Perkis of Nova Southeastern University to develop detailed benthic habitat and bathymetry maps for the entire shallow water (<30 m) areas of 3BNP based on a spectral analysis and groundtruthing information. Inspection of the 220 drop-camera, supplementary GoPro videos and WorldView-2 imagery. Accuracy of the benthic habitat classes was estimated at better than 80 %.

Chart 18: *Marine benthic classes and habitats in the 3BNP, 2014*

SIMPLIFIED CLASS	BENTHIC HABITAT	AREA (HECTARES)	HAB %	CLASS %
Coral reef	Lagoonal patch reef	62	0.5	9.0
	Algal Rim	75	0.6	
	Shallow coral build-up	446	3.5	
	Orbicella fore reef	551	4.4	
Gorgonians/Macroalgae	Hardground with Gorgonians	652	5.2	9.1
	Hardground with Macroalgae	501	4.0	
Sea Grass	Dense seagrass	3,036	24.1	28.0
	Sparse seagrass	259	2.1	
Sand	Sand with sparse macroalgae	2,510	19.9	26.2
	Sand	794	6.3	
Mud and Silt	Mud + silt	1,678	13.3	13.3
Deep water	Unclassified/Deep water	2,046	16.2	16.2
	<i>Total</i>	12,610		

Source: *Kramer et al 2016 from Perkis 2015.*

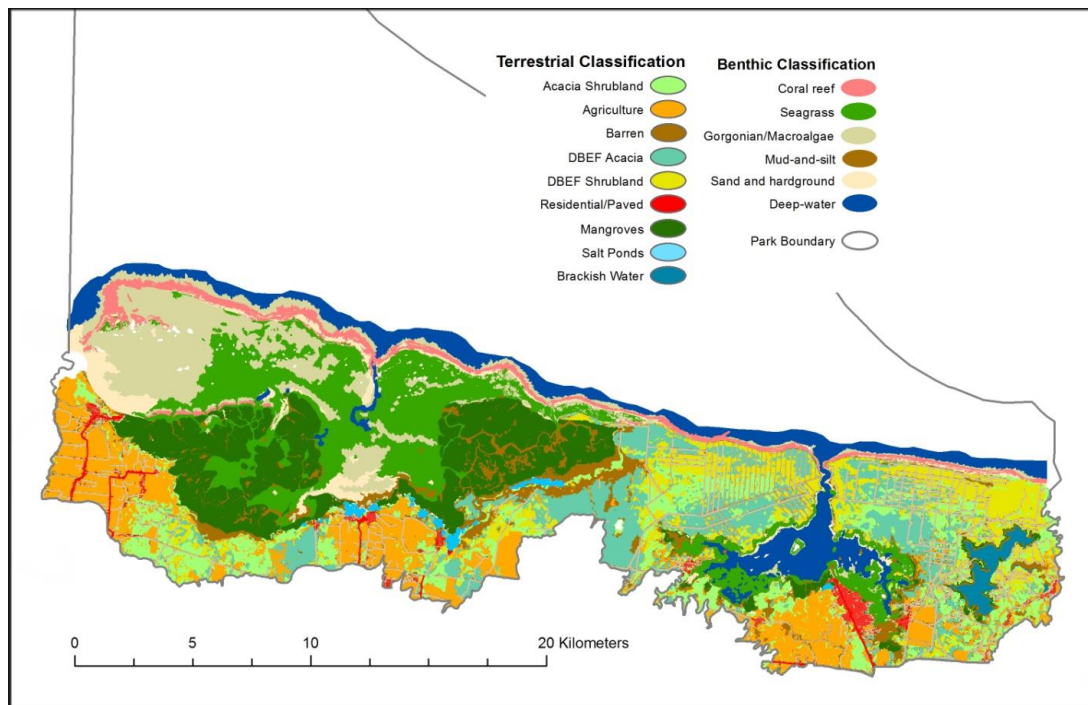
More detailed information on the marine resources inside the 3BNP could be found in Kramer et al 2016, not yet published.

9.5.4 Terrestrial setting of the 3BNP¹⁷

The terrestrial part of the park is formed by natural and human altered environments including settlements, farms, roads, and fish ponds, among others. The coastal terrestrial habitat consists of 16,677 ha, supporting a variety of animals and plants. Since 500 years ago, the native terrestrial habitats have undergone significant conversion and use, ranging from small and medium scale agriculture to ranching.

¹⁷ All the information in this subsection was taken and adapted from Kramer et al 2016, not yet published. For more detail please consult the reference.

Map 16: Map of terrestrial land cover and simplified shallow water benthic habitat classes of the Three Bays National Park



Source: Kramer et al 2016.

The terrestrial vegetation associated with the three main land use classes: Human Altered, *Acacia farnesiana* Shrubland, and Dry Broadleaf Evergreen Formation are following described (Map 16).

4. **Human Altered (HA):** includes active agriculture, fallow fields, roads, and buildings and was ~7,300 ha (~44% of the terrestrial portion of the park).

These lands are dispersed throughout the entire park, on both soil and rock depending on the usage of the land. The largest area of HA is agricultural with a variety of crops being grown. The HA class areas have low plant diversity that is primarily filled by weedy, widely distributed native and non-native species including a number of invasives. While some areas are monoculture, the vast majority are a mix of a variety of crops including annuals (rice, corn), perennials (sugar cane, beans), and fruit trees (primarily Mango).

All riverine habitat was grouped within the HA habitat type, which present very little intact native vegetation. Agriculture and roads occur directly adjacent to the rivers. In some cases a few areas with native aquatic plants are present and noted.

5. **Acacia farnesiana Shrubland (AFS):** the dominant vegetation type, particularly in the drier eastern sides of the park, which have had been cultivated in previous years, with approximately 3,400 ha (~20 % of the park). In areas that have been left fallow and for grazing it occurs as a monoculture, often growing in iron rich clay alluvial deposits. The vegetation is 2-3 m in height and forms a canopy over time. Very few species are able to co-exist within an AFS area. It is unsuitable as feedstock for grazers as it has an extensive system of 2-4 cm thorns along the stems.

6. **Dry Broadleaf Evergreen Formation (DBEF) Shrubland:** habitat that occurs as two distinct types - DBEF-shrubland (DBEF-S), which contains predominantly undisturbed native vegetation and DBEF-Acacia (DBEF-A), which is partially invaded with *A. farnesiana*. The total spatial area of DBEF (both shrubland and Acacia) is approximately 5,700ha (~33% of the park). DBEF is 1-4 m in height occurring in areas with mixed clay and limestone substrate.

DBEF-A are areas that could be used for agricultural activities, due to its low biodiversity value.

DBEF- S is a high diversity vegetation type with many native species, which occurs as a band approximately 2 km wide and is fairly common along the two peninsulas north of Fort Liberté that forms Fort Liberté Bay.

All areas of the DBEF-S surveyed appeared to have been disturbed at some point in the past and had *A. farnesiana*. In areas with a rock substrate there was less *A. farnesiana* as well as *Coccoloba uvifera*.

9.6 Land use

The SISALCO's potential 1,000 ha area of the project was, for the major part, planted with sisal as for *Map 17* (contour outline with red), by comparison to *Map 2*.

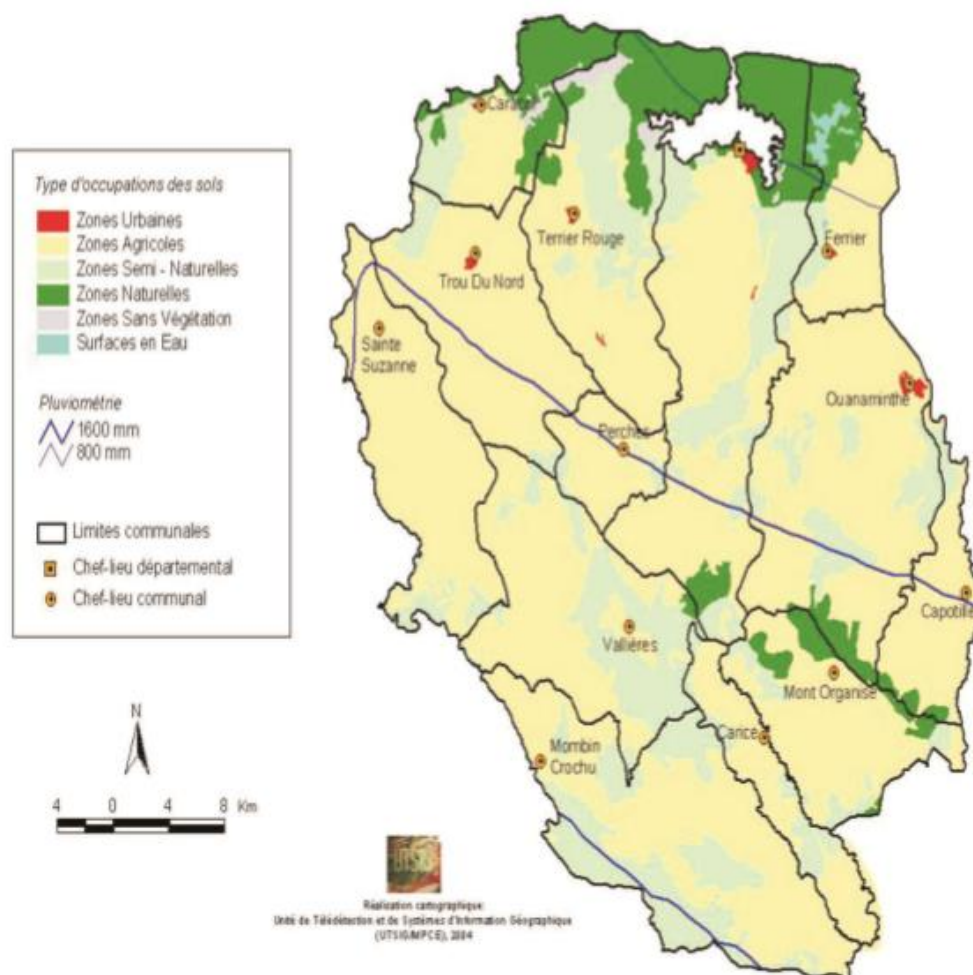
Map 17 **Boundaries of the former sisal plantation in the Northeast Region, 1960**



Note: Former sisal plantation's contour outline with red colour.

Source: CNIGS.

Map 18, shows the zoning of the Northeast department. The town is divided in five areas: agricultural zone, natural environmental area, semi-natural environmental area, residential area and no-vegetation area. Most plain area is occupied by agriculture, followed by a natural environmental area in the coast and semi-natural environmental area distributed in the region.



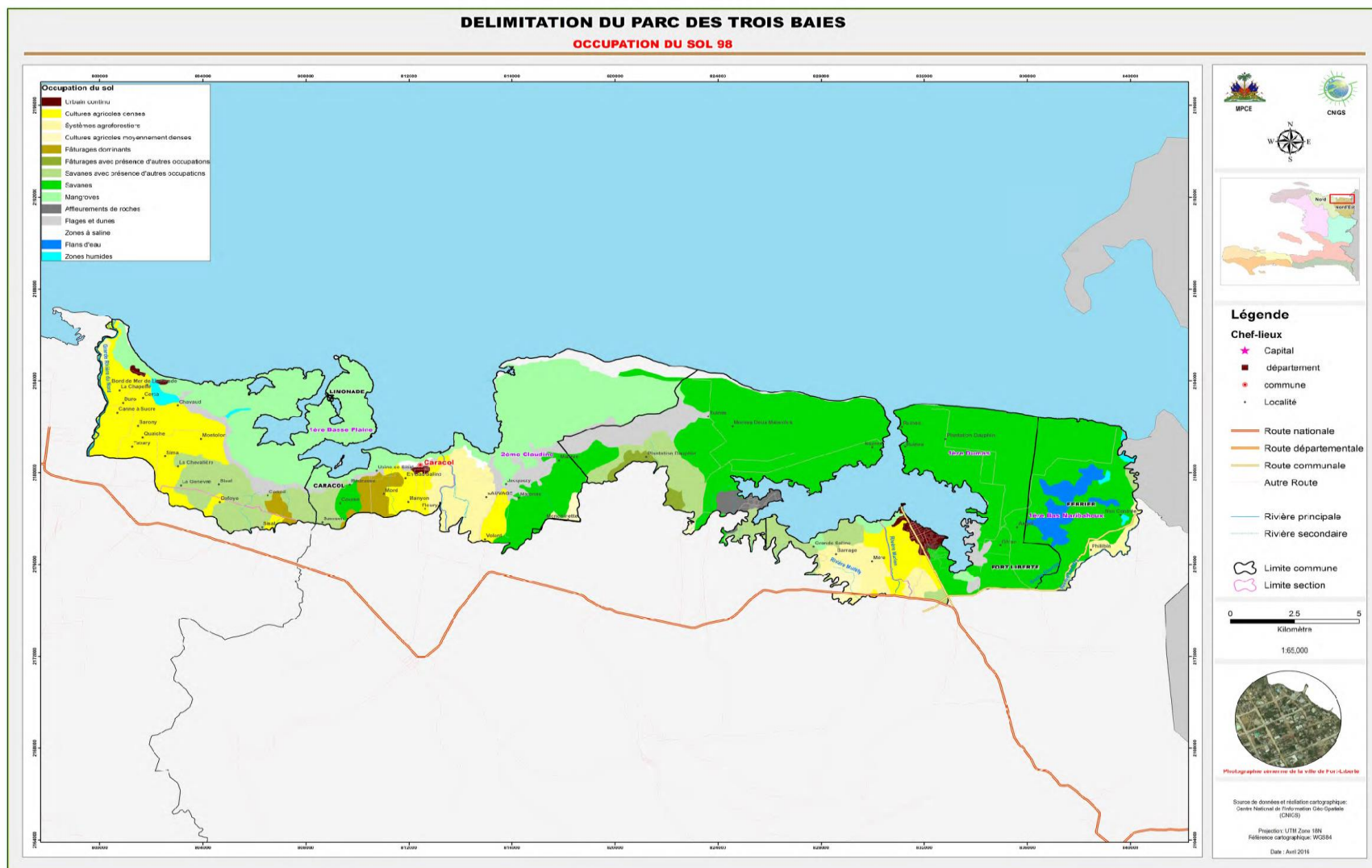
Note: Type d'occupations des sols= Types of soil occupation mm= millimeters
 Zones Urbaines= Urban zones Zones Agricoles= Agricultural zones
 Zones Semi-Naturelles= Semi-natural zones Zones Naturelles= Natural zones
 Zones Sans Végétation= Zones with no vegetation Surfaces en Eau= Water surfaces
 Pluviométrie= Rainfall Chief-lieux Départements= Capital department
 Chief-lieux Communes= Capital community Limite communales= Community boundary.

Source: Céran __ from UTSIG-MPCE 2004.

Map 19 shows the soil occupation according to (CNIGS 2016), developed from aerial photographs from December 2015 and January 2016, which shows that the area of the project is depicted as savannah (green color).

Map 19

Land use inside the 3BNP



Source: CNIGS 2016.

However, according to Kramer et al 2016, *Chart 19* shows the land cover and distribution per watershed that drains into the park, including the area within the Park itself. Most of the area is unused with vegetative cover of forest, savanna, and scrub/shrubs.

Chart 19: **Land cover and distribution into the 3BNP**

Grande Rivière du Nord watershed (627km ²)		Rivière Trou du Nord watershed (428km ²)	
Class	Hectares	Class	Hectares
Agriculture	1,954	Agriculture	4,840
Barren	1,186	Barren	4,223
Dwellings	34,095 (points)	Dwellings	22,546 (points)
Forest	25,572	Forest	9,494
Mining	11	Mining	13
Road	720 (km)	Road	607 (km)
Salt Ponds	0	Salt Ponds	130
Savanna	9,573	Savanna	11,296
Scrub/Shrub	18,696	Scrub/Shrub	8,128
Rivière Marion watershed (218km ²)		Rivière Jassa watershed (434km ²)	
Class	Hectares	Class	Hectares
Agriculture	1,101	Agriculture	2,286
Barren	427	Barren	1,525
Dwellings	9,429 (points)	Dwellings	19,697 (points)
Forest	7,728	Forest	12,576
Mining	4	Mining	2
Road	487 (km)	Road	1,144 (km)
Salt Ponds	10	Salt Ponds	0
Savanna	5,322	Savanna	9,686
Scrub/Shrub	5,319	Scrub/Shrub	11,945

Source: Kramer et al 2016.

9.7 Discharge characteristics and existing contamination sources

Many of the communities in the northern area have no drainage system to divert storm water runoff. During rain events, water floods roads making transportation difficult. Houses have simple pit latrines (USDA 2011).

According to Thummarukudy (2010), there are no major cases of chemical contamination in Haiti, because Haiti is not an industrialized country and therefore does not have many locations, where chemicals, hazardous material, or explosives are stored in industrial quantities. However, there could be some cases of small and dispersed chemical contamination. This situation refers to small quantities of various chemical substances that could be mixed with demolition debris - from school laboratories and similar institutions: quantities of bleach and other household chemicals, refrigerating chemicals from freezers, refrigerators and air conditioners, hazardous substances from rotting meat in the debris of supermarkets and restaurants, and industrial gases and paints mixed with demolition debris in workshops and hospitals.

In Fort-Liberté, sediments deposited in the coast are carried by runoff from watersheds. Also, the runoff carries sewage, waste generated by the city, and hydrocarbons. Consequently, some seagrass and coral areas are threatened by sedimentation and pollution (Céran ____).

9.8 Construction density and solid waste management

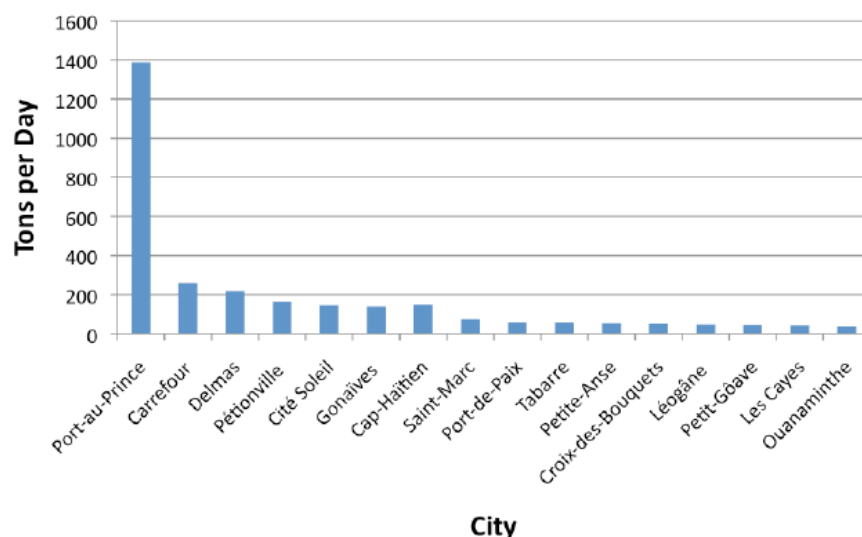
Solid waste management in Haiti is deficient (Swanna 2010). It is considered that the Service Metropolitain de Collecte des Residus Solides (SMCRS) has a division for Le Nord and serves Cap-Haïtien (Shi 2012), lack capacity to manage the service, also suffers from deficient capital investment, ineffective maintenance of equipment, and inadequate operating revenues.

Around 50 % to 75 % of trash in the north is organic. The major part of this waste decomposes, is composted, or is eaten by animals. The remaining trash is burned, mostly plastics and other non-biodegradable materials. Their incineration - at a low-temperature open fires - releases large amounts of common pollutants, among which sulfur and nitrogen oxides, carbon monoxide, volatile organic compounds, particulate matter and methane, as well as toxic pollutants such as persistent organic pollutants, acetone, styrene, phenols, PCBs, polycyclic aromatic hydrocarbons, formaldehyde, hydrogen chloride, hydrogen cyanide and heavy metals. Some of the ash from burning that reaches waterways and the food chain can also be toxic (Shi 2012).

There is no system for trash collection or disposal in the communities of Fort Liberté and Terrier Rouge, neither there are dumps to dispose garbage. Piles of trash line the city streets, disrupt the traffic flow, and causes drainage problems, which contribute to flooding. This is also a major health and sanitation issue as waste and stagnant water can lead to mosquito and water borne diseases. One of the few ways that citizens are reducing the amount of trash is through burning, which is a major health concern, especially with the high prevalence of plastic waste, which emits deadly fumes when burned. One of the most obvious issues related to the lack of waste management services is the negative impact in the image of the city. The large amounts of trash negatively impacts the aesthetics of the city along with smell, air quality, and in general the environment (USDA 2011; SWANNA 2010; Cérans ___).

Figure 2, shows that cities located in the northern region, such as Cap-Haitien and Ouana-minthe, generate less tons per day of waste compare with the metropolitan city.

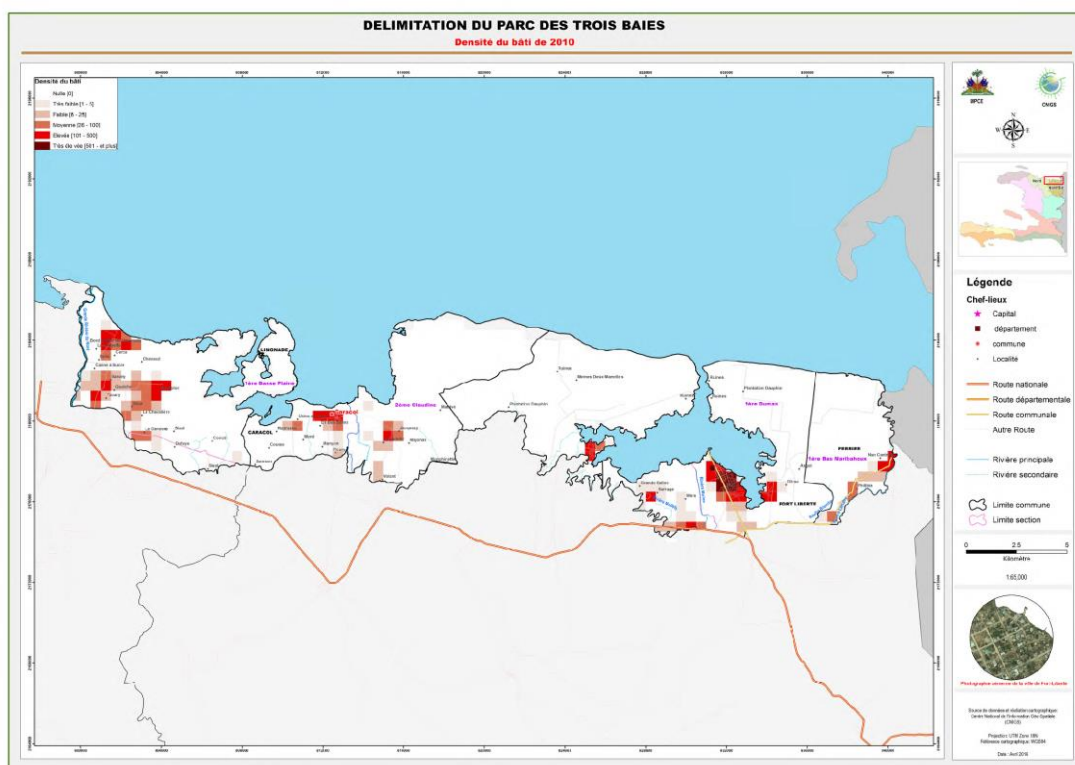
Figure 2: Waste Generation Rate in Major Cities in Haiti



Source: Booth et al. 2010.

The construction density is proportional to the quantity of waste, likely there is not too many constructions inside the 3BNP; however, there is a considerable amount nearby the areas of the project (Fort Liberté and Dérac) (Map 20).

Map 20 **Construction density inside the 3BNP**



Source: CNIGS 2016.

9.9 Air quality

In Haiti there are no regulations of environmental and public health, neither air quality standards. The principal issue is the indoor air quality, because the use of wood fuels and charcoal for cooking. Women and children are the most exposed population to smoke from stoves, increasing the risk of pneumonia and lower respiratory infections. In 2004, 297 deaths under age 5 per 1000,000 and 40 deaths of those over age 5, was reported as consequence of indoor air pollution (USDA 2011).

In the northern corridor, even though there are no studies about the relative contribution of emissions of different sectors, it can be concluded that the principal impact is caused by vehicular exhaust, dust from unpaved roads, and the burning of solid waste. The major part of the organic trash is decomposed or eaten by animals. The non-biodegradable materials are burned, causing large amounts of common and toxic pollutants. Also the ash enters waterways and the food chain and could also be toxic (Vilmont 2015, Shi 2012, USDA 2011).

The sisal project will increase the traffic of cars and trucks, which means higher air pollution and emissions. Vehicles such as heavy-duty trucks will be used for transport the sisal leaves, fibers, and final products. Heavy-duty trucks are vehicles greater than 8,500 lb gross weight, equipped with heavy-duty engines. Chart 20 shows the average emission rate of heavy-duty trucks: gasoline trucks generate higher emissions than diesel trucks (EPA 2008).

Chart 20: *Average heavy-duty truck emission rates for heavy-duty vehicles (g/mi)*

Pollutant	HDGV	HDDV
HC	1.635	0.453
CO ₂	13.130	2.311
NOx	3.914	8.613
PM _{2.5}	0.044	0.202
PM ₁₀	0.051	0.219

Note: CO: carbon monoxide, g/mi: grams per mile, HDGV: Heavy-duty gasoline vehicle HDDV: Heavy-duty diesel vehicle, HC: Hydrocarbons, Nox: Nitrogen oxides, PM_{2.5}: Particle matter under 2.5 microns diameter, PM₁₀: Particle matter under 10 microns diameter.

Source: EPA 2008.

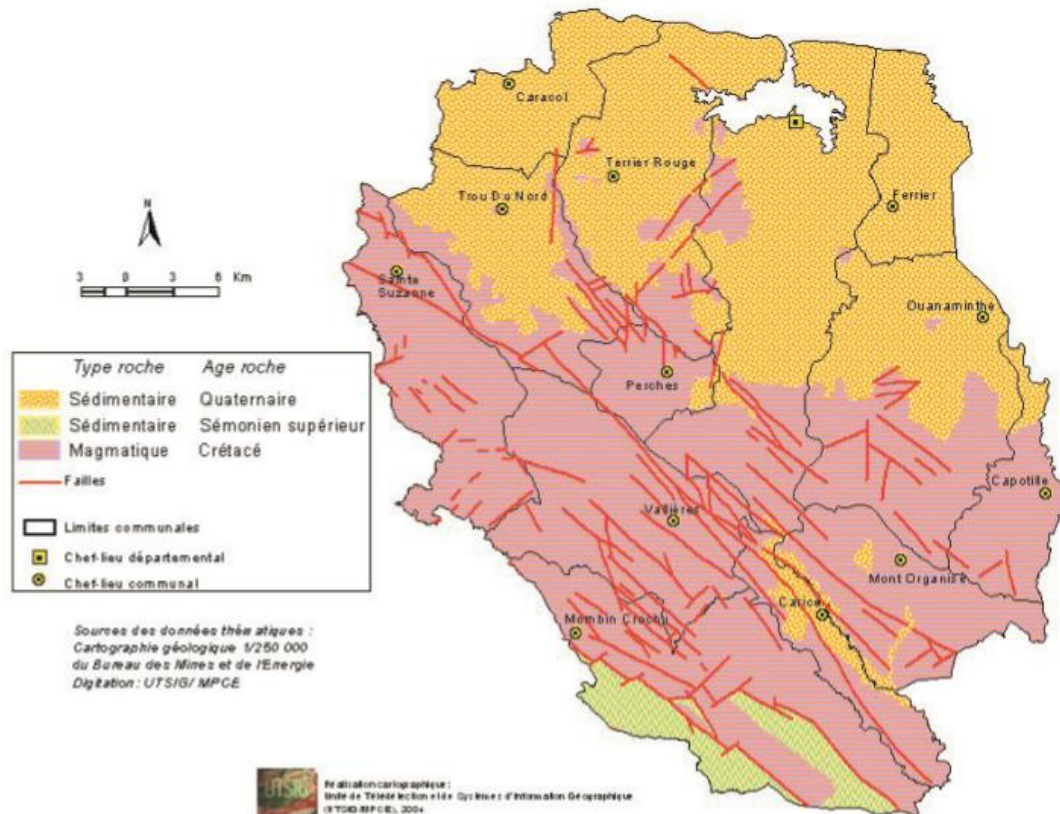
9.10 Geography and geology

The Northeast relief is dominated by two major physiographic units: The plain area, which include coastal limits, is bathed by the Atlantic Ocean. This area called *the Plain du Nord*; which has an extension of 2,000 square kilometers, 150 kilometers long, and 30 kilometers wide, begins in the Northern Department and extends through the Northeast Department. These lowland lies along the northern border with the Dominican Republic. Around the coast, there is a very low elevation above the sea level, which is the basis for the strong presence of wetlands. This plain presents soils composed in a major part of igneous or metamorphic materials and it is also influenced by highly calcareous waters that come from the limestone layers, which occupy the highest parts of Northern Massif, enriching soils of the plains, and tending to increase the pH that its generally slightly acid (Lee and Minson 2010; Tucker 2009; Céran ____).

The other physiographic unit is the mountainous area, which is part of The Massif du Nord. The Massif du Nord is an extension of a mountain range that begins in Dominican Republic called "*Cordillera Central*". In Haiti, it begins at the north of the Guayamouc River, located in the eastern border and ends at the northern peninsula. The elevation range goes from 600 to 1,100 meters. The Massif du North is composed by volcanic, intrusive, and sedimentary rocks. These rocks are flows, tuffs and agglomerates that are principally plagioclase-phyric andesites, and dacites, with lesser quartz and locally biotite-phyric rhyolites. Intrusive rocks range from ultramafic intrusions and apophyses through plagioclase and/or potassium feldspar porphyritic diorite – granodiorite - granite suites (Lee and Minson 2010; Tucker 2009; Céran ____).

Map 21 shows that the Northeast Department is divided by two types of rocks, the major part of the plain area is composed by sedimentary rocks with some pockets of magmatic rocks, originated in the quaternary and cretaceous period, accordingly. Almost all the mountainous area is composed by magmatic rocks, formed in the magmatic period with some pockets of sedimentary rocks originated in the Quaternary and superior Senonian period. The project will be located in the plain area, which is composed predominantly by sedimentary rocks.

Map 21: Type and age of the rocks in the Northeast Department

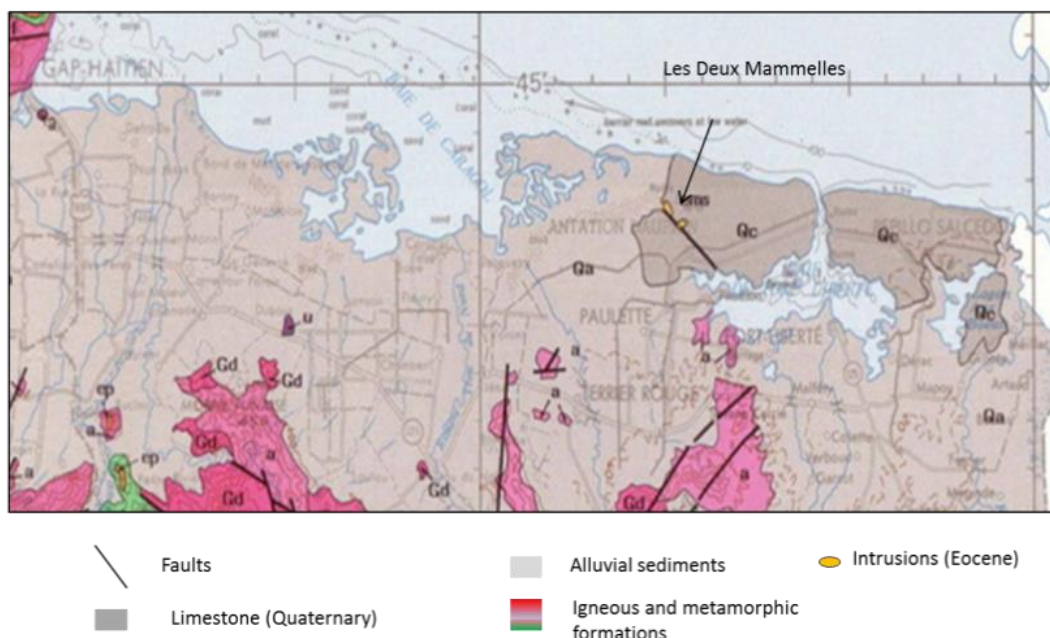


Note: Type roche= Rock type Age roche= Rock age Sédimentaire= Sedimentary
Magmatique= Magmatic Quaternaire= Quaternary
Sémonien supérieur= Superior Senonian Crétacé= Cretacic
Chef-lieu départemental= capital department
Limites communales= community boundaries
Chef-lieu communal= Capital community

Source: Céran __.

The majority of 3BNP land area is alluvial detritus, which forms rich farming soils in and around the rivers. In the surroundings of Fort Liberté and Lagon aux Boeufs, an uplifted terrace (up to 10 m masl) of coral reef limestone occurs, which is different from the detrital sediments found across most of the Northern Plain. This Plio-Pleistocene limestone reef terrace is formed of coral fragments loosely cemented and in some places mixed with fine red siliciclastic clay. Two distinctive low hills (Les Deux Mamelles by Columbus) represent post-Eocene intrusions of andesite and granite that are found along a secondary fault line that trends NW-SE. These igneous intrusions are much harder than the surrounding limestone and have had a major influence on the recent erosional and depositional history of the area (Map 22) (Kramer et al 2016).

Map 22: *Principle geological units of Northeastern Haiti*



Source: *Kramer et al 2016.*

9.11 Natural hazards

According to the World Bank's Natural Disaster Hotspot study, Haiti ranks as one of the countries with highest exposure to multiple natural hazards. Natural disasters such as hurricanes, floods, earthquakes, and landslides are the main natural vulnerabilities of Haiti. According to the information showed in *Chart 21*, about 70 % of the natural hazards occurred in Haiti were tropical storms and hurricanes, but the hazard that affected the major part of the population were earthquakes (Thieme & Jacobs 2012; GFDRR 2010).

Chart 21: *Most destructive natural hazards in Haiti since 18th century*

Hazards	N° events	%	Fatalities	%	Affected	%
Hydro-meteorological	97	69.29	19,262	7.53	5,363,876	45.60
Droughts	20	14.29	-	-	2,668,000	22.68
Earthquakes	13	9.29	235,952	92.22	3,721,730	31.64
Landslides and torrential debris flows	10	7.14	635	0.25	10,509	0.09
<i>Total</i>	<i>140</i>	<i>100.00</i>	<i>255,849</i>	<i>100</i>	<i>11,764,115</i>	<i>100</i>

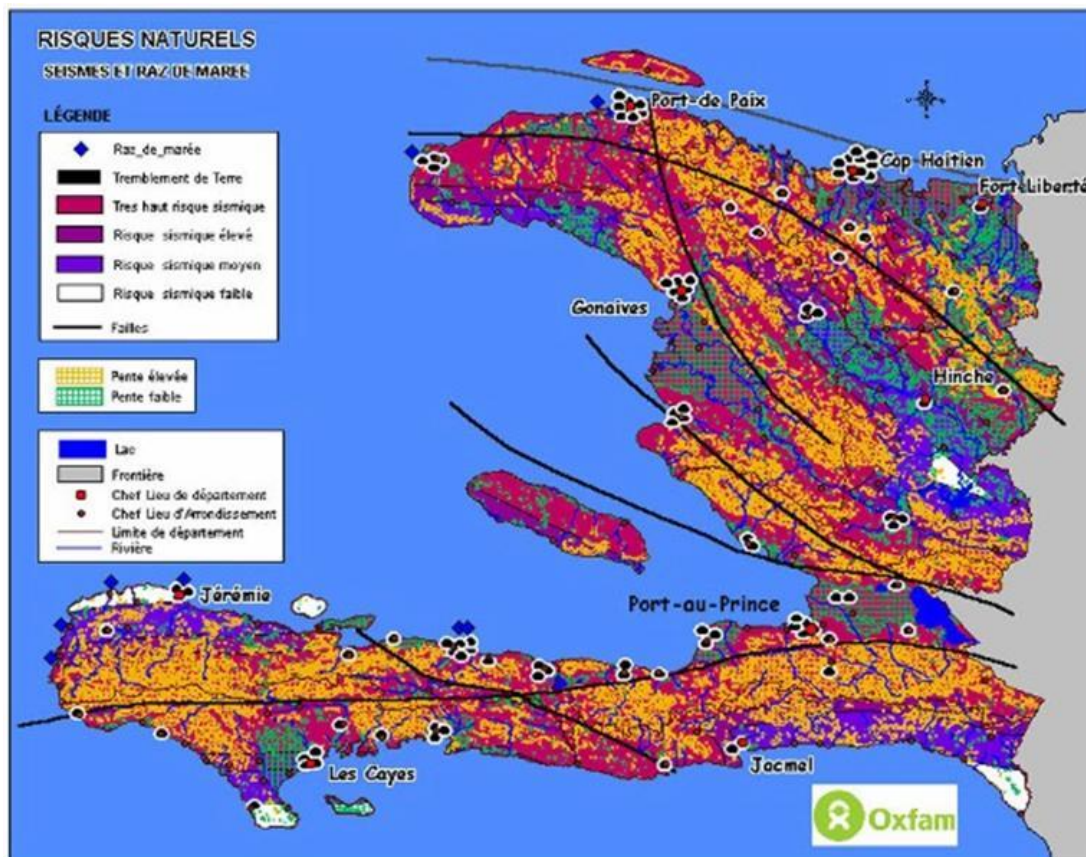
Source: *GFDRR 2010.*

9.11.1 Seismic risk

The Hispaniola Island is located between the Caribbean and North American Plates, therefore is an active seismic region. *Map 23* shows seismic faults in Haiti. The most important are the Enriquillo-Plantain Garden, Septentrional strike-slip faults and the Matheux-Neiba

thrust fault. The Enriquillo-Plantain Garden fault crosses the southern Tiburon peninsula to Miragoane and Pétionville, then continues eastward along the southern border of the Cul-de-Sac plain as far as Enriquillo Lake in the Dominican Republic. The Septentrional Fault runs along Haiti's northern coast, from Môle St Nicolas, canal de la Tortue and Cap Haïtien, and then continues onshore into the Cibao valley in the Dominican Republic. The last major earthquake along this fault in the Dominican Republic was around 800 years ago, while the part that lies above the northern coast of Haiti last ruptured in 1842, when it destroyed much of Cap-Haïtien (Kramer et al 2016, Thieme & Jacobs 2012; Shie et al. 2012; Government of Haiti 2010; Lee & Minson 2008).

Map 23 *Seismic faults and tidal waves in Haiti*



Note: Risques naturels= Natural risks seismes et raz de merée= seismic and tidal waves
 légende= legend tremblement de terre= earthquake
 tres haut risque sismique= very high seismic risk lac= lake
 risque sismique élevé= high seismic risk pente faible= low slope
 risque sismique moyen= medium seismic risk pente élevée= high slope
 risque sismique faible= low seismic risk failles= faults
 frontière= frontier
 chef lieu de département= capital department
 chef-lieu de arrondissement= capital of district
 limite de département= departmental boundaries, rivière=river.

Source: Mathieu et al. 2012.

The ongoing strike slip movement along the Septentrional fault, measured at rates of 8-10mm/year, directly influenced the geomorphology of Haiti's north coast and continues to create significant seismic risks for the area (Kramer, P, M Atis, S Schill, SM Williams, E

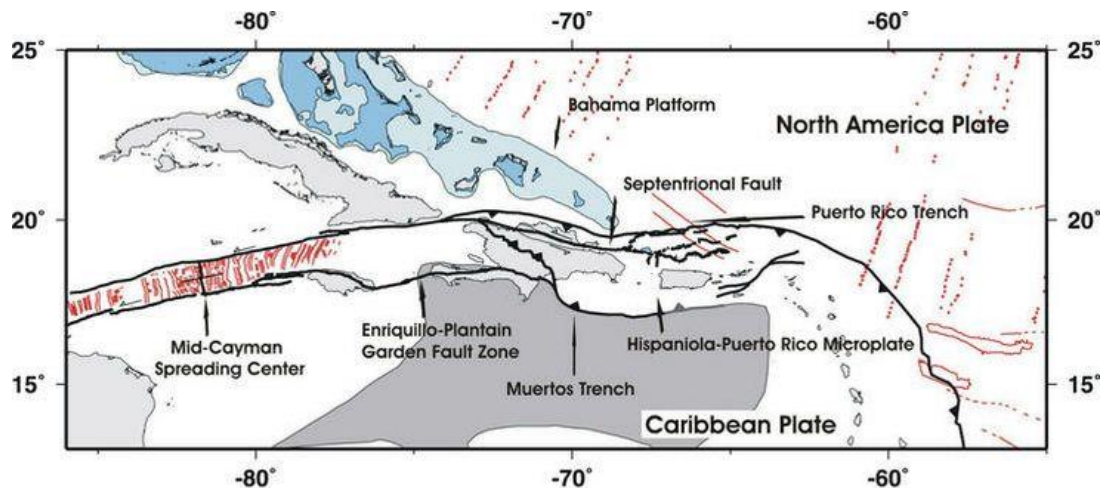
Freid, G Moore, JC Martinez-Sanchez, F Benjamin, LS Cyprien, JR Alexis, R Grizzle, K Ward, K Marks, D Grenda 2016)

The Matheux-Neiba Fault is a poorly studied thrust fault just to the north of Port-au-Prince that may currently accommodate north–south convergence. The Enriquillo-Plantain Garden and Septentrional Faults have been recognized as major tectonic features for decades and the earthquake potential of these faults had been widely reported. The Enriquillo-Plantain Garden fault gave origin to the major earthquake in Haiti, in January 2010, which killed approximately 200,000 people and affected 3.7 million people (Thieme & Jacobs 2012; Government of Haiti 2010; Lee & Minson 2008).

According to NATHAT's evaluation, the entire region of the project lies in an area of moderate risk to earthquakes (; Shie et al. 2012).

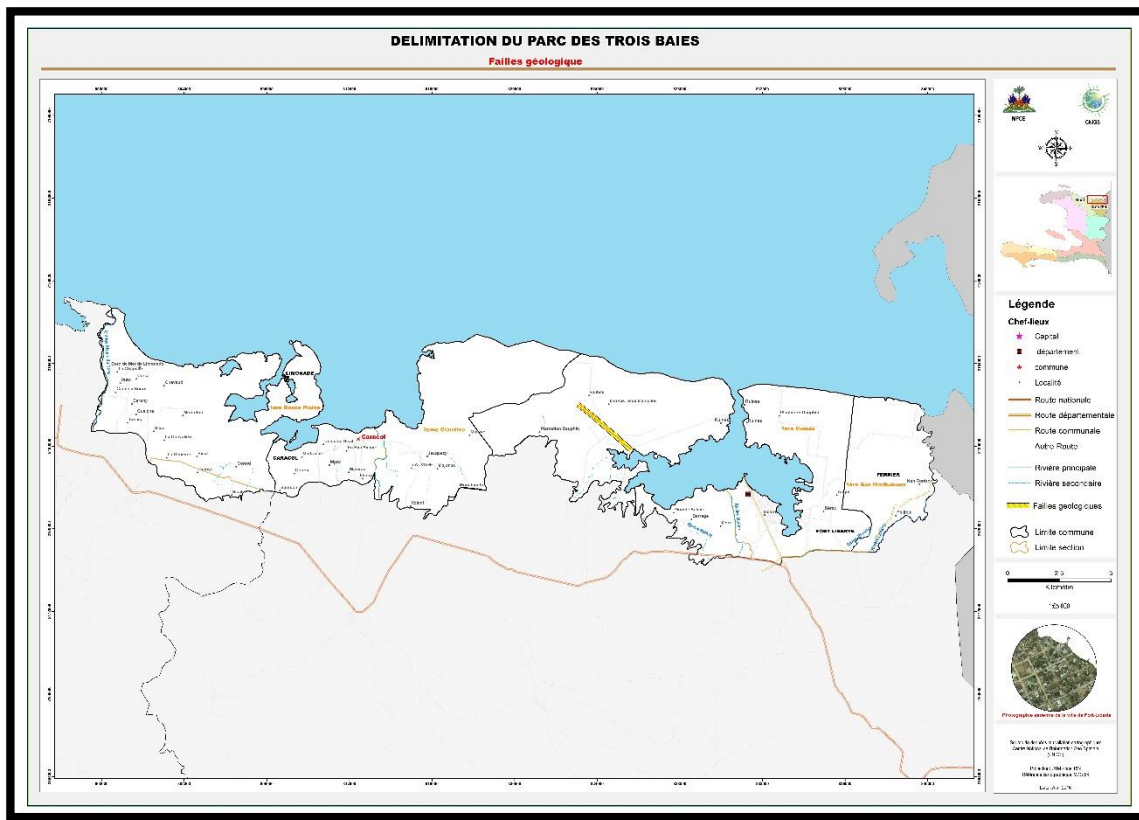
The ongoing strike slip movement along the Septentrional fault, measured at rates of 8-10 mm/year (Kramer et al 2016 from Mann et al. 2002), has heavily influenced the geomorphology of Haiti's north coast and continues to create significant seismic hazards for the north-east area, where numerous earthquakes have been recorded. In 1842 a major earthquake destroyed most of the structures in Cap-Haïtien along with half its population at the time. Folding and upthrust associated with the Septentrional fault has produced an extensive mountain chain all along the northern coast of Hispaniola. In Haiti, these mountains are known as the rugged Massif du Nord Mountains, which rise up abruptly from the coast to elevations in excess of 3,000 m. Over millions of years, runoff and erosion from these mountains has transported huge volumes of siliciclastic detritus down to the north coast forming a wide flat plain between the towns of Cap-Haïtien and Monte Christi called the Northern Plain (Kramer et al 2016).

Map 24 **Regional plate tectonics affecting Hispaniola**



Source: Kramer et al. 2016.

Map 29 shows that north of Phaeton, in one of the potential areas of the sisal project, there is a geological fault, which should be taken into account during project design.



Note: Yellow tick line= geological fault.

Source: CNIGS 2016.

9.11.2 Flooding risk

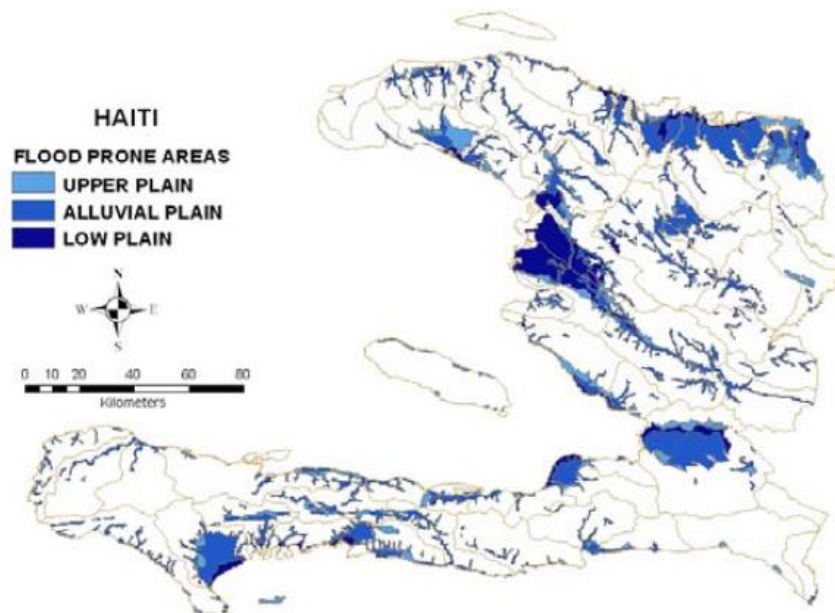
The whole country is susceptible to tropical storms and hurricanes, which occur mostly between the months of June and November. Storms could be predicted, but not its precise location and intensity. The most important impacts of hurricanes and tropical storms provoke flooding, wind damage, landslides, and torrential debris flows. In 2008 occurred four storms in Haiti. The rains from these storms killed 793 people, left 310 missing, injured 593, destroyed 22,702 homes, and damaged another 84,625. About 800,000 people were affected – 8 % of Haiti's total population (GFDRR 2010; Thieme & Jacobs 2012).

Map 26 shows that coastal and low-lying areas and estuaries are very susceptible to flooding. The South Department in the region of Les Cayes and the East Department on the coast are the most exposed ones to flooding. The Nord and Northeast departments on the coast of Cap-Haitien and Fort Liberté are also susceptible to flooding (Thieme & Jacobs 2012).

Deforestation, the uneven landscape, and water runoff - from rainfall, which is not infiltrated into the soil - contribute for flash flood situations, which season is between the months of March and December (Thieme & Jacobs 2012).

Map 26

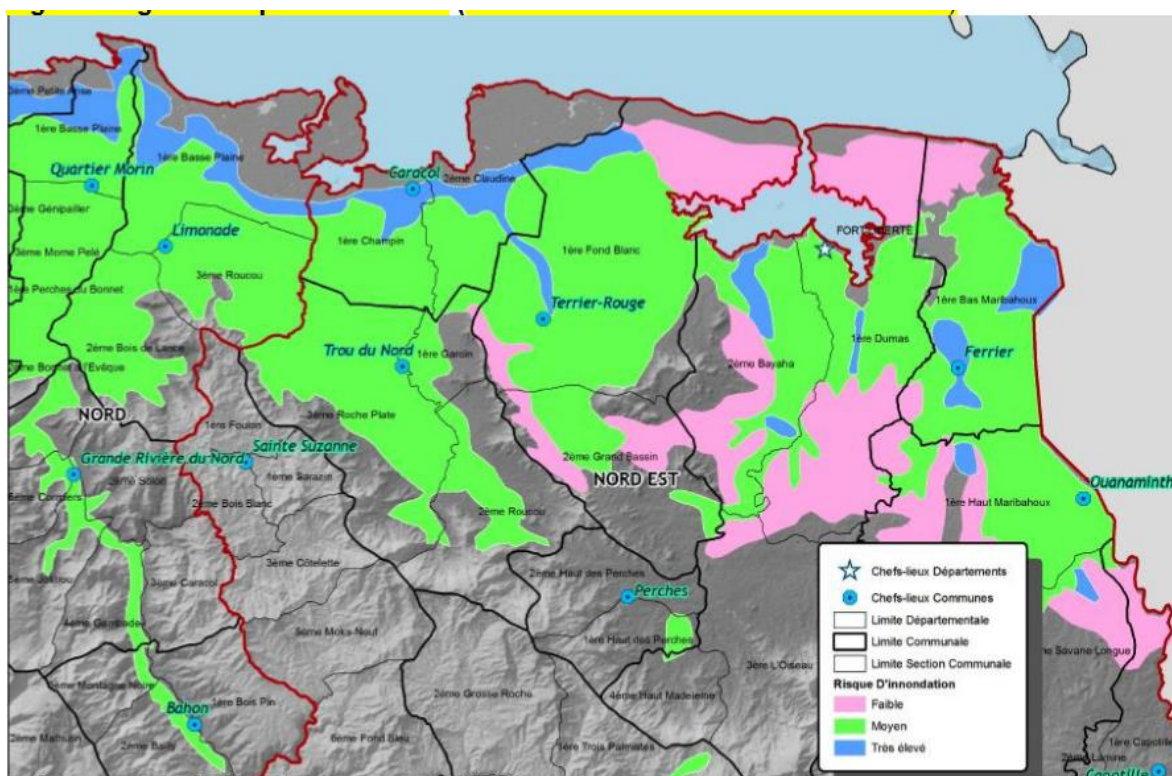
Flood prone area map of Haiti



Source: Smucker et al. 2007.

The risk of flooding in the northeast region is shown in *Map 27*. Most of the coastal plain of Le Nord and Nord-East faces medium to high risk of flooding. Most of the main settlements along the corridors are situated alongside or near primary rivers in the region – Cap-Haïtien, Quartier Morin and Limonade (Grande Riviere du Nord), Caracol, and Trou du Nord (Riviere Trou du Nord), Terrier Rouge, Fort Liberté, Ferrier, and Ouanaminthe. These towns and cities are vulnerable to both flooding caused by overflowing rivers, as well as undrained stormwater running off the cities impermeable surfaces.

Map 27 **Flood prone area map of the northern region**



Note: Chief-lieux Départements= Capital department Chief-lieux Communes= Capital community
 Limite communales= Community boundary
 Limite départementale= Department boundary Limite Section Communale= Communal section boundary
 Risque D'inondations= Flooding risk
 Faible= Low Moyen= Medium Très élevée= very high.

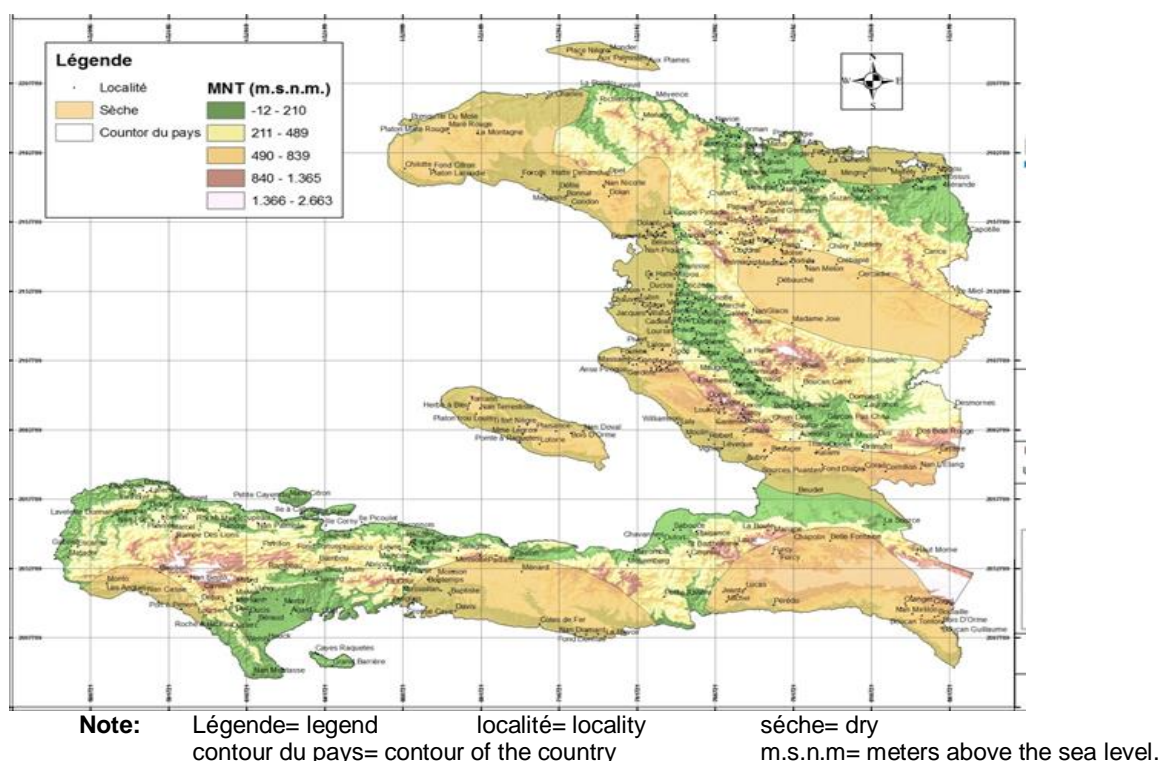
Source: Céran ____.

9.11.3 Drought risk

Sisal is resistant to droughts and high temperatures.

Another natural risk in Haiti is droughts, which result in food insecurity and famine. During the 20th century, historical documents cite episodes in 1923-24, 1946-47, 1958-59, 1966-68, 1974-77, 1981-85. Map 28, shows that most susceptible areas for droughts are located in the northwestern, some areas on the southern coast, and part of the northeast region. Droughts normally occur between November and January, and from March to May (Thieme & Jacobs 2012; Government of Haiti 2010).

Map 28 **Haiti drought zones**



Source: Shie et al. 2012.

9.11.4 Landslide and erosion risk

Landslides are another natural hazard present in Haiti, which occur in mountainous areas. Deforestation increases the susceptibility to landslides, because soil is not firmly hold together, then, natural events like earthquakes and heavy rainfall cause large pieces of land to slide from hillsides.

The combination of steep slopes and high rainfall make mudslides an important risk in the region. The slopes above Cap-Haïtien, where many people have constructed shanties with no slope support infrastructure, are at significant risk to mudslides.

According to Map 29, the major part of the northeast region has a low erosion risk, also the area of the Sisal Project. Nevertheless, it is important to mention that the coastal development will increase demand for charcoal, wood, sand and soil for construction, and food and fruit products that come from the mountains. Although this increased pressure could present a risk of greater pressure on existing trees, it could also lead to mountainous communities planting more stands of productive trees that reduce erosion, so long as they have access to credit and nurseries.

Map 29

Soil erosion risk map of the Northeast region

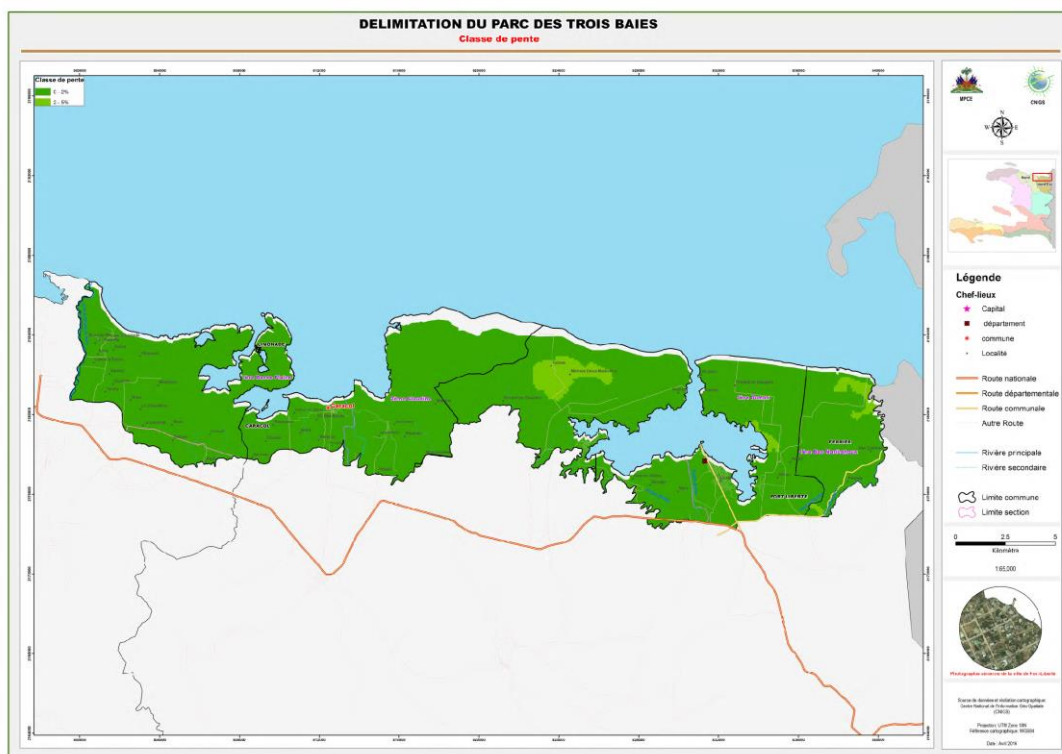


Note: Chief-lieux Départements= Capital department, Chief-lieux Communes= Capital community, Limite communales= Community boundary, Limite départementale= Department boundary, Limite Section Communale= Communal section boundary, Risque érosion= Erosion risk, Risque nul ou très Faible= No or very low risk, Risque Faible= Low risk, Risque Moyen= Medium risk, Risque élevé= High risk, Risque grave= Grave risk, Risque tres grave= Very grave Risk.

Source: Shie et al. 2012.

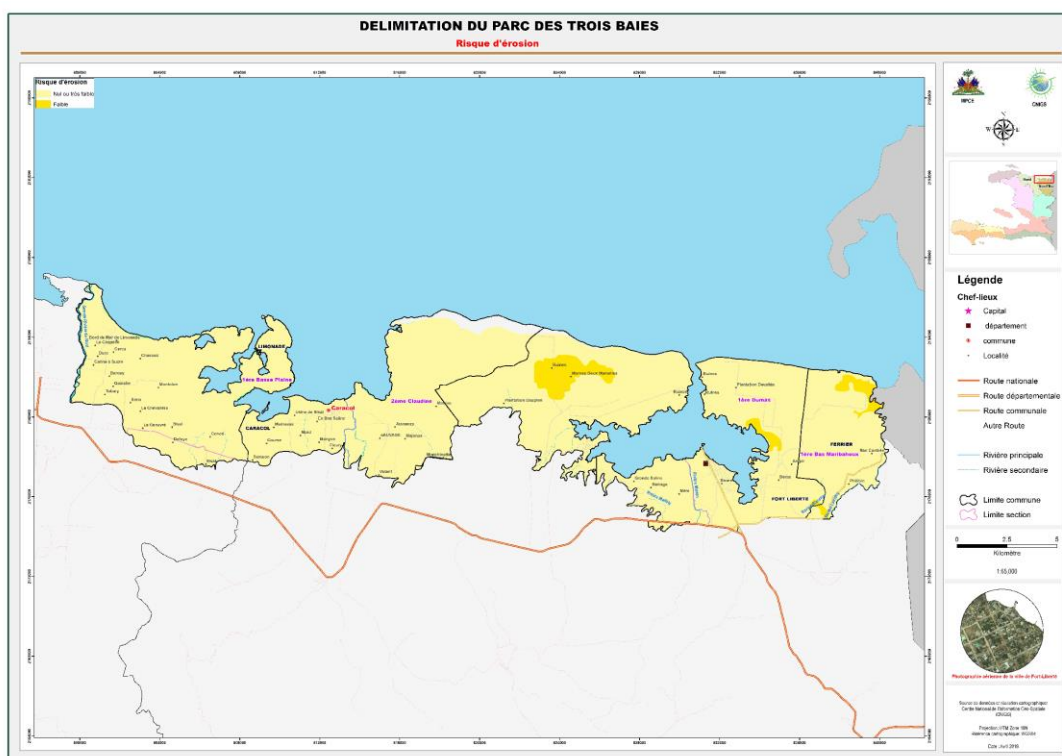
Map 30 shows the slope class and erosion probability in the area of the 3BNP and specifically in the area of the project. The slope in the area of the project in general varies from zero to two (except in a small area north of Phaeton, which varies from 2-5 %) and there is null or low risk erosion probability (null/low is light yellow and low probability orange color).

Map 30 **Type of slope and erosion risk in the 3BNP**



Note: Green= 0-2 %

Light green= 2-5 %,



Note: Light yellow= null/low

Orange= low probability.

Source: CNIGS 2016.

9.12 *Annex 2:*

IDB Environmental Policies

The Project will be designed and run in compliance with the IDB policies. The following chart presents the main directives and how is the Project going to guarantee the accuracy with them.

Chart 22: Compliance with the IDB policies

POLICY / DIRECTIVE APPLICABLE ASPECT	PROJECT COMPLIANCE
OP-703 ENVIRONMENT AND SAFEGUARDS COMPLIANCE POLICY	
A.1 Mainstreaming Environment and Strategies by Identification and analysis	The Project has accomplished a deep analysis of the Haitian level of institutional development, civil society participation, access to information, adequacy of the legal, policy, and regulatory framework, as well as the level of enforcement and compliance with environmental standards, and public sector capacity for environmental management.
A.5 Tracking Environmental Sustainability Indicators of performance	The project will adapt the sustainability indicators of performance to the national and internationally agreed targets and goals
A.6 Assessing Environmental Risks and Opportunities	The consultation processes and the management plans will enhance policy dialogue, leveraging public-private partnerships, and engaging civil society participation, at the local level according to the Project location.
A.7 Promoting Corporate Environmental Responsibility	The project is compromised in the promotion of practices for reducing, re-using and recycling waste and materials; minimizing the consumption and emissions of hazardous substances; and providing a healthy and safe working environment (GRI).
B.1 Bank's Policies	There are several potential issues regarding compliance with IDB safeguards and Environmental laws which will need to be monitored by the Project and the Bank during project implementation. The report includes some of the internal guidance for that.
B.2 Country laws and regulations	The project will be in full compliance with all Haitian laws, policies and regulations. The ESIA will be presented to Haitian Ministry of Environment.
B.3/B.5 Project has undergone or will undergo an adequate assessment process	Project is categorized as B ¹⁸ based on its environmental and social potential impacts and risks. Requires both an ESIA and a Preliminary Resettlement Plan. Elements such as compliance with relevant legal requirements, governance capacity, sector-related risks, risks associated with highly sensitive environmental and social concerns, and vulnerability to disasters, are

¹⁸ Any operation that is likely to cause significant negative environmental and associated social impacts, or have profound implications affecting natural resources, will be classified as **Category "A"**. These operations will require an environmental assessment (EA), normally an Environmental Impact Assessment (EIA) for investment operations, or other environmental assessments such as a Strategic Environmental Assessment (SEA) for programs and other financial operations that involve plans and policies. Category "A" operations are considered high safeguard risk. For some high safeguard risk operations that, in the Bank's opinion raise complex and sensitive environmental, social, or health and safety concerns, the borrower should normally establish an advisory panel of experts to provide guidance for the design and/or execution of the operation on issues relevant to the EA process, including health and safety. Operations that are likely to cause mostly local and short-term negative environmental and associated social impacts and for which effective mitigation measures are readily available will be classified as **Category "B"**. These operations will normally require an environmental and/or social analysis, according to and focusing on, the specific issues identified in the screening process, and an environmental and social management plan (ESMP). Operations that are likely to cause minimal or no negative environmental and associated social impacts will be classified as **Category "C"**. These operations do not require an environmental or social analysis beyond the screening and scoping analysis for determining the classification. However, where relevant, these operations will establish safeguard, or monitoring requirements.

POLICY / DIRECTIVE APPLICABLE ASPECT	PROJECT COMPLIANCE
	been analyzed through an adequate consultation and information dissemination process; and the corresponding management plans.
B.4 Other Risk Factors Governance capacity	The Executing Agency exhibits weak institutional capacity for managing environmental and social issues. A component of the project will be designed to address certain safeguards mitigation measures, and the management and monitoring system will go further than the local and national legal requirements.
B.5 EA Requirements	Application of adequate assessment process. EIA includes infrastructure aspects of the project implementation, such as irrigation, buildings, wells, paths, among others.
B.6 Consultation	Consultations processes are being carried out, in accordance to the IDB guidelines. Additional public consultation will be necessary during any EIA process, and during the development of the project to ensure appropriate participation of stakeholders in the process. This will be a key factor to involve stakeholders closely in the process to ensure the overall success of the project.
B.7 Supervision and Compliance	Supervision, reporting, consistent evaluation and Bank supervision is included in the project development cycle design
B.9 Natural habitats and cultural sites	Some production areas will be located inside in a protected area. The creation decree defines different levels of protection/uses of the land. The EIA will determinate the management system required to accomplish first, with the national legislation, and with the IDB guidelines and the UICN criteria.
B.10/B.11 Hazardous materials - Pollution Prevention and Abatement	Specific management procedures will be included in management plans, together with relevant pollution mitigation measures. The project will not use pesticides and other agrochemical products. An overarching assessment of CO2 emissions and occupational save and health will be included.
B.12 Projects Under Construction	The Project is not currently in construction.
B.13 Non-Investment and Flexible Lending Instruments	The project classifies under "Loans that are based on performance criteria, sector-based approaches, or conditional credit lines for investment projects". There are not other lending institutions.
B.16 In-Country Systems	Haitian' existing system of safeguard is not equivalent to the IDB guidelines for identifying and managing environmental and social impacts. The ESIA will accomplish with both regulations.
B.17 Procurement	The project is compromised with an environmentally and socially responsible resource use, work environment, and community relations. According with that is willing to incorporate it into project-specific loan agreement.
OP 704 DISASTER RISK MANAGEMENT	
1.7 Application	Natural hazards, including the hydro-meteorological hazards – wind-storms, floods and droughts – are being analyzed in order to include measures in the corresponding protocols and plans.
Disaster Risks	Vulnerability to disasters – Earthquakes and Tropical storms. Project implementation will develop guidance and protocols to address seismic and tropical storm risks.
A-2 Risk and project viability	Haitian information related with distribution in frequency, duration and intensity of hazard events in the relevant area of the project will be included

POLICY / DIRECTIVE APPLICABLE ASPECT	PROJECT COMPLIANCE
	in the management plan, including both structural and non-structural mitigation measures. Those will include safety and contingency planning to protect human health and economic assets.
Project Classification	The project's disaster risk classification is under study on the ESIA, based on projected frequency of occurrence and magnitude or intensity of storms, seismic, others.
3. Project Analysis	The project will propose management and mitigation measures in compliance with international standards, national laws and regulations, planning policies, as well as national building codes and standards.

9.13 *Annex 3*

Institutional landscape

The Ministry of Environment (MDE) is one of the most important institutions for the project. The MDE is the entity responsible for the overall management and coordination of environmental activities. It prepares, implements and monitors national policy on the environment and is also responsible for monitoring compliance with obligations made under international Conventions such as United Nations Framework Convention for Climate Change (UNFCCC), Convention on Biological Diversity (CBD), Convention to Combat Desertification (CCD).

Different institutions and ministries are part of the institutional landscape that is related with the project. The main ones, but not limited to, include “Public works, Transport and Communications”, “Agriculture, Natural Resources and Rural Development”, “Public Health” and “Planning”, “National Office of Potable Water and Sanitation (DINEPA) / CAEPA”, “National Institute for Agro Reform (INARA)” and the “Interministerial Commission for Land Development (CIAT)”.

The National Environmental Management System (NEMS) was created by decree published on January 26, 2006. The Decree provides framework and structural arrangements for sustainable land management¹⁹. Agence Nationale des Aires Protegees (ANAP) is responsible for the management of the Parc des Trois Baies at the national level.

The following chart displays the most relevant Haitian institutions that are tied to the different steps of the Project, that needs to be accomplished for the installation phase and the sisal production cycle.

Chart 23: Relevant national institutions

TYPE OF ORGANIZATION	ORGANIZATION
National Government	Ministry of Environment (MDE)
	Ministry of Agriculture, Natural Resources and Rural Development (MARANDR)
	Ministry of Public Works, Transportation and Communications (MTPTC) / Infrastructure Regulations
	National Office of Potable Water and Sanitation (DINEPA) / CAEPA
	National Institute for Agro Reform (INARA)
	Interministerial Commission for Land Development (CIAT)
	National Commission on Land Development (CONAT)
	Ministry of Economy and Finance (MEF)
	-General Tax Directorate (DGI)
	-Directorate for Domain Management
	-Directorate of Registration/ Transcription
	Ministry of Public Health and the Population
	Ministry of Trade and Industry
	Ministry of Public Works, Transportation and Communications (MTPTC) / Infrastructure Regulations
	Agence Nationale des Aires Protegees (ANAP)
Local Government	Mairies of Limonade, Caracol and Fort Liberté
	<ul style="list-style-type: none"> Municipio de terrier rouge: <ul style="list-style-type: none"> 1ère section Fond-Blanc: Terrier rouge, Phaéton, Paulette

¹⁹ The NEMS is made up of a network of the following organisms: Inter-ministerial Council on Environment and Land Settlement (CIMATE), National Council of Environment and Land Settlement (CONATE), The Ministry of Environment (MDE), Inter-ministerial Technical Commissions of Environment and Land Settlement (COTIME), Environmental Sectorial Technical Units (UTES), Territorial collectives, Ecological organizations, Other organized groups working in the field of environmental protection.

TYPE OF ORGANIZATION	ORGANIZATION
	<ul style="list-style-type: none"> Municipio de de Fort Liberté: 1ère section Dumas: Derac 2ème section Bayaha: Malfety, Savane Carré
	CASEC / ASEC
International	IDB

9.13.1 The Ministry of Environment (MDE)

Within the MDE, the following divisions are tasked with implementing the MDE mission:

- **Soils and Ecosystems Division:** Responsible for management of land degradation, protected areas, conservation, sustainable use of ecosystems and other biodiversity issues, abatement and control of coastal and marine degradation, protection of landscape, protection of water resources;
- **Land Quality and Sanitation Division:** Charged with managing and regulating land-based pollution control, sustainable pest and chemical uses, ozone depletion activities control, hazardous products, and land use in relation to mitigation of ecological risks (climatic or geologic);
- **General Inspectorate for the Environment (DISE):** Responsible for law enforcement of environmental regulations and Environmental Impact assessments. This includes:
 - Coordinating the design and implementation of the Ministry's policy and procedures relating to standards and extensive summary assessments of environmental impacts, environmental audits, non-objectionable activities may affect the environment and the administration body environmental monitoring;
 - Maintaining a central registry of Studies Environmental Impact Assessment (EIA) and environmental objections not granted or denied at the national level;
 - Combatting water pollution in rivers, lakes and bodies of water of the sea, as well as groundwater, in particular water intended for human consumption;
- **Planning Division:** Responsible for the overall planning in environmental matters, annual plan and public sector investment programme, negotiation of cooperation projects, monitoring and evaluation of environmental programs and projects performances.
- **Living Organisms and Sanitation:** Develops and coordinates the implementation of the Ministry's policy regarding the areas of the built environment, sanitation, pollution and environmental risks and sustainable prevention of pollution.
- **Watershed management and Resources Division:**
 - Establish norms and standards, in collaboration with relevant sectors, to facilitate the rational management of the resource, its environmental corollaries and sanitation.
 - Develop and coordinate the implementation of the Ministry's policy regarding the specific area of water resource management by creating the following services: Hydro-meteorological (GHS), Hydrology and Sedimentology (SHS), and Hydro-geology and geophysics (SHG).
 - Establish standards and procedures for assessment of impacts studies for all public sector initiatives or private applicability of the polluter – payer.

- Prevention of Risks and Disasters and Combat against Climate Change Division:

The following are autonomous organisms that fall under the tutelage of the MDE²⁰:

- L'Agence Nationale des Aires Protégées et des Forêts (Agency for Protected Areas and Forests)
- L'Agence Nationale de Gestion des Ressources en Eau (Agency for the Water Resource Management)
- Le Conservatoire du Littoral (Coastline Conservation)
- L'Observatoire National de l'Environnement et de la Vulnérabilité (ONEV)
- National Observatory for Environment and Vulnerability
- Le Bureau National des Biotechnologies et de la Biosécurité (BURNAB) (National office for Biotechnology and Biosecurity)
- Le Fonds pour la Réhabilitation de l'Environnement Haïtien (FREH) (Fund for Rehabilitation of the Environment)
- La Caisse Nationale des Résidus Solides (CNRS) (National Solid Waste Fund)

9.13.2 DINEPA

In 2009, the Haitian government made a sweeping reform of the water regulatory structure and passed the Loi Cadre Portant Organisation du Secteur de l'eau potable et de l'assainissement (Law on the organization of potable water and sanitation sector). Under this new law, the General Directorate for Water Supply and Sanitation (DGEPA) was established to execute the national policy on potable water and sanitation along three main axes, including: the national development of potable water and sanitation services, regulation of the sector.

The actual administration of the DGEPA is done through the National Directorate for Potable Water and Sanitation (DINEPA), the Regional Offices for Potable Water Supply and Sanitation (OREPA) which oversee the Committee on the supply of potable water and sanitation (CAEPA), working primarily in rural and perimeter urban zones; the private entities, possessing the necessary experience to manage water within large towns and secondary cities; and professional operators, individuals or entities chosen at the local level, within the rural areas to manage improvement in potable water and sanitation.

The DINEPA is comprised of seven committee members including: the MPTC (President); a representative from the Ministry of the Economy (Vice President); Representatives from the Ministry of the Interior, the Chamber of Commerce and Industry, the Ministry of the Environment, and the Ministry of Public Health and Population.

The DINEPA has been authorized to serve and execute the potable water and sanitation policies of the government through a list of functions. In this way, the DINEPA is attached to technical, financial, administrative and juridical mechanisms. Moreover, in this new system the DINEPA inherited much of the administrative capacity of the CAMEP/SNEP/POCHEP including regulation over industrial water use and discharge.

DINEPA is specifically responsible for creating a drinking water regulatory scheme that protects drinking water sources from contamination by either individuals or industry, and is also

²⁰ Article 61, Décret définit la politique nationale en matière de gestion de l'environnement et de la régulation de la conduite des citoyens et citoyennes pour un développement durable.(2005)

responsible for the enforcement of a system wherein all water distributors are regulated by the agency.

9.13.3 Ministry of Agriculture and Natural Resources

The MARNDR has always been considered as primarily responsible for natural resources management since the major part of the territory, including the mountains, is used for agriculture. Its mission is to define the policy of the Haitian government economic sector with regards to agriculture, livestock, renewable natural resources and rural development.

The MARNDR is oriented towards actions that target local development in its entirety (economic and social). Conservation of water and soil on the slopes (stone beads, seepage canals, hedges, gradual terraces, etc.) and development of ravines and riverbeds profiling; and integrated development planning for priority watersheds (studies and preparatory work, awareness, mobilization, organizational and technical training ...), increase productivity and production of irrigated areas and transfer the management to users.

9.13.4 Ministry of Economy and Finance (MEF)

The fundamental mission of the MEF is to formulate and implement economic and financial policy of the state, including drafting an annual public budget for passage by the parliament.

9.13.5 Haitian National Police (PNH)

The PNH provides direct services for environmental monitoring, for the following:

1. *protecting life and property around the protected areas and in the interior thereof at the request of the Ministry of Environment or National of the Agency of Protected Areas;*
2. *supervision and respect of environmental norms relating to motor vehicles;*
3. *supervision of compliance with environmental standards in the maritime waters under Haitian jurisdiction;*
4. *conducting criminal investigations in cases of environmental violations.*

9.14 *Annex 4:*

Legal framework

9.15 International environmental legal framework

Haiti has a legal framework on human and environmental, associated with the main rights of the person, the safeguarding of human dignity, and the exercise of the rights without discriminatory constraints. A non-exhaustive list of international instruments that constitute the international legal framework of Haiti is shown in following chart. International legal framework. International convention on the environment signed by Haiti includes International and regional Conventions and Protocols such as Desertification, Climate Change, Ramsar, CITES, SPAW, Land based Convention, Sea Convention, agreements for watersheds and coastal zones such as Cartagena Convention, Convention on Biological Diversity (CBD).

Chart 24: *Instruments of the international legal framework of Haiti*

INTERNATIONAL TREATIES / CONVENTIONS	
Human rights	
Universal Declaration of Human Rights (UDHR)	
<i>Convention relating to the Status of Stateless Persons</i>	
<i>International Convention on the Elimination of All Forms of Racial Discrimination</i>	
<i>International Covenant on Civil and Political Rights</i>	
International Covenant on Economic, Social and Cultural Rights	
<i>Convention on the Elimination of All Forms of Discrimination Against Women</i>	
<i>Convention on the Rights of the Child</i>	
<i>The International Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families</i>	
<i>Convention on the Protection and Promotion of the Diversity of Cultural Expressions</i>	
<i>Convention on the Rights of Persons with Disabilities</i>	
<i>Declaration on the Rights of Indigenous Peoples</i>	
Environmental	
Convention on Biodiversity	
Kyoto Protocol to the United Nations Framework Convention on Climate Change	
Montreal Protocol on Substances that Deplete the Ozone Layer	
Convention on Nature Protection and Wild Life Preservation in the Western Hemisphere	
International Labor Conventions	
<i>C029 Forced labor convention</i>	
C087 Freedom of Association and Protection of the Right to Organize Convention	
C097 Migration for Employment Convention	
<i>C098 Right to Organize and Collective Bargaining Convention</i>	
C100 Equal Remuneration Convention	
C105 Abolition of Forced Labor Convention	
C107 Indigenous and Tribal Populations Convention	
C110 Plantations Convention	
C111 Discrimination (Employment and Occupation) Convention	
C138 Minimum Age Convention	
C141 Rural Workers' Organizations Convention	
C143 Migrant Workers (Supplementary Provisions) Convention	
C144 Tripartite Consultation (International Labor Standards) Convention	
C169 Indigenous and Tribal Peoples Convention	
C182 Worst Forms of Child Labor Convention	

INTERNATIONAL TREATIES / CONVENTIONS
C184 Safety and Health in Agriculture Convention
Interamerican system (OAS)
<i>American Convention on Human Rights (Pact of San José)</i>
Additional Protocol to the American Convention On Human Rights in the Area of Economic, Social, and Cultural Rights (Protocol of San Salvador)
Inter-American Convention on Support Obligations
Inter-American Democratic Charter

9.16 National legal framework

9.16.1 Haitian constitution (1987)

Haiti's Constitution defines the political system, and regulates the administrative and territorial structure. The Constitution recognizes and guarantees the right to private property, as well as the requirement to the agricultural landowners to cultivate their land and protect it against erosion (USAID, 2012). The Constitution regulates the environment protection and pollution safeguards.

Chart 25: Haitian constitution regulations

1987 HAITIAN CONSTITUTION REGULATIONS
ECONOMICS AND AGRICULTURE
ARTICLE 246: The State encourages in rural and urban areas the formation of cooperatives for production, processing of raw materials and the entrepreneurial spirit to promote the accumulation of national capital to ensure continuous development.
ARTICLE 248: A special agency to be known as THE NATIONAL INSTITUTE OF AGRARIAN REFORM shall be established to organize the revision of real property structures and to implement an agrarian reform to benefit those who actually work the land. This Institute shall draw up an agrarian policy geared to optimizing productivity by constructing infrastructure aimed at the protection and management of the land.
PROPERTY / ENVIRONMENT PROTECTION / POLLUTION
ARTICLE 36: Private property is recognized and guaranteed. The law specifies the manner of acquiring and enjoying it, and the limits placed upon it.
Art. 36 – 4: Landowners must cultivate, work, and protect their land, particularly against erosion. the penalty for failure to fulfill this obligation shall be prescribed by law.
Article 253. - The environment is the natural frame of life of the population, practices that might disturb the ecological balance are strictly forbidden.
Art. 257 - The law specifies the conditions for protecting flora and fauna, and punishes violations thereof.
Article 258. - No one may introduce into the country waste or residues of any kind from foreign sources, whatsoever.

9.16.2 National environmental regulations

The following sections present the most important Haitian legal norms on agricultural issues, environmental provisions, labor regulations, procedure and permits needed in order to install the project, as well as the infrastructure and the institutional framework.

9.16.2.1 Environmental regulations

The Haitian Constitution contains provisions that address environmental resources management. As shown in previous chart, Article 22 recognizes a right of every citizen to decent housing, education, food, and social security. Article 23 recognizes a right to appropriate means to protect human health. Furthermore, article 36-5 distinguishes an individual's right to property from coasts, springs, rivers, and watercourses, which belong to the state.

Constitution imposes on citizens a duty to respect and protect the environment²¹. Articles 253-258 broadly address the government's role towards the environment, articulating vague principles of environmental protection. (Florida International University, 2015).

The Ministry of the Environment's Environmental Action Plan creates a Haitian vision, based on a program that calls for several implementing strategies, including land-use plans, watershed management plans, and the promotion of "conservationist agriculture." (FIU, 2015)

Environmental Management Decree

The Environmental Management Decree made explicit the Ministry of the Environment's authority over national environmental policy. This includes the right to declare eroded land to be inappropriate for agriculture, and explicitly transfer powers over forest management and water resources from the Ministry of Agriculture to the Ministry of the Environment. It also requires the Ministry of the Environment to lead the coordination effort between ministries and local governments, and creates the same bottom-up approach to environmental management planning that the Ministry of Agriculture's Watershed Management Policy created in 1999 (FIU, 2015)

The Environmental Management Decree is specific defining roles and responsibilities. At the same time keeps authority over irrigation systems with the Ministry of Agriculture, which creates a competitive dynamic between the two ministries. The Decree also doesn't provide commitments toward staffing and financing the Ministry of the Environment (FIU, 2015)

Decentralization Decree

The Decentralization Decree delegates certain powers to local governments. Chapter 3 of the Decree addresses the environment, imposing on sections, communes, and departments the duty to enforce logging prohibitions, protect watercourses, control pollution, and regulate livestock farming.

According to FIU, the Decree may seek to empower local governments, but without a commitment to provide financial and human resources to them, a Decree of this nature cannot be fulfilled (FIU, 2015). Main Environmental regulations can be seen in Annex 1 chart Environmental legal Regulations.

Protected land

On October 9, 2013, the Council of Ministers and the President of the Republic approved an Arrêté sur la Creation du Parc National des Trois Baies et des Lagon aux Boeufs, which creates a protected area for the marine eco-system, coastline and land that is situated on the eastern side of the Haiti's northern coast²². There are three areas of influence are:

²¹ Article 52-1

²² Arrêté was published in the Moniteur on Wednesday, December 11, 2013.

- A central zone located within the limits of the territorial waters where any exploitation is prohibited - (23,864 ha).
- A buffer zone where the open exploitation of resources is subject to restrictions that are in effect - (21,186 ha).
- A transition zone where the exploitation of available resources is permitted with prior authorisation from the MDE - (77,498 ha).

The Decree, published in the Official Journal "Le Moniteur" No. 54 dated March 21, 2014, in article 8 reaffirms the different categories of areas defined in the 2013 decree.

Article 5 defines that the land under the State domain can be sold by the General Directorate of Taxes. Additionally, the decree establishes that all the works on this land require the authorization of the MOE and a strict control of this institution. A management plan is required to define the use of this land. The Ministry of Environment, the Ministry of Interior and Territorial Communities and the Ministry of Public Works, Transport and Communications are responsible for implementation of the decree.

9.16.2.2 Water in the Rural Code and other laws

The rural code, in chapter I defines surface water as natural bodies of water that belong to the state but owners of land on which they are found have use rights under certain conditions. This includes underground sources of water, irrigation and drainage. As mentioned below, Haitian Constitution distinguishes an individual's right to property from coasts, springs, rivers, and watercourses, which belong to the state.

The Ministry of Agriculture, Natural Resources and Rural Development retains significant and nearly exclusive authority over irrigation and agricultural water management, although it has recently attempted to broaden its powers to include watershed management in general. Its watershed management policies attempt to bring local governments into its policy regime, though from a legal-regulatory perspective, the Ministry of Agriculture has little statutory support for its role in establishing water resources policy. Still, it exerts significant influence in the sector due to its financial and human resources, and the importance of agriculture to the Haitian economy (FIU, 2015). Water legal regulations chart can be seen in Annex 1, chart Water Legal regulations.

9.16.2.3 Production cycle regulations

The Project will accomplish with the legal framework during all the stages, including the production cycle.

Additionally, it is important to consider the Haiti Investment Code – 2002, that defines investment in agriculture the organic or non-organic horticulture (fruits and vegetables, decorative and medicinal plants, flowers, teas, spices, etc.), as well as all investments considered as such by the Inter-Departmental Commission on Investments²³.

According to the Code, agricultural undertakes companies for agricultural development, and in addition to other benefits provided by this Code and by laws on Agriculture, the Investment Code creates the following benefits²⁴:

1. Customs duty and tax relief on import of equipment goods and materials necessary for the establishment and operations of the enterprise, including: – tractors, two-wheel tractors, fishing boats and outboard motors and any other equipment necessary for

²³ Art. 30 CI

²⁴ Art. 31 CI

the enterprise's operations, – seed, fry, fertilizer, pesticides, plants, fungicides and all other agriculture, stockbreeding and fishing inputs, – nets, traps and other fishing equipment, – devices and equipment used in the construction of hothouses, incubators for the production of poultry, – spare parts and tools used in equipment maintenance, – post-harvest machines, tools and equipment such as gins, pulpers, grain threshing machines, – packaging, preserving and processing materials and all equipment deemed necessary in company production.

2. Exemption from payroll taxes and all other direct internal taxes for a period which shall not exceed fifteen (15) years.
3. Exemption from the security deposit provided for by the Customs Tariff Code for temporary entry imports.

9.17 *Annex 5:*

OSHA

Occupational Safety and Health (OSH)

In Haiti, occupational safety and health is defined by the 1961 Labour Code (Code du Travail)²⁵ in relation to the specific sector of activity, and applies to this project as agricultural and industrial activity. Agricultural activities are defined as places where agricultural production operations are carried out, as is the case in the current project where there are “agricultural holdings for production, harvesting, storage and transportation of plants and fruit”²⁶.

The Ministry of Social Affairs and Labour (Ministère des Affaires Sociales et du Travail) is the competent national authority for regulating occupation safety and health. The office of occupational accident insurance, sickness and maternity (OFATMA)²⁷ has an important mandate in monitoring safety and health regulation compliance within the workspace.

According to the Code du Travail the employer is obligated to implement internal regulations on the conditions of work and to provide them to workers; Further, it is the responsibility of the employer to create appropriate working space as well as equipment with appropriate hygiene, safety and operational conditions. The use of clothing or protective equipment should be supplied, cleaned and maintained by the employer at no cost to the worker who uses them.²⁸

The Code du Travail defines specific requirements regarding the provision and the availability of first-aid, sanitary installations, drinking water, rest and eating areas. In addition, the employer is compelled to provide access to expert advice and/or support in health and safety, such as medical services when the company has at least twenty employees (Arts. 477 - 479).²⁹

The duties of the worker are to comply with the schedule in the establishment and to collaborate by respecting the legal or regulatory provisions with regards to labour. Whereas general provisions relating to the handling, storage, labelling and use of biological and chemical hazards, including the use of pesticides were cited, there was no further specific data found so as to better grasp the means of application of those provisions. Risks related to machinery and tools are established in Art. 445 to 451.

The employer in accordance with the Department of the General Labour Inspectorate, shall define the appropriate measures for the general conditions to provide sufficient protection for the health of workers, particularly with regards to noises and vibrations, which may be harmful to the health of workers, as well as determining which activities are unhealthy or dangerous with regards to the storage of hazardous substances.³⁰

OSHA labour inspectors have the responsibility of ensure the implementation of laws regarding working conditions and the protection of workers, and provide necessary information and technical advice to employers and workers on the most effective ways for observance of such laws³¹. Labour inspectors, with a duly sealed ID card, signed by the Secretary of

²⁵ The Labour Code was updated in 1984.

²⁶ Art. 91, 92 Chapter I, Art. 374, Chapter XI

²⁷ Office d'assurances accidents du travail, maladie et maternité

²⁸ Décret du 24 février 1984 portant code du travail actualisé. (Art. 31)

²⁹ Art. 478: The doctors will provide their services to the company in the following way: - once a week for a company employing at least twenty employees; twice a week for company employing at least one hundred employees; - three times per week for a company employing at least two hundred employees. Enterprises with over two hundred employees will have a permanent medical service with at least one clinic

³⁰ Art. 439, 438

³¹ Arts. 411, 415, 420 and 429

State for Social Affairs and their managers, have the power to investigate the accomplishment in the work place³².

OSHA prevention and protection

The following matrix is an overview of preventive actions to be considered in the OSHA Management Plan based on previous experiences in the operations for growing and processing sisal. The recommendations incorporate technology, organization of work, working conditions, social relationships and the influence of environmental factors at work³³.

PREVENTIVE MEASURES AND PROTECTION OF RISKS	
Chemical Risks	<u>Pesticides</u> <ul style="list-style-type: none"> • Safety data sheets of the products. • Medical and laboratory monitoring of staff • Provision of personal protective equipment (hat, gloves, closed shoes, respirator or mask, apron, goggles. • Inventory Control.
Chemical Risks	<ul style="list-style-type: none"> • Storage. • Showers, eyewash fountain, signage, spill control and waste, fire control equipment (fire extinguishers, trolleys or fixed systems), 20% ventilation floor area, lighting, non-absorbent and fire-resistant shelf, slope of 1% of floor, electrical tubing, inspection space between the wall and the product away from sources of water, retaining wall. • Respect periods of reentry into the areas treated with pesticides, as required for each product. • Follow the instructions on the label of each product.
Biohazards Cultivation Stages	<ul style="list-style-type: none"> • Closed shoes. • Drinking Water. • Health and hygiene measures. • Inspect work areas. • Supply of gloves • Provide first aid and medical attention to any skin lesion.
Risks associated with the topography Cultivation Stages and initial prep	<ul style="list-style-type: none"> • Mandatory use of footwear in good condition. • Report of the plantation areas presenting holes, wells, pits and deep trenches.

³² Arts. 413 and 428. Powers among others: To enter freely and without previous notice at any hour of the day or night, in work establishments. To interview the employer or the staff of the company on all matters relating to the implementation of the Labour Code. To require the production of any books, records and documents whose content is prescribed by the laws relating to working conditions. To enforce the posting of notices under the labor laws. To take or remove for purposes of analysis, samples of materials or substances used or handled. To order that immediate executory measures shall be taken in cases of imminent danger to the health and safety of workers

³³ OIT, Serie técnica: seguridad y salud ocupacional en la agricultura, Noviembre 2004. Costa Rica

Mechanical Hazards Initial Stages – Clearing of land	<ul style="list-style-type: none"> • Place the blade guards to shovels, and other sharp tools. • Preventive maintenance of tools and equipment. • Place crosshead to machetes and knives. • Conduct security audits to machines, engines and teams to identify those with risky conditions and proceed to control those that do not guarantee the safety of workers. • Store tools in a safe place. • Do not operate equipment without training and authorization. • Report the machines and parts that pose risks for workers (yellow blankets and instructions in indicating not to operate without guard).
Risks associated with transport Final packaging stages	<ul style="list-style-type: none"> • Provide preventive maintenance to the means of transportation. • Train drivers on road safety rules. • Prohibit the transport of persons with pesticides or machinery not designed for this purpose. • Select better and more appropriate means of transport. • To provide workers with good options to move around on plantations.
Electrical Risks Final packaging stages	<ul style="list-style-type: none"> • Implement a program of preventive maintenance and periodic inspections to review the electrical system. • All equipment must be grounded. • Attaching lightning rods in the packing plant. • Cased electrical systems or properly insulated. • Label panels, high voltage areas and transformers. • To locate in the plant the pushbutton STOP in case of emergency.
Risks associated with the workplace Final packaging stages	<p><u>Agricultural Facilities</u></p> <ul style="list-style-type: none"> ▪ Provide adequate agricultural facilities for workers. ▪ Improve physical condition of facilities. ▪ Provide maintenance for the facilities. ▪ Ensure minimum safety conditions (fire resistant casing, housekeeping, good distribution, good lighting and ventilation, exits and evacuation routes, fixed and portable firefighting equipment, security signaling, electrical system etc.). ▪ Implement a strict program or order and cleanliness. ▪ Placement of drainage grates in the packing plant. ▪ Avoid water leakage in the fruits washing area. ▪ Place non-slip material in hallways and stairs to prevent falls. ▪ Maintenance of existing stairs. Especially to climb scaffolding. ▪ Periodically review the conditions of the existing scaffolding and build it on those risk areas that lack scaffolding. ▪ In the maintenance of the plant used ladders in good condition. <p><u>Confined spaces</u></p> <ul style="list-style-type: none"> ▪ Follow safety procedure ▪ Labeling risk areas. ▪ Do not allow entry by themselves of workers to the refrigeration chambers. <p><u>Risks associated with work at height</u></p> <ul style="list-style-type: none"> ▪ Inspect work areas. ▪ Use seat belts and appropriate ladders when working at high altitudes. <p><u>Storage and handling of Materials</u></p> <ul style="list-style-type: none"> ▪ Identify and keep the aisles free of obstacles due to the personal's movement of the packing plant. ▪ Delineate jobs, storage areas, and the areas and corridors through which passes the team.

Risks arising from the hygienic - Sanitary Conditions	<ul style="list-style-type: none"> • Provide appropriate housing conditions • Transport • An appropriate place for food intake, drinking water, Restrooms, etc • Health services, vaccination
Risks from the environment and eco-systems Initial – Final Stages	<ul style="list-style-type: none"> • Develop and implement an emergency plan. • Define roles and who are responsible of the working team in case of a natural disaster. • To establish security zones. • To have a team available for emergencies • Conduct drills to evaluate response times. • Establish contacts with relief agencies to improve the quality of emergency support.
Work demands derived from physical activity Initial – Final Packaging Stages	<ul style="list-style-type: none"> • Improve methods and means of work (pace of work, weight lifting and transporting loads). • Establish technical criteria about the weights to lift and carry. • Establish a process of training and information for workers in handling, lifting and manual handling of loads. • Establish rest breaks. • Rotate tasks to avoid repetitive continuous movements. • To assess hand tools assess in an efforts to reduce repetitive motion. • Search alternative mechanical handling and transportation of materials to reduce physical burden.
Work requirements derived from the organization, and content division of the tasks: Initial - Final Packaging Stages	<ul style="list-style-type: none"> • The forms of hiring and the compensation system should not be detrimental to worker's health. • The workday must contain breaks and time for food intake. • To regulate the duration of the working day during the times of high volumen production. • Provide good working conditions and fair treatment to the temporary workers involved in the tillage. • The supervisor-employee relationship should not affect work operations. • It is the responsibility of the company to develop training programs on issues of work and human development. <hr/> <ul style="list-style-type: none"> • Define prevention policies. • Assigning responsibilities at all levels of the organization. • Create an administrative structure of prevention (Health and Safety Committees and Risk Prevention Department). • Develop safety procedures. • Implement a permanent audit system for continuous improvement. • Provide training on the risks and preventive-corrective measures. • Other (investigate accidents, accident rates, etc.).

Fuente: OIT, Forastieri, 2004.

9.18 *Annex 6:*

**List of participants on the draft
ESIA workshop held in Port-au-
Prince on Tuesday June 8th**

FEUILLE DE PRESENCE

THEME/SUJET: RENCONTRE SUR LA LIGNE ECOLOGIQUE DU PN3B

DATE: 7 JUIN 2016

HEURE: 2:00 PM

LIEU: CIAT

	PRENOM - NOM	INSTITUTION	FONCTION	TELEPHONE	TELEPHONE	EMAIL
1	Evem ^{Henrice} Henrice	MARNDP	Co-d. Ance	36100500	4800606	evemhenrice@yahoo.fr
2	Estie Valtair	Consultant	Marndp	34577229		valtaire@yahoo.fr
3	Alfred Mathe	BID	Consultant	3701.8078	2812.5000	amathelma@iads.net
4	Agustin Filiger	BID	Chef d'équipe Projets	+202 230 6429		agustinfiliger@iads.net
5	Valérie Grenier	Sisalco	Consultant	3587-0606		greniervalerie@gmail.com
6	Hubert René	Sisalco	Consultant	34550833	-	hubert563@gmail.com
7	Alain Thierm	MARNDP	Exp ENV	3455-3301		alainthierm@gmail.com
8	Julio Guzman	Consultant Proje	ENV. Spec.	+506 8392116		julioentruiguzman@gmail.com
9	ANDY RENÉ	SISALCO - Avocat	Avocat	+509 37027447		grene@lexaconsultants.com
10	Pierre-Yves Gaudin	Sisalco	Président	37011779		Pygardere@yahoo.com

9.19 *Annex 7:*

**List and photographs of
participants on the ESIA
workshop held in Terrier Rouge
on Wednesday June 9th**

COOPERATIVE PETITS PLANTEURS NORD'EST

CPPNE

ASAMBLE JENERAL EKSTRAODINE

21 JEN 2016, TERIE WOUJ

LISTE DES PARTICIPANTS

Nom	Prénom	Institution	Signature
HENRICE	Edouard	MARNDR	
Baptiste	Christine	CPPNE	
Erene	Cyril Antoine	CPPNE	
Pierre	Toussaint	CPPNE	
Cherchez	Phileas	CPPNE	
Augustin	Gregoire	CPPNE	
Elienne	Elias	CPPNE	
Jean	Devilbert	CPPNE	
Jean Gilles	Gomez	CPPNE	
Jean Baptiste	Marcelle	CPPNE	
Genade	Elisane	CPPNE	
Dicore	Elisa	CPPNE	
Donnestime	Diplomine	CPPNE	
Jean	Philine	CPPNE	
Toussaint	Alfred	CPPNE	
Julien	Baryella	CPPNE	
Toussaint	Abdonel	CPPNE	
Toussaint	Abel	CPPNE	
Toussaint	Martine	CPPNE	
Comper	Jacques	CPPNE	
Fernand	Emilienne	CPPNE	
Jean	Rose Fovales	CPPNE	
Jean	Addencia	CPPNE	
Delit	Begita	CPPNE	
Jean Baptiste	Jolande	CPPNE	
Jacques	Chantale	CPPNE	
Joseph	Claudine	CPPNE	
Joseph	Eliotade	CPPNE	
Alain	Pierre	CPPNE	
Breus	Allande	CPPNE	

Nom	Prénom	Institution	Signature
N° Ocas	Island	CPPNE	
Phaneus	Eliane	CPPNE	
Philidor	Antoine	CPPNE	
Monestime	Jean Widy	CPPNE	
MONARD	Jaentilia		
Jean	Rose Laure		
Breus	Morne Suna	CPPNE	
maruemath	Ferdinand	CPPNE	Volmar Bui
Volmar	Bertrice B.	CPPNE	
Jacques	Myrtha	CPPNE	
Darius	Registe	CPPNE	
Mondesir	Guilene	CPPNE	Mondesir
Kasana	Jean Jacques	CPPNE	
Joseph	Charite	CPPNE	
Pierre	Abellard	CPPNE	
Jean	Caciany	CPPNE	

Lamour	Wanitho	CPPNE	Wes
Emmanuel	Elio	CPPNE	
Auguste	Barth	CPPNE	
Jacques O	Jacques O	CPPNE	
Paul	René Delius	CPPNE	
Widy	CHAIKS	CPPNE	
MADEGE	OBAS	CPPNE	
Jacques	Dieu Donne	CPPNE	
Motoute	Clement	CPPNE	
ELIPHETE (PHILAMAR)	Philamar	CPPNE	Eliphete, Fubma
Brenayme	Pierrojel	CPPNE	B. pierrojel
Bethel	Norris	CPPNE	Bethel Norris
Jacques	Jonas	CPPNE	Jacques Jonas
Vincent	Agelus	CPPNE	Vincent Agelus
Elena	Kaise	CPPNE	Evelyn Mosa
Jean Jacques	Berlean	CPPNE	Jean Jacques Berf
Joseph	Lariston	CPPNE	Joseph Lariston
LOUIS (Ephene)	Ephene	CPPNE	Louis Ephene
Pierre Gilles	Misus	CPPNE	P. Gilles Mesius
Jean	Elumen	CPPNE	Jean Elumen
Pierre Jules	Mathieu	CPPNE	Pierre G. Math
Louis	Garry	CPPNE	Louis Garry
Moise	Jouissant	CPPNE	Moise Jouissant
Jean	Sabrinus	CPPNE	Jean Sabrinus
Macelus	Elesone	CPPNE	Macelus Elys
Lamour	Michelin	CPPNE	Lamour Michelin
	Michot Henri	CPPNE	Michot Henri

Nom	Prénom	Institution	Signature
Etienne	Tervens	CPPNE	E. Tervens
François	Jean Baptiste	CPPNE	J. B.



9.20 *Annex 8:*

**List and photographs of
participants on the ESIA
workshop held in Terrier Rouge
on Tuesday July 19th**


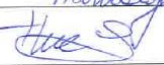





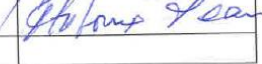
PROGRAMME ANCRE
ETUDE D'IMPACT SOCIAL ET ENVIRONNEMENTAL DU PROJET SSALCO
ATELIER DE RESTITUTION


LISTE DES PARTICIPANTS

PRENOM ET NOM	INSTITUTION	TELEPHONE	SIGNATURE
Zalinx PIERRE	CAI, International/Assoc	4262-7515	Zalinx
Siméon charité	Té. P. T.	4068 57 31	charité
JEAN Képlair	Education	4282-5091/391-4072	JEAN
Telfort Moneslime	KOET	36287330/324096	Telfort
Chervil Anatol	CPPNE	18795793	Chervil Anatol
SAINT-Pierre Delinc	KOET	42-12-03-90	SAINT-Pierre
Daphney Delc	North Coast Corporation	4641-45-23	Daphney
Georges KETELLUS	KPTAT	3749721/3226074	Georges
Christine Baptiste	CPPNE	3705-1666	Christine
PIERRE Edson	NCDC	3747-4047	PIERRE
PRENOM ET NOM	INSTITUTION	TELEPHONE	SIGNATURE
Princivil Aray	NCDC	3747-7868	Princivil
Wilson Charles	press	3827 0501	Wilson Charles
Zele Pierre	OPADNE	4264 4644	Zele
Maria Elena Daniel Pongas	Mairie	33478174	Maria Elena
Nadège François	Marie	33713868	Nadège
Emmanuel Desvillers	Marie	81042304	Emmanuel
Macdonald Jean-Louis	Mairie T-Rouge	4485-8575	Macdonald
DANIE/ CHAMPYR	HARNAR	33559907	DANIE/CHAMPYR
Daniel Marcel		3643 4542	Daniel
LESLIE VOLTAIRE	Consultant MARR	3457 7229	LESLIE
Pierre d'us Goudie	Giselle	3701 1779	Pierre

PRENOM ET NOM	INSTITUTION	TELEPHONE	SIGNATURE
Alfred M. M. M.	BID	3701-8058	<i>[Signature]</i>
Karl Delahun	B3D	3411 4526	<i>[Signature]</i>
Aboussou Filippo	BID	41 202 230 6429	<i>[Signature]</i>
Chery Rodelin	ITANE	3370-9480	<i>[Signature]</i>
HERNS CARL D. S. Y.	BIEN	33 93-6657	<i>[Signature]</i>
Christopher Etienne P.R.	BIEN	3946 3504	<i>[Signature]</i>
PIERRE JACQUES S. D. M.	MARNDR	3622 8543	<i>[Signature]</i>
Max T. K. K.	MARNDR/DANE	3412 451	<i>[Signature]</i>
Joseph Johanna-S	ESIA	—	<i>[Signature]</i>
Auguste Eric	MARNDR/DANE	3995-7070	<i>[Signature]</i>

PRENOM ET NOM	INSTITUTION	TELEPHONE	SIGNATURE
Berita Petit frère	CPPNE	4444 0654	Petit frère
Jacques Chantale	CPPNE	3606 8499	<i>[Signature]</i>
Volmar Bertrice B.	CPPNE	3755 7380	B. Volmar
Etienne Elies	CPPNE	3789 1771	<i>[Signature]</i>
Jolid H. Darius	MARNDR	3895 5029	<i>[Signature]</i>
Bien aimé Peemogel	CPPNE	4129 4076	Bien aimé Peemogel
Celestin Leroy	Radyo VLP Grand Pré (Katie Mon)	3629-5987/3394-1383	Celestin Leroy
Toussaint Charnel	Radyo VLP Grand Pré (Katie Mon)	4892-9793/3392-14022	<i>[Signature]</i>
Joseph Richard	Kaci	3487-6928	<i>[Signature]</i>
CELESTIA MORONI	CAIT/Agiocowet	4174 0970	<i>[Signature]</i>

PRENOM ET NOM	INSTITUTION	TELEPHONE	SIGNATURE
Evans Henrice	ANAC/MARNDR	3810 0500	
Monise Jean		3623-1282	Monisej
Thomas Eliphète	OPADNE	43256950	
THOMAS EVINX	OPADNE	43256950	
E. Daniel Noël	MARNDR	49023687	
Jeanne Jean Bertin	MARNDR	86573526	
François JE Barthe	CPPNE	4657-85-51	
Jean Consilvert	CTPNE	38536937	
Jean Philomé	CPPNE	37856240	

PRENOM ET NOM	INSTITUTION	TELEPHONE	SIGNATURE
Francisco Joseph	MPTR	48088982	
Fadius OSCAR	ASPE	43582228-37200591	OSCAR Fadius
Julio Guzmán	Consultant	(506)8379-2116	Julio
Maxo Erick VAL	INARA	48931200 / maxoerick.val@yahoo.b	M.E.V



9.21 *Annex 9:*

Questionnaires

Draft Environmental and Social Impact Assessment
4,000 ha Sisal Project in Northern Haiti

Interview to key informants: community members

We are carrying out an ESIA of a 4,000 ha Sisal Project in Northern Haiti and would like to know your perception about the community and the project itself. The project intends to rent 2,000 ha agricultural land (not buy), for its own sisal production and produce another 2,000 ha with interested farmers as out-growers, which could be expanded in the future. The idea is to process and export all the production that meets international standards. The information you provide will be used confidentially and for statistical purposes only.

Name of interviewer _____ Date. _____ # _____

Name of settlement _____ Municipality _____

I PROFILE OF INTERVIEWEE

1. Name of interviewee: _____
2. Sex: M _____ F _____
3. Date of birth: _____ Age: _____
4. Occupation: Domestic unpaid work _____ Salaried _____ Own income generated _____
Unemployed _____ Retired _____ Remittances, from over-seas _____ Other _____
5. Address, telephone and/ any other contact information: _____
6. Any education (last year approved)? No=0 yes= 1 no education _____
2= Elementary _____ 3=secondary _____ 4=university _____ 5=professional _____ 6=other _____

II ABOUT YOUR HOUSEHOLD

7. How many members are in your family ? : Adults _____ Minors _____
Wife/husband _____ Children _____ Other _____ please, specify _____
8. How many live there permanently: Adults _____ Minors _____
9. Occupation of other family members:
Wife/husband _____ Other _____ Other _____ Other _____ Other _____ Children _____

III ABOUT YOUR HOME

10. Do you own or rent your residence:
1=live free in company house _____ 2= live free in family house _____
3=owner _____ 4=rent _____ 5=other _____ specify _____

11. Please describe your residence:

A-Detail construction materials:

Type 1: Thin wood or soil house with thatched roof _____
Type 2 : Concrete or cement block house with concrete roof _____
Type 3: Concrete or cement block house with iron roof _____
Type 4: Wood house with iron roof _____
Type 5: Food for the poor houses _____
Type 6: other _____

B-Number of rooms _____

C-Existence of toilets/latrine no=0 yes=1

Interviewer state also his/her point of view and ask for permission to take pictures (home and productive activities): _____

IV ABOUT YOUR AGRICULTURAL LAND

12. Property of the land? 1= owner _____
2= sharecropper _____ To whom _____
3= Rent _____ from whom _____
4= squatter _____ To whom _____
5= Other _____ Please explain _____
13. How much do you pay every year for the land ?
1= The state _____ 2= Private _____ 3= coop/assoc. _____ 4= other, explain _____
14. In the past did the family grow sisal or worked in the sisal plant?
no=0 yes=1
15. If you produce Sisal now what do you do with it ?
0= no we do not produce
1= I sell it in the market 2= I sell it to the sisal plant
3= I use it for handicraft 4= I use it for animal's feed
5= I fabricate ropes and bags 6= others
16. Do you sell: 1= The leaves _____ 2= The fiber _____
17. At what price ? goud _____ unit _____
18. If you sell fibers, How do you extract it?
1= electric equipment _____ Who is the owner _____
2= Traditional plank and nail _____
19. What do you do with the mulsh?
1= animal feed _____ 2= Fertilizer _____ 3= nothing _____
4= other _____ describe: _____
20. Are you interested in producing Sisal? No=0 Yes=1 _____
21. What would you need in order to produce sisal?
Training: No _____ Yes _____ What _____
Technical assistance: No _____ Yes _____
Plants: No _____ Yes _____
Credit: No _____ Yes _____
Other: No _____ Yes _____ Please specify: _____

22. Total extension of land _____ ha

If you are engaged in Agricultural Activities, what do you produce:

Crop	ha	Qty har-vested	unit	Unit price	% sold	Where /to whom

23. What are the most adapted and yielding crops? _____

24. Do they use any agrochemical for production? No=0____ Yes____,

1= natural fertilizer 2= agrochemical 3= both

25. For what crops do you use agrochemicals? _____ Qty / year _____

26. Do you breed domestic animals:1= cows____2=goats__ 3=sheep____

4= poultry____ 5= horse 6=other _____

ANIMAL	QUANTITY	QUANTITY SOLD (specify units)	UNIT PRICE (GOURDES)

V ABOUT YOUR SOURCES OF INCOME

27. What is your main source of income HTG/month?

salary _____ own business _____ Remittances from overseas _____

other income _____ other income _____

28. How do you complement your income _____ amount/year _____

Please explain _____

VI ABOUT THE COMMUNITY

29. For how long have you lived/worked in the community(ies) _____ (months/years)

30. Are you member of association/organization,cooperative no=0____ yes=1 _____

31. Name of the association/organization,cooperative _____

32. Why are you member /why are you not a member ? _

33. Role and Service(s) provided and/or activities carried out in the community by the institutions/organizations mentioned:

What are the main problems and/or demands of the community members and community leaders?

Please evaluate the (current state of) services and community infrastructure:

(1= very good 2= good 3= regular 4= very bad)

Potable water_____

Energy_____

Connectivity_____

Health services_____

Roads_____

Education establishment_____

Sewage_____

Storm drain_____

Irrigation_____

Other(s), please describe_____

34. What kind of energy do you use?

Electrical____ Solar____ Generator____ Wood____ Charcoal____
Gas____ Other(s)____ Please describe:_____

35. What are the main environmental risks and/or problems of the community (ies)?

(1= slight 2= medium 3= strong 4= very strong)

Flooding____ Draught____ Rain____ Hurricanes____ Earthquake____

Other(s)____ Please describe:_____

36. What is - on your view - the current state (quality) of natural resources in the community? (1= very good 2= good 3= regular 4= very bad)

River(s)____ forest____ Soils____ Air____ Other____,
please specify_____

37. When you or other member of the family is sick , where do you go?

1= public clinic 2= Health center 3= hospital 4=traditional healer

5=vodou priest 6= private clinic or doctor 7= other _____

38. What is the cost of transportation to these places? 0= no cost 1=_____Gdes

39. During the past 6 months were you or a member of your family sick?

no 0= wi 1= __:Sickness_____

40. Are the children vaccinated? No =0____ yes=1____

41. How and where do you get water? 1= river/spring 2= wells 3=we buy
from watertruck 4= water tank 5= other_____

42. Is it potable water? no =0 yes=1

How do you make it potable _____

43. Do the children school have cafeteria. Do they eat there? No= 0 yes=1

VII PERCEPTION ABOUT THE PROJECT

44. Did you know before this interview about this sisal project?

Non=0 ____ (if no, go to question 48) yes=1 ____

45. Based on the information you have, what is your opinion about the project?

46. Would you like to have more information?

No=0 ____ (if no go to question 49) Yes ____

If yes, how would you like to have it:

in a workshop with other community members _____ written _____

both _____ other _____

It is expected that the 4,000 Sisal Project will generate employment opportunities and demand for related services, such as laborers, food, materials, clothing, drivers, cultural entertainment and crafts, among others.

47. Do you think this project could bring positive effects on the community and the environment? No ____ (if no, go to question 51) Yes =1 ____ 2= don't know

Please describe the possible positive effects on the community? _____

48. What measures would you recommend to improve the positive effects?

49. Do you think this project could bring negative effects on the community and the environment?

N=0 ____ (if no, go to question 53) Yes =1 ____

Please describe the possible negative effects on the community?

50. What measures would you recommend to avoid or diminish the negative effects?

51. On your view, what might be three core reasons for local opposition to the project?

52. What institution(s)/person(s)/force(s) outside the community do you think could oppose the project and/or generate conflicts and why? _____

53. What would you recommend to avoid conflicts and social tension and enhance project benefits for project preparation and implementation? _____

54. Do you think local people could be in favor of the project? Yes ____ No ____

Why? _____

55. What _____ would _____ be _____ their _____ main _____ expectations? _____

56. What actions would you recommend to improve community support in favor of the project?_____

57. Taking into account the positive and negative aspects of the project, what is your position before its development?

In favor _____

Against _____

*Please explain:*_____

Thank you very much!

Draft Environmental and Social Impact Assessment

4,000 ha Sisal Project in Northern Haiti

Interview to key informants: institutions/organizations

We are carrying out an ESIA of a 4,000 Sisal Project in Northern Haiti and would like to know your perception about the community and the project itself. The project intends to rent 2,000 ha agricultural land (not buy), for its own sisal production and produce another 2,000 with interested farmers as out-growers, which could be expanded in the future. The idea is to process and export all the production that meets international standards. The information you provide will be used confidentially and for statistical purposes only.

Name of interviewer _____ Date. _____

Name of settlement _____ Municipality _____

I PROFILE OF INTERVIEWEE

1. Name of interviewee: _____
2. Organization/institution: _____
3. Position: _____
4. Telephone and email _____

II ABOUT THE COMMUNITY

5. Name of the community(ies) where your institution works and is related to the project: _____
6. Role and Service(s) provided and/or activities carried out in the community by the institutions/organizations mentioned:

Actively _____

7. What else should it do? _____
8. 8- What other organizations are working in the area? _____
9. What are the main resources and/or strengths of the community?

1-Civil society organizations _____ 2-Support among their family/ neighbors/ producers _____

3-Local production _____ 4-Commercial associations _____ 5-Agricultural land _____

6-Natural resources _____ 7-water location _____ 8-Sea _____ 9-other _____

Please describe: _____

10. What are the main problems and/or demands of the community members and community leaders? _____

11. Please evaluate the (current state of) services and community infrastructure:

(1= very good 2= good 3= regular 4= very bad)

Potable water _____ Roads _____

Connectivity _____ Sewage _____

*Irrigation*_____

*Health services*_____

*Education establishment*_____

*Storm drainage*_____

*Energy*_____

*Other(s), please describe*_____

12. What kind of energy do they use?

Electrical___% Solar___% Generator___% Other(s)_____%

Wood___% Charcoal___% Gas___% other(s)_____%

Please _____ de-
scribe:_____

13. What are the main environmental risks and/or problems of the community (ies)?

(1= slight 2= medium 3= strong 4= very strong)

Flooding___ Draught___ Rain___ Hurricanes___

Earthquake_____ Fire _____ Other(s)___ Please de-
scribe:_____

14. Are the recent changes on quality of natural resources caused by human activi-
ties, if yes which type?

15. Are the local community members doing anything to address the negative
changes?_____

16. Do the farmers use any agrochemical for production? No___ Yes___,
please describe:

17. What is - on your view - the current state (quality) of natural resources in the
community? (1= very good 2= good 3= regular 4= very
bad)

Rivers___ Soils___ Air___ Trees___
Other_____,

18. What institution/people/NGO/ are responsible for the services below:

Wells drilling	
Provision of potable water	
Emergency & disaster	
Garbage management	
Road and bridge building & repair	
Irrigation Canal construction	
Health Care	
Electricity	
Housing	

19. What is the state of health of local community members?

Diarrhea___ Malaria___ Poor nutrition___ Hypertension___

Respiratory .illnesses___ Elephantiasis___ Diabetis___ Vision.problems___

Alcoholism___ Drugs___ Other_____

20. Please describe the existence of local health infrastructure and state the way
they obtain medical assistance in case of emergency?

Traditional healer____ private Clinic____ public clinic ____public health center____
 State Hospital____ NGO clinic____ NGO health center____ NGO Hospital____
 Another type of health infrastructure, describe:_____

21. What is the distance to the nearest health equipment? _____
22. How do the people get potable water? _____
23. Does school canteens exist for kid in the community? no=0 yes=1 how many _____
24. 24- Do the community have Electricity? No=0 yes =1 other=2 describe _____

III PERCEPTION ABOUT THE PROJECT

25. Did you know before this interview about this sisal project?

No= 0 ____ (if no, go to question 27) Yes=1

26. Based on the information you have, what is your opinion about the project?
- _____

27. Would you like to have more information on the project?

NO=0 Yes=1 If yes, how would you like to have it: In a workshop with other community members____ Written____ both____ other way _____

It is expected that the 2,000 Sisal Project will generate employment opportunities and demand for related services, such as laborers, food, materials, clothing, drivers, cultural entertainment and crafts, among others.

28. Do you think that this project could bring positive effects on the community and the environment?

No =0 ____ (if no, go to question 30) yes=1 don't know=2
 Please describe the possible positive effects on the community? _____

29. What measures would you recommend to improve the positive effects?

30. Do you think that this project could bring negative effects on the community and the environment? No=0) ____ (if no, go to question 32) Yes=1

Please describe the possible negative effects on the community? _____

31. What measures would you recommend to avoid or diminish the negative effects?

- 32- Do you think that the development of this project could generate any type of opposition and/or negative reaction from part of the community(ies)' members and/or other?

Yes=1 _____no =0 don't know=2 _____ Please describe: _____

32. On your view, what might be three core reasons for local opposition to the project: ____

33. What institution(s)/person(s)/force(s) outside the community do you think could oppose the project and/or generate conflicts and why? _____
34. What actions would you recommend to avoid conflicts in the construction and operation of this project? _____
35. What actors do you think could be in favor of the project and why? _____
What would be their main expectations? _____
36. 37-What actions would you recommend to improve community support in favor of _____ the _____ project? _____
37. Taking into account the positive and negative aspects of the project, what is your position before its development? *Against = 0* _____ *In favor= 1 Please describe* _____
38. Please can you give some name or institution that can take responsibility in those tasks:

<i>Organize sisal production with farmers</i>	
<i>Management of garbage</i>	
<i>Emergency & disaster</i>	
<i>Security</i>	
<i>Violence against woman</i>	
<i>Other</i>	

Thank you very much!

9.22 *Annex 4:*

DEFINITION OF VARIABLES FOR THE EVALUATION OF ENVIRONMENTAL IMPACTS (Campos et al 2015; Olympic Peru Inc., Equas S.A. 2013)

SIGN (+, -)

The sign of effect (impact) refers to the beneficial (+) or harmful character (-) of the various actions that act upon the various factors considered.

There is the possibility of including a third character (*), reflecting effects associated with circumstances external to the activity, so that only through a comprehensive study its nature could be defined.

INTENSITY (IN)

It is the degree of incidence of the action on the factor. The rating scale will be between 1 and 12, in which 12 expresses the total destruction of the factor in the area where the effect occurs (PA_{total}), and 1 minimal effect. Values between those two terms reflect intermediate situations, which must be duly justified and argued.

It should be noted that this assessment is made based on a percentage of the project area (PA and / or their catchment areas, if applicable) directly affected.

EXTENSION (EX)

It refers to the theoretical area of influence of the impact in relation to the environment of the activity (percentage area, relative to the environment, in which the effect manifests).

If the action produces a localized effect, the impact will be considered in an ad hoc basis (1). If the effect does not allow a precise location within the environment of the activity, taking a widespread influence on the whole, the impact will be Total (8), considering the intermediate situations as partial (2) or large (4) impact.

In the event that the effect occurs in a critical location (next spill and upstream of a water intake, landscape degradation in a highly visited area, or near an urban center, among others), it will take a value of 4 units above that one that would correspond only based on the percentage of extension in which it manifests. If in addition to critical, the effect is dangerous and impossible to introduce corrective measures, an immediate alternative to the operation or process' activity giving rise to the effect must be sought, annulling the cause that produces it.

SYNERGY (SI)

This attribute provides reinforcement of two or more simple effects. The total manifestation of simple effects, caused by actions acting simultaneously, is higher than the manifestation of effects when the actions act independently and not simultaneously.

When an action acting on a factor, is not synergistic with other actions that affect the same factor, the attribute takes a value of 1, if there exists a moderate synergism, it is set to 2, and if it is highly synergistic should be assigned a value 4.

When, on the contrary, weakening cases occur, the assessment of the effect takes negative values, reducing the final value of the significance of the impact.

ACCUMULATION (AC)

This attribute gives the idea of a progressive increase of the effect, when the generating action persists continuously or repeatedly. (The repeated ingestion of DDT, not removed from the tissues, results in a progressive increase of its presence and its consequences, often resulting in death).

If an action does not produce cumulative effects (simple accumulation), the effect is evaluated as (1). If the effect is cumulative the value increases to (4).

EFFECT (EF)

This attribute refers to the cause-effect in terms of its direction: the way the effect manifests on a factor, because of an action. An impact may be direct or indirect at the same time, although in different factors, since the scale is exclusive, and do not consider the fact that it could be direct and indirect, the rating should be done exclusive.

The effect can be direct or primary: in this case, the impact is a direct result of the action, then takes a value of 4 (The emission of CO₂ impacts on the surrounding air).

The effect can be indirect or secondary: if it takes place from a primary effect, and there is no direct effect associated with this action, a value of 1 is assigned to the impact. Its manifestation is a direct result of the action, but occurs from a primary effect, which is acting as a second order action. (The emission of fluorocarbons impact directly on air quality and indirectly (or secondary) on the thickness of the ozone layer.

MOMENTUM (MO)

It refers to time between the onset of the action (t_o) and the beginning of the effect (t_i) on the factor or environmental aspect considered.

When the time is zero, the momentum will be immediate, and if less than one year, short-term, assigning a value of (4) in both cases. If the - period of - time ranges from one to five years, medium term (2), and if the effect takes more than five years to manifest, long-term, with an assigned value of (1).

If concur any circumstances that would make the critical moment of impact, one might ascribe a value four units above (noise at night in the vicinity of a hospital –immediate -, predictable appearance of a pest or a pernicious effect operating just before harvest - half-term).

PERIODICITY (PR)

It refers to the regularity the effect is manifested, either in a cyclic or recurrent way (periodic effect), sporadically in time (irregular effect), or constant over time (continuous).

A continuous effect takes a value of 4, a periodic one a value of 2, and that of irregular appearance, which should be values in terms of probability of occurrence, as well as the discontinuous one, a value of 1.

PERSISTENCE (PE)

It refers to the time the effect remains from its appearance, and from which the affected factor would return to the pre-action state by natural means or by introducing corrective measures.

If the effect remains for less than a year, then the action produces a fleeting effect, with a value of (1). If it lasts between 1 and 5 years, temporary (2); and it is longer than 5 years, the effect is permanent assigning a value of (4).

Persistence is independent of reversibility.

The fleeting or temporary effects are usually reversible or recoverable.

RECOVERABILITY (RE)

It refers to the possibility of total or partial reconstruction of the affected factor as a result of the activity undertaken; in other words, the possibility to return to the pre-action initial conditions, through human intervention (introduction of corrective measures).

If the effect is fully recoverable, and if so immediately, a value of 1 is assigned or a value of 2, if it is recoverable in the medium term. If the recovery is partial and the effect is mitigated, it takes a value of 4; and when the effect is unrecoverable (disturbance impossible to repair, by natural or human action) the value of 8 is assigned. In the case of unrecoverability, but with the possibility of introducing compensatory measures, the value is 4.

REVERSIBILITY (RV)

It refers to the possibility of reconstructing the affected factor or the possibility of returning to the pre-action initial conditions, by natural means, once the action taken ceases to act on the environment.

If it is a short term, less than a year, a value (1) is assigned. If a medium term, a period ranging from 1 to 5 years (2); and if the effect is irreversible, or lasts more than five years, a value (4). The time intervals comprising these periods, are identical to those assigned in the case of Persistence.

IMPORTANCE OR SIGNIFICANCE OF THE IMPACT (I)

It is very important to distinguish between the importance (significance) of the impact, which is the importance of the effect of an action on a factor or environmental aspect, and (not to be confused with) the importance of the affected environmental factor.

A number that is derived from the following formula represents the importance of the impact:

$$I = 3IN + 2EX + SI + AC + EF + MO + PR + PE + RE + RV$$

The importance of impact takes values between 13 and 100. It takes intermediate values (between 40 and 60) under any of the following circumstances:

- *Total intensity and minimum affection of the remaining variables.*
- *Very high or high intensity and high or very high affection of the remaining variables.*
- *High intensity, unrecoverable effect and very high affection of one of the remaining variables.*
- *Medium or low intensity, unrecoverable effect and very high affection of at least two of the remaining variables.*

Impacts with importance values lower than 25 are irrelevant, in other words, compatible; or the environmental measures were taken into account in the project design. Moderates impacts show an importance between 25 and 50. Impacts will be severe, when the importance is between 50 and 75, and critical when the value exceeds 75.

9.23 *Annex 5:*

**EVALUATION OF IDENTIFIED
ENVIRONMENTAL IMPACTS**

Annex 4.1 Evaluation of identified potential environmental impacts during nursery establishment and operation

Chart 26 *Evaluation of the importance (I) of the impact in the nursery, factor soil: fuel and oil spills caused by the use of machinery*

Factor: Soil		
Impact: fuel and oil spills caused by the use of machinery		
VARIABLE	VALUE	COMMENTS
Sign	negative	Fuel and oil spills from machinery, trucks, and other transport vehicles could contaminate soil, reducing its agricultural production capacity
Intensity (IN)	1	Low intensity of the impact
Extension (EX)	1	Punctual, it is possible to precisely locate the spill
Synergy (SY)	1	It is not synergistic with other activities
Accumulation (AC)	4	The spills are accumulative and will degrade the soil
Effect (EF)	4	The effect is a direct consequence of the exposition to the spills from the use of machinery
Momentum (MO)	1	The spills will show a negative effect after a long period of accumulation
Periodicity (PR)	4	The effect is continued when manifesting
Persistence (PE)	4	The accumulation of oil and fuel spills are persistent in the long term in the soil
Recoverability (RE)	4	The spills are partially recoverable and mitigatable
Reversibility (RV)	4	Soil could be partially recuperated and the action mitigated
Σ (Importance)	- 31	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Moderate	$I = 3*1+2*1+1+4+4+1+4+4+4+4$

Chart 27 **Evaluation of the importance (I) of the impact in the nursery, factor soil: soil erosion caused by water runoff**

Factor: Soil		
Impact: <i>sedimentation and erosion caused by surface water runoff during rains and/or wind erosion</i>		
VARIABLE	VALUE	COMMENTS
Sign	negative	<ul style="list-style-type: none"> Land clearance expose soil to rain and wind Weed control increase the risk of erosion by runoff water
Intensity (IN)	4	The intensity of the impact is medium, due to the flatness of the land
Extension (EX)	4	The risk of sedimentation and erosion is manifested in the whole nursery
Synergy (SY)	1	It is not synergistic with other activities
Accumulation (AC)	4	Erosion is accumulative and will degrade the soil's quality
Effect (EF)	4	The effect is a direct consequence of the exposition of the soil to rains and wind
Momentum (MO)	2	Surface water runoff and wind will show a negative effect after a medium period of continued erosion
Periodicity (PR)	4	The effect is periodic during the rainy and windy seasons, intermittent, and continuous
Persistence (PE)	4	The accumulation of soil loss due to run-off could affect production for many years
Recoverability (RE)	2	Soil could be partially recuperated and the action mitigated
Reversibility (RV)	2	Soil could return to the previous state after a medium term period of time (5 years)
Σ (Importancia)	- 43	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Moderate	$I = 3*4+2*4+1+4+4+2+4+4+2+2$

Chart 28 **Evaluation of the importance (I) of the impact in the nursery, factor soil: Erosion in the slopes and river/creeks banks caused by land clearance and building of elevated beds**

Factor: Soil		
Impact: Erosion in the slopes and river/creeks banks caused by land clearance and building of elevated beds		
VARIABLE	VALUE	COMMENTS
Sign	negative	It is a risk, especially during land preparation
Intensity (IN)	3	The intensity of the impact is low-medium, due to the slope of the elevated beds and banks
Extension (EX)	2	The risk of erosion is manifested in the elevated beds and river/creeks banks only, but it could affect the water course
Synergy (SY)	1	It is not synergistic with other activities
Accumulation (AC)	1	Bank degraded could be reconstructed
Effect (EF)	4	The effect is a direct consequence of the exposition of the denude soil to rains and wind
Momentum (MO)	2	Lack of vegetation will expose soil to erosion throw wind and water runoff
Periodicity (PR)	4	The effect is periodic during the rainy season, intermittent, and continuous and during periods of hard wind
Persistence (PE)	1	The elevated beds and banks degradation due to run-off and wind could be reconstructed and avoided by introducing corrective measures
Recoverability (RE)	1	Elevated beds and banks could be recuperated and the action avoided
Reversibility (RV)	2	Soil could return to the previous state after a medium term period of time (5 years)
Σ (Importancia)	- 29	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Moderate	$I = 3*3+2*2+1+1+4+2+4+1+1+2$

Chart 29 **Evaluation of the importance (I) of the impact in the nursery, factor soil: soil compaction caused by the use of machinery**

Factor: Soil		
Impact: soil compaction caused by the use of machinery		
VARIABLE	VALUE	COMMENTS
Sign	negative	Compaction is common due to the use of heavy machinery and years of cultivation
Intensity (IN)	3	Low-medium intensity of the impact
Extension (EX)	5	The activities will impact the whole area of the nursery
Synergy (SY)	2	The actions (machinery and years of cultivation) present a moderate synergism
Accumulation (AC)	4	Compaction is accumulative and degrades the soil
Effect (EF)	4	The effect is a direct consequence of use of machinery and continuous cultivation
Momentum (MO)	2	Compaction is detected after several years of use of machinery and cultivation (medium term)
Periodicity (PR)	4	The effect is continued when manifesting
Persistence (PE)	1	When manifested the effect will not disappear by itself, but corrected measures could be applied
Recoverability (RE)	1	The effect is recoverable if corrective measures are applied
Reversibility (RV)	4	Soil could not be recuperated by natural means
Σ (Importance)	- 41	$I = 3IN + 2EX + SI + AC + EF + MO + PR + PE + RE + RV$
Qualitative valuation	Moderate	$I = 3 \cdot 3 + 2 \cdot 5 + 2 + 4 + 4 + 2 + 4 + 1 + 1 + 4$

Chart 30 **Evaluation of the importance (I) of the impact in the nursery, factor superficial and ground water: contamination of superficial and/or groundwater caused by fuel and oil spills**

Factor: Superficial and ground water		
Impact: contamination of superficial and/or groundwater caused by fuel and oil spills		
VARIABLE	VALUE	COMMENTS
Sign	negative	It is a risk, especially during land preparation
Intensity (IN)	3	The intensity of the impact is low-medium, due to the use of machinery during nursery establishment and per- ation
Extension (EX)	4	The risk of pollution could be manifested in a large area of the nursery
Synergy (SY)	1	It is not synergistic with other activities
Accumulation (AC)	4	Pollution could accumulate specially in ground water
Effect (EF)	4	The effect is a direct consequence of the exposition of fuel and oil spills in water
Momentum (MO)	2	Spills will expose the factor to immediate and short-term pollution
Periodicity (PR)	1	The effect is manifested only during nursery establish- ment and operation
Persistence (PE)	4	The spills could last many years in water reservoirs (Gil- lis; Kaufman 2010)
Recoverability (RE)	4	It is possible, but very difficult and costly to recover oil spills, especially in underground water
Reversibility (RV)	4	After oil spills it takes many years for the water reser- voirs and environment to return to its natural state
Σ (Importancia)	- 41	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Moderate	$I = 3*3+2*4+1+4+4+2+1+4+4+4$

Chart 31 *Evaluation of the importance (I) of the impact in the nursery, factor superficial and ground water: contamination caused by non-treated effluents and sewage*

Factor: Superficial and ground water		
Impact: contamination caused by non-treated effluents and sewage		
VARIABLE	VALUE	COMMENTS
Sign	negative	Effluents and sewage from the normal operation of a sisal nursery could pollute water resources if not well treated
Intensity (IN)	5	The intensity of the impact is medium, if the effluents and sewage are not well treated
Extension (EX)	3	The risk of contamination could be manifested in a large area of the surroundings
Synergy (SY)	1	No synergism
Accumulation (AC)	4	The effect of contamination of water resources for effluents and sewage are accumulative, for example, effluents from the facilities and decortication houses
Effect (EF)	4	The effect in the surroundings could be a direct consequence of effluents and sewage not treated
Momentum (MO)	4	Non-treated effluents and sewage will expose the surroundings to immediate and short-term contamination
Periodicity (PR)	4	The effect could be manifested in a continuous basis
Persistence (PE)	2	The effect would be temporary (1 to 5 years)
Recoverability (RE)	1	It is possible to correct the problem short after its appearance
Reversibility (RV)	2	It is possible to reverse it by natural means in a medium term (1-5 years)
Σ (Importancia)	- 43	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Moderate	$I = 3*5+2*3+1+4+4+4+4+2+1+2$

Chart 32 **Evaluation of the importance (I) of the impact in the nursery, factor air: wind erosion caused by exposition of soil materials during land preparation**

Factor: Air		
Impact: wind erosion caused by exposition of soil materials during land preparation		
VARIABLE	VALUE	COMMENTS
Sign	negative	It is a risk, especially with strong winds
Intensity (IN)	5	The intensity of the impact is medium, due to the risk of exposing soil to strong winds
Extension (EX)	4	The risk of erosion is manifested in a large area of the project
Synergy (SY)	1	It is not synergistic with other activities
Accumulation (AC)	1	It is not accumulative
Effect (EF)	4	The effect is a direct consequence of the exposition of soil to wind
Momentum (MO)	4	Spills will expose the factor to immediate erosion
Periodicity (PR)	1	The effect is manifested only during land preparation
Persistence (PE)	4	If soil is lost it is difficult to recover
Recoverability (RE)	3	It is possible to mitigate the action
Reversibility (RV)	4	Soil recovery takes many years
Σ (Importancia)	- 45	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Moderate	$I = 3*5+2*4+1+1+4+4+1+4+3+4$

Chart 33 **Evaluation of the importance (I) of the impact in the nursery, factor air: machinery and transport vehicles will emit GHG to the atmosphere**

Factor: Air		
Impact: emissions of GHG to the atmosphere caused by the use of machinery and transport vehicles		
VARIABLE	VALUE	COMMENTS
Sign	negative	There exists emissions of chlorofluorocarbons (CFC), due to fuel burning. These emissions will modify the air quality in the surroundings of the project
Intensity (IN)	1	There exist low probability of impact in the area of the project, although emissions will contribute to climate change (CC) and destruction of the ozone layer (OL) (GCE__)
Extension (EX)	2	Partial in the area of the project, although wind could disseminate emissions in the surroundings
Synergy (SY)	1	It is not synergistic with other activities
Accumulation (AC)	1	It is not accumulative for the air quality of the locations near the project, although accumulative for CC and OL
Effect (EF)	4	The effect is a direct consequence of the use of machinery and transport vehicles
Momentum (MO)	4	The effect takes place immediately after the start of the activity
Periodicity (PR)	1	The effect is manifested only during the activities that require the use of machinery, and when transporting is needed
Persistence (PE)	1	Temporal, in the surroundings, but permanent with respect to CC and OL
Recoverability (RE)	1	Immediate in the surrounding after finishing the activity
Reversibility (RV)	1	In the surroundings air quality will recover immediately after the activity is finished, but the reversibility with respect to CC and OL takes many years
Σ (Importancia)	- 25	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Moderate	$I = 3*1+2*4+1+1+4+4+1+1+1+1$

Chart 34 **Evaluation of the importance (I) of the impact in the nursery, factor vegetation: Undesirable ecological regime shifts by scattered trees loss**

Factor: Vegetation		
Impact: Undesirable ecological regime shifts by scattered trees loss		
VARIABLE	VALUE	COMMENTS
Sign	negative	Tree cutting could affect wildlife, especially birds
Intensity (IN)	4	Medium-low probability of impact, because the area of the project is mostly agricultural land, with few dispersed trees
Extension (EX)	2	Only in the project area where there exist dispersed trees
Synergy (SY)	1	It is not synergistic with other activities
Accumulation (AC)	1	It is not accumulative
Effect (EF)	4	The effect is a direct consequence of cutting the trees
Momentum (MO)	4	The effect takes place immediately after the start of the activity
Periodicity (PR)	1	The effect is manifested only during land clearing, once in the lifetime of the project
Persistence (PE)	1	Temporal in the surroundings and will disappear after the the tree cutting stops
Recoverability (RE)	1	Immediate in the surrounding after finishing the activity
Reversibility (RV)	1	In the surroundings air quality will recover immediately after the activity is finished
Σ (Importancia)	- 30	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Moderate	$I = 3*4+2*2+1+1+4+4+1+1+1+1$

Chart 35 **Evaluation of the importance (I) of the impact in the nursery, factor air: noise and vibrations to adjacent communities cause by the use of heavy machinery**

Factor: Community welfare		
Impact: noise and vibrations to adjacent communities cause by the use of heavy machinery		
VARIABLE	VALUE	COMMENTS
Sign	negative	Noise and vibrations could affect communities in the surroundings of the nursery, while machinery is working
Intensity (IN)	2	Higher probability of impact in the communities inside or surrounding the area of the project
Extension (EX)	2	Only in the project area close to communities
Synergy (SY)	1	It is not synergistic with other activities
Accumulation (AC)	1	It is not accumulative for on locations near the project
Effect (EF)	4	The effect is a direct consequence of the use of machinery
Momentum (MO)	4	The effect takes place immediately after the start of the activity
Periodicity (PR)	1	The effect is manifested only during the activities that require the use of machinery
Persistence (PE)	1	Temporal in the surroundings and will disappear after the machinery stops
Recoverability (RE)	1	Immediate in the surrounding after finishing the activity
Reversibility (RV)	1	In the surroundings air quality will recover immediately after the activity is finished
Σ (Importancia)	- 24	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Irrelevant	$I = 3*2+2*2+1+1+4+4+1+1+1+1$

Chart 36 **Evaluation of the importance (I) of the impact in the nursery, factor HH&S workers' risks caused by activities performed**

Factor: Human health and safety		
Impact: workers' risks caused by overload of activities performed		
VARIABLE	VALUE	COMMENTS
Sign	negative	Workers are exposed to risks such as the ones associated to the use of mechanical hand tools, machinery, equipment, and lifting and transporting materials and equipment, as well as exposition to the sisal leaves
Intensity (IN)	8	High probability of impact, because these activities affect workers with a workload, increased by other risk factors: irregular topography and presence of trenches and pits, adverse weather conditions (heat and humidity), biological (insects and rodents), and mental workload (organization and content of work); without neglecting poor hygienic-sanitary conditions and natural disasters and the danger of sisal leaves (Chinchilla, Rojas, Forastieri 2004)
Extension (EX)	2	All workers, especially the ones dedicated fieldwork activities
Synergy (SY)	4	It is synergistic with other working activities and conditions
Accumulation (AC)	4	It is accumulative, especially on workers with a workload
Effect (EF)	4	The effect is a direct consequence of the workload
Momentum (MO)	4	The effect takes place short after the start of the activity
Periodicity (PR)	4	The effect is manifested with a continuous workload
Persistence (PE)	2	The evaluation should be done in an ad hoc basis
Recoverability (RE)	2	It is not immediate
Reversibility (RV)	2	It is not immediate
Σ (Importancia)	- 54	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Severe	$I = 3*8+2*2+4+4+4+4+4+2+2+2$

Annex 4.2 Evaluation of identified potential environmental impacts during project construction and farm establishment

Chart 37 Evaluation of the importance (I) of the impact during construction and farm establishment, factor soil: fuel and oil spills caused by the use of machinery

Factor: Soil		
Impact: fuel and oil spills caused by the use of machinery		
VARIABLE	VALUE	COMMENTS
Sign	negative	Fuel and oil spills from machinery, trucks, and other transport vehicles could contaminate soil, reducing its agricultural production capacity
Intensity (IN)	1	Low intensity of the impact
Extension (EX)	1	Punctual, it is possible to precisely locate the spill
Synergy (SY)	1	It is not synergistic with other activities
Accumulation (AC)	4	The spills are accumulative and will degrade the soil
Effect (EF)	4	The effect is a direct consequence of the exposition to the spills from the use of machinery
Momentum (MO)	1	The spills will show a negative effect after a long period of accumulation
Periodicity (PR)	4	The effect is continued when manifesting
Persistence (PE)	4	The accumulation of oil and fuel spills are persistent in the long term in the soil
Recoverability (RE)	4	The spills are partially recoverable and mitigatable
Reversibility (RV)	4	Soil could be partially recuperated and the action mitigated
Σ (Importance)	- 31	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Moderate	$I = 3*1+2*1+1+4+4+1+4+4+4+4$

Chart 38 **Evaluation of the importance (I) of the impact during construction and farm establishment, factor soil: sedimentation and erosion caused by surface runoff during rains**

Factor: Soil		
Impact: sedimentation and erosion caused by surface runoff during rains		
VARIABLE	VALUE	COMMENTS
Sign	negative	This is a risk, especially during land preparation
Intensity (IN)	4	The intensity of the impact is medium, due to the flatness of the land
Extension (EX)	4	The risk of erosion is manifested in the whole plantation
Synergy (SY)	1	It is not synergistic with other activities
Accumulation (AC)	4	Erosion is accumulative and will degrade the soil's quality
Effect (EF)	4	The effect is a direct consequence of the exposition of the denude soil to rains and wind
Momentum (MO)	2	Surface runoff will show a negative effect after a medium period of continued erosion
Periodicity (PR)	4	The effect is periodic during the rainy season, intermittent, and continuous
Persistence (PE)	4	The accumulation of soil loss due to run-off could affect production for many years
Recoverability (RE)	4	Soil could be partially recuperated and the action mitigated
Reversibility (RV)	2	Soil could return to the previous state after a medium term period of time (5 years)
Σ (Importancia)	- 45	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Moderate	$I = 3*4+2*4+1+4+4+2+4+4+4+2$

Chart 39 **Evaluation of the importance (I) of the impact during construction and farm establishment, factor soil: erosion in the slopes caused by land clearance along river/creeks banks with slopes of 20 %-30 % caused by land clearance**

Factor: Soil		
Impact: erosion in the slopes caused by land clearance along river/creeks banks with slopes of 20 %-30 % caused by land clearance		
VARIABLE	VALUE	COMMENTS
Sign	negative	It is a risk, especially during land preparation
Intensity (IN)	1.5	The intensity of the impact is low-medium, due to the slope of the banks and the possible existence of no rivers (or superficial water bodies) on the project area
Extension (EX)	2	The risk of erosion is manifested in the river/creeks banks only, but it could affect the water course
Synergy (SY)	1	It is not synergistic with other activities
Accumulation (AC)	1	Bank degraded could be reconstructed
Effect (EF)	4	The effect is a direct consequence of the exposition of the denude soil to rains and wind
Momentum (MO)	2	Lack of vegetation will expose soil to erosion throw wind and water runoff
Periodicity (PR)	4	The effect is periodic during the rainy season, intermittent, and continuous and periods of hard wind
Persistence (PE)	1	The banks degradation due to run-off and wind could be reconstructed and avoided by introducing corrective measures
Recoverability (RE)	1	Banks could be recuperated and the action avoided
Reversibility (RV)	2	Soil could return to the previous state after a medium term period of time (5 years)
Σ (Importancia)	- 24.5	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Irrelevant	$I = 3*1,5+2*2+1+1+4+2+4+1+1+2$

Chart 40 **Evaluation of the importance (I) of the impact impact during construction and farm establishment, factor soil: soil compaction caused by the use of machinery**

Factor: Soil		
Impact: soil compaction caused by the use of machinery		
VARIABLE	VALUE	COMMENTS
Sign	negative	Compaction is common due to the use of heavy machinery and years of cultivation
Intensity (IN)	1,5	Low-medium intensity of the impact
Extension (EX)	5	The activities will impact the whole area of the plantation
Synergy (SY)	2	The actions in this case are not synergistic
Accumulation (AC)	4	Compaction is accumulative and degrades the soil
Effect (EF)	4	The effect is a direct consequence of use of machinery
Momentum (MO)	2	Compaction is detected after several years of use of machinery (medium term)
Periodicity (PR)	4	The effect is continued when manifesting
Persistence (PE)	1	When manifested the effect will not disappear by itself, but corrected measures could be applied
Recoverability (RE)	1	The effect is recoverable if corrective measures are applied
Reversibility (RV)	4	Soil could not be recuperated by natural means
Σ (Importance)	- 36.5	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Moderate	$I = 3*1,5+2*5+2+4+4+2+4+1+1+4$

Chart 41 **Evaluation of the importance (I) of the impact during construction and farm establishment, factor superficial and ground water: contamination of superficial and/or groundwater caused by fuel and oil spills**

Factor: Superficial and ground water		
Impact: contamination of superficial and/or groundwater caused by fuel and oil spills		
VARIABLE	VALUE	COMMENTS
Sign	negative	It is a risk, especially during land preparation
Intensity (IN)	3	The intensity of the impact is medium-high, due to the use of machinery during construction and farm development
Extension (EX)	4	The risk of pollution is manifested in a large area of the project
Synergy (SY)	1	It is not synergistic with other activities
Accumulation (AC)	4	Pollution could accumulate specially in ground water
Effect (EF)	4	The effect is a direct consequence of the exposition of fuel and oil spills on water
Momentum (MO)	2	Spills will expose the factor to immediate and short-term pollution
Periodicity (PR)	1	The effect is manifested only during project construction and farm establishment
Persistence (PE)	4	The spills could last many years in water reservoirs (Gillis; Kaufman 2010)
Recoverability (RE)	4	It is possible, but very difficult and costly to recover oil spills, especially in underground water
Reversibility (RV)	4	After oil spills it takes many years for the water reservoirs and environment to return to its natural state
Σ (Importancia)	- 41	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Moderate	$I = 3*3+2*4+1+4+4+2+1+4+4+4$

Chart 42 **Evaluation of the importance (I) of the impact during construction and farm establishment, factor air: dust produced by wind erosion caused by exposition of soil materials during land preparation**

Factor: Air		
Impact: dust produced by wind erosion caused by exposition of soil materials during land preparation		
VARIABLE	VALUE	COMMENTS
Sign	negative	It is a risk, especially with strong winds
Intensity (IN)	2	The intensity of the impact is medium, due to the risk of exposing soil to strong winds
Extension (EX)	4	The risk of erosion and dust dissemination is manifested in a large area of the project
Synergy (SY)	1	It is not synergistic with other activities
Accumulation (AC)	1	It is not accumulative
Effect (EF)	4	The effect is a direct consequence of the exposition of soil to wind
Momentum (MO)	4	Strong winds will expose the factor to immediate erosion and dust dispersion
Periodicity (PR)	1	The effect is manifested only during land preparation
Persistence (PE)	4	If soil is lost it is difficult to recover
Recoverability (RE)	4	It is possible to mitigate the action
Reversibility (RV)	4	Soil recovery would take many years
Σ (Importancia)	- 37	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Moderate	$I = 3*2+2*4+1+1+4+4+1+4+4+4$

Chart 43 **Evaluation of the importance (I) of the impact during construction and farm establishment, factor air: emissions of GHG to the atmosphere caused by the use of machinery and transport vehicles**

Factor: Air		
Impact: emissions of GHG to the atmosphere caused by the use of machinery and transport vehicles		
VARIABLE	VALUE	COMMENTS
Sign	negative	There exists emissions of chlorofluorocarbons (CFC), due to fuel burning. These emissions will modify the air quality in the surroundings of the project
Intensity (IN)	1	There exist low probability of impact in the area of the project, although emissions will contribute to climate change (CC) and destruction of the ozone layer (OL) (GCE__)
Extension (EX)	4	Partial in the area of the project, although wind could disseminate emissions in the surroundings
Synergy (SY)	1	It is not synergistic with other activities
Accumulation (AC)	1	It is not accumulative for the air quality of the locations near the project, although accumulative for CC and OL
Effect (EF)	4	The effect is a direct consequence of the use of machinery and transport vehicles
Momentum (MO)	4	The effect takes place immediately after the start of the activity
Periodicity (PR)	1	The effect is manifested only during the activities that require the use of machinery, and when transporting is needed
Persistence (PE)	1	Temporal, in the surroundings, but permanent with respect to CC and OL
Recoverability (RE)	1	Immediate in the surrounding after finishing the activity
Reversibility (RV)	1	In the surroundings air quality will recover immediately after the activity is finished, but the reversibility with respect to CC and OL takes many years
Σ (Importancia)	- 25	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Moderate	$I = 3*1+2*4+1+1+4+4+1+1+1+1$

Chart 44 *Evaluation of the importance (I) of the impact during construction and farm establishment, factor vegetation: loss of biodiversity in DBEF Shrubland and coastal areas due to agricultural related activities*

Factor: Vegetation		
Impact: Loss of biodiversity in DBEF Shrubland due to agricultural related activities		
VARIABLE	VALUE	COMMENTS
Sign	negative	Minimal outside the 3BNP and negative inside the park due to agricultural activities
Intensity (IN)	2	Medium probability of impact, because the area of the project is mostly agricultural land, with few dispersed trees, but some could be inside the 3BNP
Extension (EX)	2	Only where the sisal plantations are closer to the border with DBEF shrubland
Synergy (SY)	1	It is not synergistic with other activities
Accumulation (AC)	1	It is not accumulative
Effect (EF)	4	The effect is a direct consequence of the sisal project
Momentum (MO)	4	The effect takes place immediately after the start of the activity
Periodicity (PR)	1	The effect is manifested during the lifetime of the project
Persistence (PE)	4	Permanent while the agricultural activities persist
Recoverability (RE)	1	Immediate in the surrounding after any negative impact is detected
Reversibility (RV)	1	The surroundings will recover immediately after the impact is detected and mitigated
Σ (Importancia)	- 27	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Moderate	$I = 3*2+2*2+1+1+4+4+1+4+1+1$

Chart 45 **Evaluation of the importance (I) of the impact during construction and farm establishment, factor vegetation: Undesirable ecological regime shifts by scattered trees loss**

Factor: Vegetation		
Impact: Undesirable ecological regime shifts by scattered trees loss		
VARIABLE	VALUE	COMMENTS
Sign	negative	Tree cutting could affect wildlife, especially birds
Intensity (IN)	3	Medium-high probability of impact, because the area of the project is mostly agricultural land, with few dispersed trees, but some could be inside the 3BNP
Extension (EX)	2	Only in the project area where there exist dispersed trees
Synergy (SY)	1	It is not synergistic with other activities
Accumulation (AC)	1	It is not accumulative
Effect (EF)	4	The effect is a direct consequence of cutting scattered trees
Momentum (MO)	4	The effect takes place immediately after the start of the activity
Periodicity (PR)	1	The effect is manifested only during land clearing, once in the lifetime of the project
Persistence (PE)	1	Temporal in the surroundings and will disappear after the machinery stops
Recoverability (RE)	1	Immediate in the surrounding after finishing the activity
Reversibility (RV)	1	In the surroundings air quality will recover immediately after the activity is finished
Σ (Importancia)	- 27	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Moderate	$I = 3*3+2*2+1+1+4+4+1+1+1+1$

Chart 46

Evaluation of the importance (I) of the impact during construction and farm establishment, factor air: noise and vibrations to adjacent communities cause by the use of heavy machinery

Factor: Community welfare		
Impact: noise and vibrations to adjacent communities cause by the use of heavy machinery		
VARIABLE	VALUE	COMMENTS
Sign	negative	Noise and vibrations could affect communities in the surroundings of the project, while machinery is working
Intensity (IN)	2	Medium probability of impact in the communities, because they are not close to the project area, especially inside the 3BNP
Extension (EX)	2	Only in the project area close to communities, if any
Synergy (SY)	1	It is not synergistic with other activities
Accumulation (AC)	1	It is not accumulative for on locations near the project
Effect (EF)	4	The effect is a direct consequence of the use of machinery
Momentum (MO)	4	The effect takes place immediately after the start of the activity
Periodicity (PR)	1	The effect is manifested only during the activities that require the use of machinery
Persistence (PE)	1	Temporal in the surroundings and will disappear after the machinery stops
Recoverability (RE)	1	Immediate in the surrounding after finishing the activity
Reversibility (RV)	1	In the surroundings air quality will recover immediately after the activity is finished
Σ (Importancia)	- 24	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Irrelevant	$I = 3*2+2*2+1+1+4+4+1+1+1+1$

Chart 47 **Evaluation of the importance (I) of the impact during construction and farm establishment, factor HH&S: workers' risks caused by the activities performed**

Factor: Human health and safety		
Impact: workers' risks caused by overload of the activities performed		
VARIABLE	VALUE	COMMENTS
Sign	negative	Workers are exposed to risks such as the ones associated to the use of mechanical hand tools, machinery, and equipment.
Intensity (IN)	8	Very high probability of impact, because these activities affect workers with a workload, increased by other risk factors: especially dynamic physical load, irregular topography, presence of trenches and pits, adverse weather conditions, biological hazards, and mental load, without neglecting poor hygienic/sanitary conditions and risks from environment and the ecosystem
Extension (EX)	2	All workers, especially the ones dedicated to construction and land activities
Synergy (SY)	4	It is synergistic with other working activities and conditions
Accumulation (AC)	4	It is accumulative, especially on workers with a workload
Effect (EF)	4	The effect is a direct consequence of the workload
Momentum (MO)	4	The effect takes place short after the start of the activity
Periodicity (PR)	4	The effect is manifested with a continuous workload
Persistence (PE)	2	The evaluation should be done in an Ad hoc basis
Recoverability (RE)	2	It is not immediate
Reversibility (RV)	2	It is not immediate
Σ (Importancia)	- 54	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Severe	$I = 3*8+2*2+4+4+4+4+4+2+2+2$

Annex 4.2 Evaluation of identified potential environmental impacts during project operation

Chart 48 Evaluation of the importance (I) of the impact during project operation, factor soil: soil erosion caused by water runoff

Factor: Soil		
Impact: soil erosion caused by water runoff		
VARIABLE	VALUE	COMMENTS
Sign	negative	Weed control increase the risk of erosion by runoff water
Intensity (IN)	1	The intensity of the impact is medium, due to the flatness of the land
Extension (EX)	4	The risk of erosion is manifested in the whole plantation
Synergy (SY)	1	It is not synergistic with other activities
Accumulation (AC)	4	Erosion is accumulative and will degrade the soil's quality
Effect (EF)	4	The effect is a direct consequence of the exposition of the soil to rains and floodings
Momentum (MO)	2	Surface runoff will show a negative effect after a medium period of continued erosion
Periodicity (PR)	4	The effect is periodic during the rainy season, intermittent, and continuous
Persistence (PE)	4	The accumulation of soil loss due to run-off could affect production for many years
Recoverability (RE)	4	Soil could be partially recuperated and the action mitigated
Reversibility (RV)	2	Soil could return to the previous state after a medium term period of time (5 years)
Σ (Importancia)	- 36	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Moderate	$I = 3*1+2*4+1+4+4+2+4+4+4+2$

Chart 49 **Evaluation of the importance (I) of the impact during project operation, factor soil: fuel and oil spills caused by the use of machinery**

Factor: Soil		
Impact: fuel and oil spills caused by the use of machinery		
VARIABLE	VALUE	COMMENTS
Sign	negative	Fuel and oil spills from machinery, trucks, and other transport vehicles could contaminate soil, reducing its agricultural production capacity
Intensity (IN)	1	Low intensity of the impact
Extension (EX)	1	Punctual, it is possible to precisely locate the spill
Synergy (SY)	1	It is not synergistic with other activities
Accumulation (AC)	4	The spills are accumulative and will degrade the soil
Effect (EF)	4	The effect is a direct consequence of the exposition to the spills from the use of machinery
Momentum (MO)	1	The spills will show a negative effect after a long period of accumulation
Periodicity (PR)	4	The effect is continued when manifesting
Persistence (PE)	4	The accumulation of oil and fuel spills are persistent in the long term in the soil
Recoverability (RE)	4	The spills are partially recoverable and mitigatable
Reversibility (RV)	4	Soil could be partially recuperated and the action mitigated
Σ (Importance)	- 31	$I = 3IN + 2EX + SI + AC + EF + MO + PR + PE + RE + RV$
Qualitative valuation	Moderate	$I = 3*1 + 2*1 + 1 + 4 + 4 + 1 + 4 + 4 + 4 + 4$

Chart 50 **Evaluation of the importance (I) of the impact during project operation,**
factor soil: soil compaction caused by the use of machinery

Factor: Soil		
Impact: soil compaction caused by the use of machinery		
VARIABLE	VALUE	COMMENTS
Sign	negative	Compaction is common due to the use of heavy machinery
Intensity (IN)	1	Low intensity of the impact
Extension (EX)	4	The activities will impact the whole area of the plantation
Synergy (SY)	1	No synergism
Accumulation (AC)	4	Compaction is accumulative and degrades the soil
Effect (EF)	4	The effect is a direct consequence of use of machinery
Momentum (MO)	2	Compaction is detected after several years of use of machinery and cultivation (medium term)
Periodicity (PR)	4	The effect is continued when manifesting
Persistence (PE)	1	When manifested the effect will not disappear by itself, but corrected measures could be applied
Recoverability (RE)	1	The effect is recoverable if corrective measures are applied
Reversibility (RV)	4	Soil could not be recuperated by natural means
Σ (Importance)	- 32	$I = 3IN + 2EX + SI + AC + EF + MO + PR + PE + RE + RV$
Qualitative valuation	Moderate	$I = 3*1 + 2*4 + 1 + 4 + 4 + 2 + 4 + 1 + 1 + 4$

Chart 51 **Evaluation of the importance (I) of the impact during project operation, factor soil: soil contamination caused by agrochemicals and waste water from dicortication**

Factor: Soil		
Impact: Soil contamination caused by agrochemicals and waste water from dicortication		
VARIABLE	VALUE	COMMENTS
Sign	negative	Agrochemical accumulation in soils provokes contamination (Muhibbullah, et al 2005; Varca __)
Intensity (IN)	4	Medium intensity of the impact if non degradable agrochemicals are used
Extension (EX)	4	The activities could impact a large area of the plantation
Synergy (SY)	2	Different agrochemicals show moderate synergism among themselves
Accumulation (AC)	4	Agrochemical pollution is accumulative and degrades the soil
Effect (EF)	4	The effect is a direct consequence of the use of non-biodegradable chemicals
Momentum (MO)	2	Agrochemical pollution affects after accumulation in the medium term
Periodicity (PR)	4	The effect is continued when manifesting
Persistence (PE)	4	When manifested the effect will remain for a long period of time
Recoverability (RE)	4	Recovery could be partial and the effect mitigatable
Reversibility (RV)	4	Soil could be recuperated by natural means in the long term
Σ (Importance)	- 51	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Severe	$I = 3*4+2*4+2+4+4+2+4+4+4+4$

Chart 52 *Evaluation of the importance (I) of the impact during project operation, factor superficial and ground water: contamination of superficial and/or groundwater caused by fuel and oil spills*

Factor: Superficial and ground water		
Impact: contamination of superficial and/or groundwater caused by fuel and oil spills		
VARIABLE	VALUE	COMMENTS
Sign	negative	It is a risk, especially during land preparation
Intensity (IN)	3	The intensity of the impact is low-medium, due to the use of machinery during project operation
Extension (EX)	4	The risk of pollution is manifested in a large area of the project
Synergy (SY)	1	It is not synergistic with other activities
Accumulation (AC)	4	Pollution could accumulate specially in ground water, which is relevant, especially inside the 3BNP
Effect (EF)	4	The effect is a direct consequence of the exposition of fuel and oil spills on water
Momentum (MO)	2	Spills will expose the factor to immediate and short-term pollution
Periodicity (PR)	1	The effect is manifested during the operation of machinery
Persistence (PE)	4	The spills could last many years in water reservoirs (Gillis; Kaufman 2010)
Recoverability (RE)	4	It is possible, but very difficult and costly to recover oil spills, especially in underground water
Reversibility (RV)	4	After oil spills it takes many years for the water reservoirs and environment to return to its natural state
Σ (Importancia)	- 41	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Moderate	$I = 3*3+2*4+1+4+4+2+1+4+4+4$

Chart 53 **Evaluation of the importance (I) of the impact during project operation, factor superficial and groundwater: Contamination of superficial and groundwater caused by waste water from decortication and if any, agrochemicals runoff from in intercropping**

Factor: Superficial and ground water		
Impact: Contamination of superficial and groundwater caused by waste water from decortication and if any, agrochemicals runoff from in intercropping		
VARIABLE	VALUE	COMMENTS
Sign	negative	There is a risk of a water pollution, especially through water runoff during heavy rain
Intensity (IN)	5	Medium-high intensity of the impact if non degradable agrochemicals are used and if applications are carried out with rain or irrigation and if water from decortication is not collected and/or treated
Extension (EX)	4	The activities could impact a large area of the plantation
Synergy (SY)	2	Different agrochemicals show moderate synergism among themselves
Accumulation (AC)	4	Agrochemical pollution is accumulative in the aquifers and the coastal wildlife inside the 3BNP
Effect (EF)	4	The effect is a direct consequence of the use of non-biodegradable chemicals, and not treated decortication liquid waste and/or combined with irrigation or rain
Momentum (MO)	2	Agrochemical pollution affects after accumulation in the medium term
Periodicity (PR)	4	The effect is continued when manifesting
Persistence (PE)	4	When manifested the effect will remain for a long period of time
Recoverability (RE)	4	Recovery could be partial and the effect mitigatable
Reversibility (RV)	4	Aquifer could be recuperated by natural means in the long term
Σ (Importance)	- 51	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Severe	$I = 3*5+2*4+2+4+4+2+4+4+4+4$

Chart 54 **Evaluation of the importance (I) of the impact during project operation, factor superficial and ground water: contamination caused by not treated effluents and sewage**

Factor: Superficial and ground water		
Impact: contamination caused by not treated effluents and sewage		
VARIABLE	VALUE	COMMENTS
Sign	negative	Effluents and sewage from the normal operation of a commercial sisal plantation could pollute water resources if not well treated
Intensity (IN)	5	The intensity of the impact is medium, if the effluents and sewage are not well treated
Extension (EX)	3	The risk of non-treated effluents could be manifested in a large area of the surroundings, especially with rains
Synergy (SY)	1	No synergism
Accumulation (AC)	4	The effect of contamination of water resources for effluents and sewage are accumulative, especially on underground water
Effect (EF)	4	The effect in the surroundings could be a direct consequence of effluents and sewage not treated
Momentum (MO)	4	Not treated effluents and sewage will expose the surroundings to immediate and short-term contamination
Periodicity (PR)	4	The effect could be manifested in a continuous basis
Persistence (PE)	2	The effect would be temporary (1 to 5 years)
Recoverability (RE)	1	It is possible to correct the problem short after its appearance
Reversibility (RV)	2	It is possible to reverse it by natural means in a medium term (1-5 years)
Σ (Importancia)	- 43	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Moderate	$I = 3*5+2*3+1+4+4+4+4+2+1+2$

Chart 55 **Evaluation of the importance (I) of the impact during project operation, factor air: machinery and transport vehicles will emit GHG to the atmosphere**

Factor: Air		
Impact: emissions of GHG to the atmosphere caused by the use of machinery and transport vehicles		
VARIABLE	VALUE	COMMENTS
Sign	negative	There exists emissions of chlorofluorocarbons (CFC), due to fuel burning. These emissions will modify the air quality in the surroundings of the project
Intensity (IN)	1	There exist low probability of impact in the area of the project, although emissions will contribute to climate change (CC) and destruction of the ozone layer (OL) (GCE__)
Extension (EX)	2	Partial in the area of the project, although wind could disseminate emissions in the surroundings
Synergy (SY)	1	It is not synergistic with other activities
Accumulation (AC)	1	It is not accumulative for the air quality of the locations near the project, although accumulative for CC and OL
Effect (EF)	4	The effect is a direct consequence of the use of machinery and transport vehicles
Momentum (MO)	4	The effect takes place immediately after the start of the activity
Periodicity (PR)	1	The effect is manifested only during the activities that require the use of machinery, and when transporting is needed
Persistence (PE)	1	Temporal, in the surroundings, but permanent with respect to CC and OL
Recoverability (RE)	1	Immediate in the surrounding after finishing the activity
Reversibility (RV)	1	In the surroundings air quality will recover immediately after the activity is finished, but the reversibility with respect to CC and OL takes many years
Σ (Importancia)	- 25	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Moderate	$I = 3*1+2*4+1+1+4+4+1+1+1+1$

Chart 56 **Evaluation of the importance (I) of the impact during construction and farm establishment, factor vegetation: loss of biodiversity in DBEF Shrubland and coastal areas due to agricultural related activities**

Factor: Vegetation		
Impact: Loss of biodiversity in DBEF Shrubland due to agricultural related activities		
VARIABLE	VALUE	COMMENTS
Sign	negative	Minimal outside the 3BNP and negative inside the park due to agricultural activities
Intensity (IN)	2	Medium probability of impact, because the area of the project is mostly agricultural land, with few dispersed trees, but some could be inside the 3BNP
Extension (EX)	2	Only where the sisal plantations are closer to the border with DBEF shrubland
Synergy (SY)	1	It is not synergistic with other activities
Accumulation (AC)	1	It is not accumulative
Effect (EF)	4	The effect is a direct consequence of the sisal project
Momentum (MO)	4	The effect takes place immediately after the start of the activity
Periodicity (PR)	1	The effect is manifested during the lifetime of the project
Persistence (PE)	4	Permanent while the agricultural activities persist
Recoverability (RE)	1	Immediate in the surrounding after any negative impact is detected
Reversibility (RV)	1	The surroundings will recover immediately after the impact is detected and mitigated
Σ (Importancia)	- 27	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Moderate	$I = 3*2+2*2+1+1+4+4+1+4+1+1$

Chart 57 **Evaluation of the importance (I) of the impact during project operation, factor HH&S workers' risks caused by activities performed**

Factor: Human health and safety		
Impact: workers' risks caused by overload of activities performed		
VARIABLE	VALUE	COMMENTS
Sign	negative	Workers are exposed to risks such as the ones associated to the use of mechanical hand tools, machinery, equipment, and lifting and transporting materials and equipment, also sisal leaves
Intensity (IN)	8	High probability of impact, because these activities affect workers with a workload, increased by other risk factors: irregular topography and presence of trenches and pits, adverse weather conditions (heat and humidity), biological (insects and rodents), and mental workload (organization and content of work); without neglecting poor hygienic-sanitary conditions and natural disasters (Chinchilla, Rojas, Forastieri 2004)
Extension (EX)	2	All workers, especially the ones dedicated fieldwork activities
Synergy (SY)	4	It is synergistic with other working activities and conditions
Accumulation (AC)	4	It is accumulative, especially on workers with a workload
Effect (EF)	4	The effect is a direct consequence of the workload
Momentum (MO)	4	The effect takes place short after the start of the activity
Periodicity (PR)	4	The effect is manifested with a continuous workload
Persistence (PE)	2	The evaluation should be done in an ad hoc basis
Recoverability (RE)	2	It is not immediate
Reversibility (RV)	2	It is not immediate
Σ (Importancia)	- 54	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Severe	$I = 3*8+2*2+4+4+4+4+4+2+2+2$

Annex 4.4 Evaluation of identified potential environmental impacts during the transformation process

Chart 58 *Evaluation of the importance (I) of the impact during the transformation process, factor air: machinery and transport vehicles will emit GHG to the atmosphere*

Factor: Air		
Impact: emissions of GHG to the atmosphere caused by the use of machinery and transport vehicles		
VARIABLE	VALUE	COMMENTS
Sign	negative	There exists emissions of chlorofluorocarbons (CFC), due to fuel burning. These emissions will modify the air quality in the surroundings of the project
Intensity (IN)	1	There exist low probability of impact in the area of the project, although emissions will contribute to climate change (CC) and destruction of the ozone layer (OL) (GCE__)
Extension (EX)	2	Partial in the area of the project, although wind could disseminate emissions in the surroundings
Synergy (SY)	1	It is not synergistic with other activities
Accumulation (AC)	1	It is not accumulative for the air quality of the locations near the project, although accumulative for CC and OL
Effect (EF)	4	The effect is a direct consequence of the use of machinery and transport vehicles
Momentum (MO)	4	The effect takes place immediately after the start of the activity
Periodicity (PR)	1	The effect is manifested only during the activities that require the use of transporting
Persistence (PE)	1	Temporal, in the surroundings, but permanent with respect to CC and OL
Recoverability (RE)	1	Immediate in the surrounding after finishing the activity
Reversibility (RV)	1	In the surroundings air quality will recover immediately after the activity is finished, but the reversibility with respect to CC and OL takes many years
Σ (Importancia)	- 25	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Moderate	$I = 3*1+2*4+1+1+4+4+1+1+1+1$

Chart 59 **Evaluation of the importance (I) of the impact during project operation, factor HH&S workers' risks caused by activities performed**

Factor: Human health and safety		
Impact: workers' risks caused by overload of activities performed		
VARIABLE	VALUE	COMMENTS
Sign	negative	Workers are exposed to risks such as the ones associated to the use of mechanical hand tools, machinery, equipment, and lifting and transporting materials and equipment, also sisal fibers and products
Intensity (IN)	8	High probability of impact, because these activities affect workers with a workload, increased by other risk factors: mental workload (organization and content of work); without neglecting poor hygienic-sanitary conditions (Chinchilla, Rojas, Forastieri 2004)
Extension (EX)	2	All workers, especially the ones dedicated to activities with machinery
Synergy (SY)	4	It is synergistic with other working activities and conditions
Accumulation (AC)	4	It is accumulative, especially on workers with a workload
Effect (EF)	4	The effect is a direct consequence of the workload
Momentum (MO)	4	The effect takes place short after the start of the activity
Periodicity (PR)	4	The effect is manifested with a continuous workload
Persistence (PE)	2	The evaluation should be done in an ad hoc basis
Recoverability (RE)	2	It is not immediate
Reversibility (RV)	2	It is not immediate
Σ (Importancia)	- 54	$I = 3IN+2EX+SI+AC+EF+MO+PR+PE+RE+RV$
Qualitative valuation	Severe	$I = 3*8+2*2+4+4+4+4+4+2+2+2$