PRO-AMBIENTE J & M, S. A.

ENVIRONMENTAL IMPACT ASSESSMENT

CAMU RIVER MULTIPURPOSE PROJECT

CLIENT: INDRHI

Santo Domingo, D. N.
July 2002

EXECUTIVE SUMMARY

Background

In January 2000, PRO-AMBIENTE J&M, S.A. concluded its preliminary environmental evaluation studies for the project, presenting the report "Evaluation of Environmental Impact on the Camu River Basin Multipurpose Project." This study presents a general description of the main environmental aspects affected, the impact and its appraisal, as well as a recommendation that a Detailed Environmental Impact Assessment Study (Detailed EIA), including a deeper examination of socioeconomic aspects of the population affected and that of the populace in general, be carried out once the definitive design had been concluded.

On that occasion, the city of La Vega perceived the project as their victory and they wanted the project to begin immediately; the population to be affected was both willing to negotiate and open to dialog in order to compensate for the impact they would undergo.

On February 5th, 2001, the National Institute of Water Resources (INDRHI) received from the Secretariat of Environment and Natural Resources (SEMARN), which had been created on August 18th, 2000 through Law 64-00, the Terms of Reference for doing a Detailed EIA based on the earlier study and on the request issued by INDRHI on November 30th of 2000.

The present study was done in two stages. In the first stage, in March 2001, the impact study was carried out, and then in January 2002, the physiological and biological studies and the Human Resettlement and Agrarian Plan were completed. The socioeconomic studies were updated with the current farming activities reported in the Resettlement Plan.

Key Aspects of the Project

According to existing records, the currents in the Camu River course have created severe floods and low watermarks over the last 30 years.

Camu River water shortages directly impact the supply of potable water and farming activities. The potable water source has recorded less than 100 LPS available for potable water supply, while in the farming sector, thousands of areas of rice crops are affected, causing a significant reduction in productivity.

Formerly, some 110,000 tareas were planted a year with rice along the Camu River; the present F is 55,000 tareas of this crop, a vitally important food source in the Dominican diet.

The large floods present in the Camu River, occurring with a frequency of 3 to 5 years, cause serious flooding in the city of Concepción de La Vega and in nearby areas. In the last 10 years, the city has had two major floods: one in 1993, and the

other during Hurricane Georges, in 1998, with significant loss of property and human lives.

The 1993 flood affected 70% of the city, with hundreds of families being affected and material damages amounting to millions of dollars. The material losses brought about by Hurricane Georges are estimated in over 40 million pesos (US$2.5 million) and more than 20,000 people were affected, 300 of whom lost their homes.

With the goal of counteracting the previously described effects, INDRHI has invested around 18 million pesos in the construction of gabion and channeling walls; these have not been enough to regulate the tremendous water volume.

The consulting firm Hanson Rodriguez S.A. began the Feasibility Study of the Bayacanes Dam, at the behest of INDRHI, in 1972, which was concluded in September 1973. This report proposes the construction of a dam in the Camu River, downstream from its merging point with the Bayacanes River; the dam proposed was to either be made of earth (44 meters high) or of concrete(45 meters high), with an earthen dike on the left abutment, with spillways and other related works. However, INDRHI decided to study other options, due to the following:

- Doubts remain regarding whether the performance of the alluvial materials when receiving the discharge of the spillway would endanger the dikes' safety and the earthen dam; there were also doubts about the endurance of the foot of the dam and the study of the concrete dam as well;
- The population increase and growth of the town of Bayacanes, which would be inundated by the reservoir adds an important social and human element, which was not considered in the 1973 Feasibility Study.

Starting in 1995, a study of options oriented toward an advantageous joint use of both the Camu River and the Yami River was begun, and various possible plans allowing construction in stages were analyzed. In all these plans, the basic, prioritized work is the Guaigüi Dam, located on the Camu River over the average bound level of the riverbed, 265.00 m.a.s.l., downstream from the confluence with the Guaigüi stream, with a basin of 75.34 km².

The plans thus analyzed are as follows:

A1: A dam at Guaigüi (HWL at the el. 315) with an equalizing reservoir at La Virgen (HWL at el. 145), with derivation from the Yami River (HWL at el. 150) and the hydroelectric power station discharging at el. 180 (HWL from the bound at the La Virgen site). In this plan, the demand from the aqueduct would be pumped from the equalizing reservoir at La Virgen).
A2: A dam at Gauguin (HWL at el. 315) with an equalizing reservoir at La Virgen (HWL at el. 145), with derivation from the Yami River (HWL at the 150 bound) and the hydroelectric power station discharging at el. 145 (HWL in re-

regulation reservoir La Virgen). In this plan, the demand from the aqueduct would be pumped from the equalizing reservoir at La Virgen).
A3: A dam at Guaigüi (HWL at el. 320) without a storage reservoir at La Virgen site, without derivation from the Yami River, with a hydroelectric power station at the foot of the dam.
A4: A dam at Guaigüi (HWL at el. 320) without a storage reservoir at La Virgen site that could add to the reduction of flooding, without derivation from the Yami River, and hydroelectric power station, discharging at el. 180.
B1: A dam in Guaigüí (HWL at el. 315) with a storage reservoir in La Virgen that can contribute to reduce floods (HWL at el. 175) without derivation from the Yami River and a hydroelectric power station with discharge at el. 180.

Taking into consideration the implementation of the plans in different stages, it has been decided for a prioritary development of the technical aspects of the works of the set dam-hydroelectric power station, using the plan with the dam at Guaigüi with HWL at el. 320 as the first stage.

The Camu River Multipurpose Project has as its goals the regulation of a water flow of 2.01 m^3/s of the high basin in order to deal with the following needs: (1) Control of flooding in order to mitigate the inundations that periodically affect the city of La Vega; (2) Assure the supply of 1.0 m^3/s of potable water for the population of the city of La Vega and nearby areas, 100% of the time, and guarantee 90% of the volume required to irrigate 600 ha (9,600 tareas) and the production of electric power for equivalent continuous power guaranteed 65% of the time at 12.4 GWh/year.

INDRHI has taken the technical decision, agreed upon by consensus, of implementing the work in different stages, giving priority to the first phase of the dam-hydroelectric power station set. In the second phase, the storage reservoir at La Virgen is to be developed, as it is essential for controlling the irrigation water supply by means of daily compensation of the flow turbined minimum.

The definitive study and design of this resource's exploitation were carried out for INDRHI by the consortium comprised of the consulting firms Statkraft, of Norway, and Ingenieros Evaluadores y Consultores, C por A (IECCA) of the Dominican Republic. Starting with the premises set forth in this study and design, the NCC International AB, as leader for Norwegian Consortium CNSA, submitted a technical, economic, and financial proposal to INDRHI for the construction of the Guaigüi dam, the hydroelectric power station, and related works, for the amount of US$42.5 million to be financed in part by ABN-AMBRO BANK with guarantee from Norwegian Export Institute (GIEK).

The principal resource exploitation features are the following:

- Basin area to the Guaigüi site 77.3Km^2

- Dam height 70.0 m
- Dam crest bound 326.50 m.a.s.l.
- Type of rockfill dam: asphalt concrete core
- Length of dam crest 190.00 metros
- Highest regulated water level 320 m.a.s.l.
- Highest extraordinary level 324.30 m.a.s.l.
- Highest level 277.00 m.a.s.l.
- Spillway without floodgates, having a discharge capacity 772 m^3/s
- Diversion tunnel with radial gate and cofferdam 350 m
- Intake for Hydroelectric power station with a slide gate, trashrack, and a fixed-wheel gate
- Discharge tunnel 605.00 m in length, for a flow 4.40 m^3/s
- Penstock in length 150 m
- Generator 12,500 volts
- Three-phase generator submerged in oil 3900 KVA
- Exit Substation
- Transmission line of 5.4 kilometers in length 69 KV

Description of environment

Climatic aspects

The regional climate of the basin is characterized by two principal patterns of moisture flow which share a common main rainy season period in the months of May and June, but which are at the same time distinguished from one another by significant features of moisture circulation.

The first pattern is unique for its flow of a warm moist mass with a strong northeast component, which crosses the Yuna River valley until encountering the first mountain spurs of the Central Range, which produces rising and cooling of the mass and the subsequent condensation and precipitation. This effect is combined with extensive cloudiness and a subsequent reduction of potential evaporation-transpiration, which produces high yield in terms of the flow specifically at the upper part of the Camu River, as shown by the gauge assessment samples of flow carried out at different points of the basin during the study.

Geomorphologic Aspects

Although the geological features of the basin will be dealt with in a separate report, the general geological map observation of the area shows the presence of low permeability materials, with minimum values in the upper part of the basin corresponding to the Ebano Verde Reserve, and with some increase in the rest of the basin up to Guaigüi, due to the presence of fractured material. Along the stretch between Guaigüi and Bayacanes, there are conditions that are comparable to those of the sub-basin up to Guaigüi.

Runoff and flow

The combination of climatic and geomorphologic characteristics gives rise to high values with respect to the runoff/rain ratio in the upper part of the basin, with a notable reduction downstream.

During the project studies, estimates have been made of the affluent flow at the dam site, the most recent being that which indicates a mean flow of 2.73 m^3/s for the 1969 –1987 period.

Sedimentation

The annual added reservoir volume has been estimated at 4,879 tons/k m^2/year, equivalent to a reservoir retention rate of 3,862 tons/k m^2/year. These Fs allow for a projection that 19.5x106 millions m^3 of dead storage provided will be sufficient for the first 65 years of reservoir operations.

Hydrogeology

The proposed site for the dam and reservoir area are located on the edge of the central range, primarily made up of igneous or magma metamorphic rock types whose hydrogeologic condition cannot be studied by the usual methods, and which have been described in the following way: "The rocks are generally not aquiferous, and water moves along planes of fissures and cracks along the upper meteorized portion. Nor does there exist any possibility of linking the few observation points of the existing levels in order to obtain a general framework under the form of iso-pieces or parts of underground water or flow direction. The amount of data available with respect to the underground water is insignificant in comparison with the size of the region itself, and scarcely allows for coming to a few indicative conclusions in certain areas."

The preceding description, excerpted from PLANIACAS, clearly indicates that the hydrogeological environment of the zone excludes the occurrence of aquifers, these being reduced to local phenomena and linked to the presence of secondary porosity in the form of cracks. It is to be supposed, then, that nearly the entire contribution of the basin located upstream from the proposed dam site is converted into superficial runoff and base river flow. Other factors, such as the high elevations, the rugged topography, the abundant availability of surface water, and the low population density result in there being practically no wells in the mountain range.

Local geology

The reservoir is located in a narrow valley, approximately 250 meters in depth, having a "V"-formation. The morphology is directly related to the different rock types in the area, and to their relative hardness and resistance to erosion and weathering. Underlying the Duarte Formation is the wide section of the valley where the dam is being planned. This area consists primarily of slate and shale. The rock type that is found in the river's narrow canyon where the reservoir and tunnels would be built is peridotite. Peridotite is a type of igneous or magma rock that consists principally of olivine and pyroxene minerals, and in comparison with slate and shale, it is very resistant.

The presence of peridotite and sediment in terraces and riverbeds has been confirmed, as well as the presence of shale zones in a strip of 100 to 200 meters wide near the upstream limit of the peridotite area.

Soil description

In physiographic terms, the basin can be divided into four (4) highly defined physiographic units, which are:

- Highlands of hills and mountains
- Slope soils
- Intermountain Valleys and Plains
- Valley and fluvial terrace soils

Soil Use and Coverage

The majority (70%) of the upper river basin area is utilized for raising grasses for grazing and livestock feed, as well as for subsistence farming crops, with no conservationist practices. This area is covered by a heterogeneous vegetation composed of conifers and latifolliads, which, according to local residents, have been gradually replaced by grasses. Despite the great expanses of land being cultivated for grasses, livestock numbers are highly reduced, with the result that overgrazing of soil is not observed.

The remainder of the upper river basin area is utilized for raising coffee plants that are shaded by the *guama* tree (a variety of custard apple); the area appears somewhat abandoned due to the lack of economic incentive for raising this formerly important cash crop. Another, less extensive zone is well protected by a dense forest of conifers and latifolliads, and this growth provides good soil protection for that particular area.

In the lower basin area, soils are dedicated to the production of smaller crops, among which are notable rice, plantain, yam, cassava, and corn, as well as others.

With respect to the contributing area of the Guaigüi reservoir, forest takes up approximately 30% of that zone, increasing upon ascent to up to 55% of the nearby zone of the Guaigüi River in the Ebano Verde scientific reserve. The forest is of

heterogeneous composition, basically represented by latifolliads such as apple, mango, poppy, green ebony, *cabirma, grayumbo*, and a few scattered types of pines. Only a few crops are raised in this area, occupying only 5%, in which the following dominate: corn, cassava, lima beans, *guandul*, fruits, and coffee plants that are shaded by the *guama* tree. Grasses for grazing take up the greater area of this basin, reaching up to 60%; this decreases to 30% in the upper part. The most common grass species are San Ramon, star, *guinea*, and *pangola*, among others.

Soil Use Potential

Given the topographic conditions and highly rugged relief of the upper part of this basin, the soils are essentially of forest and agroforest types, in which establishment of permanent planted crops, specifically of shaded coffee fields, fruits, and timber (pine, mahogany, oak, etc.) should take place. On the other hand, the soils of the lower basin area are included among those considered most productive in the Dominican Republic, characterized by the feature of a flat to nearly flat slope, and with excellent physical and chemical conditions for the establishment of intensive agriculture.

Terrestrial flora

In the area studied, various kinds of vegetation were identified, notably the riverine forests located along the Camu, Guaigüi, and Arraijanes rivers, as well as in some creeks and ravines that form part of the hydrographic basin of the reservoir area.

Along the narrow winding stretches of the Guaigüi River, the most common tree is the *cuaba* pine, ***Pinus occidentalis*** that forms highly widespread stands, mingling with other tree species.

The zone also has numerous areas devoted to crop raising of different types, though all of them being on a small scale, in other words, subsistence crops. Farmers there raise cassava, ***Manihot esculenta***; *guandul*, ***Cajanus cajan***; plantain, ***Musa paradisiaca***; the guinea banana, ***Musa sapientum***; *yautia*, ***Xanthosoma sp.***, and ***Alocasia sp.***, and sugar cane, ***Saccharum officinarum***, among others.

In the zone studied, 640 species of vascular plants, which were distributed among 110 families and 432 genus types, were catalogued. Of a total number of species present, 56 are endemic to the Hispaniola Island, and 459 are native.

The species found in the area represent 11.4 percent of the total flora of Hispaniola Island. The area maintains a high percentage of its original flora, with the notable presence of endemic species; some of these can be considered rare. Within the endemic types we find: the ***Cynometra americana***, *roblillo* (lesser oak) ***Tabebuia vinosa***; and jacaranda, ***Jacaranda poitaei***. Also found is the ***Tabebuia polyantha***,

a tree valued for its ornamental quality and common to the region, especially in Jarabacoa, Constanza, and La Vega.

Based on the findings obtained in various transects, it can be observed that those areas located along the winding river narrows are the richest in endemic plant species. We consider that the forest areas located around the Arraijanes creek, at the water intake, and the northwest hillside across from the engine house are among the most valuable places to be conserved.

Terrestrial fauna

During the present study carried out in eight (8) points of the project zone, "Camu River Multipurpose Project," La Vega province, a total number of twenty-seven (27) amphibian and reptile species were found, equivalent to 12.80% of the total of two-hundred-eleven (211) known on Hispaniola Island, as per Powell et al, 1999 (in Conservation, Consulting, and Planned Management of Animals of the Dominican Republic, 2000).

The amphibians observed in the area amounted to twelve (12) species, which represented 18.46% of the total of sixty-five (65) reported for the island. These were represented by one (1) order, four (4) families, and five (5) genus types.

In the case of reptiles, fifteen (15) species were found, these equal to 10.27% for a total of one hundred and forty-six (146) that are known on Hispaniola Island. These were represented by one (1) order, two (2) suborders, five (5) families, and six (6) genus types.

The endemic nature of the amphibians observed in the area was quite high, given that out of a total of twelve (12), ten (10) turned out to be endemic to the island and only two (2) had been introduced. With respect to the reptiles, this number was also high due to the fact that out of a total of fifteen (15) species, two (2) were considered native and three (3) were of non-specified status; the rest had originated on Hispaniola Island.

All of the reptile and amphibian species that were found in the study area are widely distributed on Hispaniola Island, with the exception of two (2) frog species, which are found to be restricted to specific zones in the Dominican Republic as well as in Haiti.

Of the forty-six (46) bird species identified in the area, eight (8) turned out to be endemic, among these the parrot (***Amazona ventralis***), bobo bird (***Saurothera longirostris***), the *Barrancoli* (***Todus subulatus***), and the mountain woodpecker (***Nesoctites micromegas***). These among others were observed in the wooded areas upon which they depend; thus, the forest remnants that still remain in the area have to be preserved.
With respect to mammals, during the environmental impact study carried out in eight (8) points of the area comprised by the "Camu River Multipurpose Project," La Vega

province, eight (8) introduced species were found, which represented 24.24% for a total of thirty-three (33) detected on Hispaniola Island SEA/DVS (1990b). These were comprised of four (4) orders, five (5) families, and six (6) genus types.

All of the mammal species that were observed in the study area have been introduced to Hispaniola Island and have managed to become established throughout the entire national territory; in general, these occasion damage to both the endemic and native fauna. Said damage is principally related with depredation and competition with wild species (SEA/DVS, 1990b).

Aquatic Biology and Water Quality

Commercial fishing is an activity of relatively little importance in the region; only a few people are even sporadically involved in crayfishing and freshwater shrimping. However, this resource has been affected in the zone by the use of pesticides and agrochemicals to raise grasses for pasture grazing, as well as by the untreated sewage outfall, chemicals, and medical residues and wastes --- all discharged into the river from the poultry, cattle, and hog farms of the middle basin area being evaluated here.

Other species such as mullets and eels, which spawn in ocean waters and then migrate to complete their life cycle in mountain rivers, such as the Camu, have not been reported for the zone. This disappearance seems to be due to the fact that they have been affected by the contamination and sedimentation levels produced by the livestock raising activities that are present, as well as by the urban wastes that the river receives along its path through the La Vega Valley. The species that have been introduced into the country's reservoirs, such as the *tilapia,* and various carp, prefer the lake environment to the torrential rapids and relatively shallow conditions of middle basin rivers such as the Camu or the Guaigüi creek. As far as is known, no programs have been carried out to repopulate the waters with trout or other swift-current swimming fish types in the middle Camu basin area. The species that are found there correspond to native insectivore or omnivorous types (family Poecilidae), which are small and have no commercial value.

The calcium carbonate ion conditions (hardness and alkalinity) are kept in proportion and increase with the flux of runoff. The alkalinity levels found are classified biologically as hard water (>40 mg/l, Boyd, 1987). The values obtained for total hardness for the purpose of sanitary engineering would be classified as hard (>75 mg/l, Sawyer & McCarty, 1976, in Boyd, 1987). It is important to note that the carbonate hardness is equal to the total water hardness and, as such, this type of water has a hardness quotient, which does not fall upon being heated to boiling temperature.

Dissolved oxygen is correlated to productivity and biological activity in water. As far as noting the presence of aerated nutrients in the waters analyzed, all the samples

taken denote no anaerobic loads that would affect this parameter; in all cases, a saturation level of above 80% is found, which is considered biologically acceptable.

With respect to microbiological analysis, it can be ascertained that bacterial contamination is present in quantities higher to what normally appear in Dominican rivers (>15000 NMP/100ml), (A. Espinosa, com. Pers., 2002, Instituto de Microbiología y Parasicología de la Facultad de Ciencias, Universidad Autonomía de Santo Domingo). The specific contamination sources themselves were not determined during this study; however, it is suspected that they could have proceeded from the same basin due to livestock raising activities, or to the common practice of using the river to dump unsanitary waste.

It may be concluded that upon detecting the presence of *Streptococcus faecalis*, the contamination is of either human or animal origin. The list of microbiological species (bacterial) present corresponds to those recognized as pathogenic and that are added to existing level of microbial contamination already present in the natural diversity of the waters. The list of microbiological species also indicates that there are no clear differences between the seasons, since *Streptococcus faecalis* appears at all times of the year in roughly the same proportions.

Based on the analysis of the data gathered, it can be confirmed that the parameters do not present marked variations; in other words, the nature of the waters of the Camu River and of the creeks is quite homogenous. The majority of the sampled parameters are within environmental norms for shallow waters; that is, they are appropriate for use in productive and recreational activities (Class A) Norm AG-CC-01.

Socioeconomics of La Vega

Population density levels for the entire province reached 150.7 persons per square Km according to the 1993 survey; however, the Municipality of Concepción de La Vega presents a density level of 328.0 persons per square Km, followed by the Municipality of Jima Abajo, with 222.8 persons per square Km; the rest of the municipalities have a density level of fewer than 100 persons per square Km.

As to the distribution per gender, the population is composed of 169,280 men and 175,441 women, for a percentage distribution of 49% and 51% respectively. Likewise, 38% of the La Vega population in 1993 resided in the urban area, that is, 130,247 persons, with 62.2% in the rural zones. At the moment there is no real quantification of the levels of country to city migrations, but it is estimated that in recent years the rate of moves from rural areas has increased.

The La Vega population is considered relatively young since more than 50% is found in the 15-to-64-age group. In 1981, 42% of the population was comprised of the group ranging from 0 to 14 years, with 54% in the group of those from 15 to 64 years old, and only 4% being 65 years or older. In 1993 the situation changed slightly as

the population group of those from 0 to 14 years rose to 36% of the total population, and those from 15 to 64 years had increased to 59% of the population, with 5% of the people being older than 65 years.

Potable water

Of a total number of people residing in private homes in the province, 53% are supplied by water from the aqueduct; 24% get water service in their homes, and 9% must obtain water from public faucets. The rest, 46%, are supplied from some another source.

This situation is evidence of the fact that half of the province's population has no access to water supply, which denotes the seriousness of the problem, taking into account that said water supply is essential to maintaining good sanitary conditions.

Health

The most frequently reported illnesses are acute respiratory infections, amounting to 44% of all medical visits, and acute cases of diarrhea, accounting for 38% of all medical visits.

Services

80.9% of the houses have electrical energy; 91.7% has sanitation services, and 6% has no sewage lines for disposal of bodily wastes, 92% of the rural population receives the services provided, and 7.8% do not have them.

Productivity

Arable land covers more than 205,000 hectares, of which 81% is actually farmed on average. Of said area, 100,000 hectares are planted with grasses for animal grazing and feed. Twenty-five percent of the rice and 30% of the plantains consumed in the country are produced in the area of influence of the Camu River basin, representing 28,125 hectares each.

Coffee and cacao cover an area of 24,414 hectares. Livestock production amounts to 160,000 heads of cattle, 70,000 pigs, 400,000 chickens and other poultry, and 14,000 horses. In 1998 the province had 2,732 pig farmers with 74,859 animals, of which 15,435 were destined for slaughter and 59,424 to be fattened.

Socioeconomics-Camu River Lower Basin

Key places in the "lower" Guarey Quarter include: Camu-Guaigui, El Anon, Arroyo Ancho, and Guanabanos, all of which are zones included in this socioeconomic study, as they are within the area of influence of the Guaigüi dam construction. According to data that were taken from the "Focus Study on Poverty in the

Dominican Republic" of 1997 (Estudio de la Focalización de la Pobreza en la Republica Dominicana 1997), these communities have a total of 1,181 inhabitants.

80.8% is constituted by private dwellings, that is, 107 homes. 45.1% of the inhabitants have been living in these homes for more than 16 years. 95% have no electrical appliances; 25% use hearths and 34.4% with use of either hearths or wood stoves for cooking. Men are head of household, and their ages range from 40-65 years; 90% of them were born in the Guaigüi area and continue to reside in the same place.

Utility services received by inhabitants are nonexistent or very limited. For example, only 0.5% has electric light, which is produced from generators, and 95% receive no electrical service whatsoever. According to the workshop results, 70% get water from the aqueduct, which was brought into being through the efforts of INDRHI and the local community; nevertheless, this community lacks water treatment facilities. 95% have no phone service, no mail delivery, or other postal services, and no access to newspapers or radios, with the exception of a very few cases, amounting to 3% of those surveyed, who said that they have cellular phones and portable radios.

With respect to garbage disposal, 80% burn their trash, and 15% dump it into ravines and ditches, and also utilize it as fertilizer in the fields. 73 dwellings have private toilets, with the rest of the inhabitants having to share public latrines.

Socioeconomics of the Dam and Reservoir Site

Within the area of influence of the Guaigüi dam construction, over 96 families in an equal number of dwellings are found, all of whom would have to be relocated, as the reservoir lake would affect them. In addition to these affected families, there are 8 more cases of multi-family occupied homes, thus the total number of families is 106. The Anon site, part of Buena Vista in the Municipality of Jarabacoa, records a total of 10 families for relocation, and in the Alto del Higo Community, 5 more homes would be impacted by the construction of access roads to the dam. With respect to the properties identified, we find that 81% of the population lives in their own homes.

75.26% of those asked said they were landowners, albeit of small land parcels, while 30.74% claimed to own no land.

Of the total number of inhabitants affected by the dam construction, 60% based their survival on farming, 2.5% work in *motoconcho*, and 7.9 are laborers. 2.5% work in business; no information was obtained from 27.5%.

Hierarchy of the Most Significant Environmental Effects and Resources that Will Be Affected by or Utilized for the Project

Below are the most significant positive and negative effects that potentially are expected during the construction and operation phases. They are classified according to their nature, magnitude, duration, reversibility, and type, and the possibility of introducing corrective and mitigation measures.

POTENTIAL IMPACT DURING THE CONSTRUCTION PHASE

Potentially Positive Impact

- Creation of 300 jobs directly related to the project, and 75 others that are indirectly related to the project, during the construction phase of the work;
- Emergence of new businesses and economic activities.

Potentially Negative Impact

PHYSICAL ENVIRONMENT

- ***Soil loss during the following activities:***
  - Preparatory activities, access to sites for testing and to the reservoir area;
  - Construction of camping sites, project offices, laboratory, and others;
  - Construction of access roads, new roads and improvements to existing ones, quarry areas, river and dam site crossings;
  - Construction of derivation, access, spillway, and sluice structures,
  - Rockfill dam construction and reservoir fill;
  - Construction of power house, electrical and mechanical installations, and transmission line;
  - Excavation of soft earth, quarrying.
- ***Damages or changes (climatic aspects, water quality, soil) due to removal of vegetation during the following activities:***
  - Preparatory activities, access to sites for testing and to the reservoir area;
- ***Problems of erosion and sedimentation during the following activities:***
  - Preparatory activities, access to sites for testing and to the reservoir area;
  - Construction of access roads, new roads and improvements to existing ones, quarry areas, river and dam site crossings;
- ***Increase in turbidity of the Camu river and its affluents, and reduction of DO and increase of DBO during the following activities:***
  - Preparatory activities, access to sites for testing and to the reservoir area;
  - Construction of camping sites, project offices, laboratory, and others;
  - Construction of access roads, new roads and improvements to existing ones, quarry areas, river and dam site crossings;

- Construction of derivation, access, spillway, and sluice structures;
- Rockfill dam construction and reservoir fill;
- Construction of power house, electrical and mechanical installations, and transmission line;
- Excavation of soft earth, quarrying.

➢ ***Damages or changes in water quality and soil) due to discharge of residual waters during the following activities:***
- Construction of camping sites, project offices, laboratory, and others;

➢ ***Damage or changes in quality of soil due to discharge of solid waste (garbage and vegetation) during the following activities:***
- Construction of camping sites, project offices, laboratory, and others;

➢ ***Damage or changes in water, air, and soil quality due to handling of toxic and/or hazardous residues during the following activities:***
- Construction of camping sites, project offices, laboratory, and others;
- Preparatory activities, access to sites for testing and to the reservoir area;
- Excavation of soft earth, quarrying.

➢ ***Noise increase during the following activities:***
- Preparatory activities, access to sites for testing and to the reservoir area;
- Construction of camping sites, project offices, laboratory, and others;
- Construction of access roads, new roads and improvements to existing ones, quarry areas, river and dam site crossings;
- Construction of derivation, access, spillway, and sluice structures;
- Rockfill dam construction and reservoir fill;
- Construction of power house, electrical and mechanical installations, and transmission line;
- Excavation of soft earth, quarrying.

BIOLOGICAL ENVIRONMENT

➢ ***Elimination of Flora and Fauna During the Following Activities:***
- Preparatory activities, access to sites for testing and to the reservoir area;
- Construction of camping sites, project offices, laboratory, and others;
- Construction of access roads, new roads and improvements to existing ones, quarry areas, river and dam site crossings;
- Construction of derivation, access, spillway, and sluice structures,
- Construction in the dike and reservoir area of 2.5 km^2.
- Construction of power house, electrical and mechanical installations, and transmission line;
- Excavation of soft earth, quarrying.

➢ ***Loss of fruit trees and hardwood trees within the 2.5 km^2 dam/reservoir area during the following activities:***
- Final stage preparatory activities, reservoir area;