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| <b>ENVIRONMENTAL IMPACT STUDY</b>   |   |                            |            |

### 3 CHARACTERIZATION

#### 3.1 STUDY AND INFLUENCE AREA

The San Matias Hydroelectric Project is located in the lower basin of San Matias River, which serves as a boundary between the municipalities of Cocorná and Granada, both belonging to the Eastern Sub region of the department of Antioquia. In accordance with the established division by the (Corporacion Autónoma Regional) in the basin of the Valleys of Rionegro and Nare -CORNARE, the first municipality is located in the area of forests and the second one in the water reservoirs.



**Photo 3-1 Panoramic view of the urban area of Cocorná from Vereda, San Juan**

Source: <http://www.tareanet.edu.co>

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**Photo 3-2 Overview of the main village of Granada.**

Source: [Www.granada-antioquia.blogspot.com](http://www.granada-antioquia.blogspot.com)

The Forest Area, besides Cocorná, is formed by the municipalities of San Luis and San Francisco, which is characterized by its richness in natural resources, whose main economic activities are agriculture, timber extraction, and the informal trade around the road axis of Medellin - Bogota. Highway.

The Water Area or Reservoirs, which Granada belongs to, also includes the municipalities of El Penol, Guatapé, San Carlos, San Rafael, Concepcion and Alejandria. This sub region is characterized by the great changes that were generated by the construction of hydroelectric projects on the East, that in the shaping of their dams, flooded suitable agricultural land, reduced agricultural activity peasant smallholding type, altered the socioeconomic relations of the communities and to a large extent, turned tourism in the main activity, although with withdrawal in the last few decades due to the armed conflict<sup>1</sup>.

### **3.1.1 Direct Influence Area (DIA)**

In accordance with the defined Terms of Reference of the Ministry of Environment, Housing and Territorial Development, for Studies of Environmental Impact, Energy Sector, Construction and operation of generating hydroelectric plants HE-TER-1-01, " *The direct project influence area, is the one where occurs the environmental impacts generated by the construction and operation activities; it is related to the project site and its associated infrastructure.*"

<sup>1</sup> Government of Antioquia. Strategic Plan of the Department of Antioquia PLANS TO. Profile of the sub regional east of Antioquia.

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For the Biotic and Physical Environment, the direct influence area is composed by areas to be occupied by the project facilities: power house, workshops, industrial squares plazas, access roads, parking area. The area occupied by the facilities is 8.42 ha.

In addition, it includes those areas adjacent to the San Matias River, between the power house of the El Molino Hydroelectric Project and the discharge of the San Matias hydroelectric project, where it will be reduction of flows associated with the latest project.

The Direct Influence Area of the Socioeconomic Environment, covers the municipal territories affected by the project facilities and the San Matias River flow reduction, comprising the following Veredas : Las Faldas and La Arenosa of the municipality of Granada, affected by the flow reduction of the San Matias River; and Los Mangos, La Inmaculada and San Lorenzo, affected by the facilities and the flow rate reduction. (See Cartography 2148-12-EV-DW-017).

### 3.2 ABIOTIC ENVIRONMENT

#### 3.2.1 Atmosphere

##### 3.2.1.1 Air Quality

To determine the air quality in the influence area of the San Matias hydroelectric project, were taken the results of the Air Quality Monitoring made for the base line of El Molino hydroelectric project, and two monitoring points carried out for the El Popal hydroelectric project, required in the environmental license before starting the construction, since the analysis points set forth in these studies are consistent with the influence area of the San Matias hydroelectric project.

The studies on the air quality of the hydroelectric projects El Molino and El Popal were carried out from September 26 to October 14, 2011, and April 30 to May 18 of 2011, respectively, using sampling and calculating methods recommended by the Environmental Protection Agency (US EPA) of the United States of America and endorsed by Colombian law. What follows is a comparison of the measurements results, with the current standard for air quality, Resolution 610 of March 24, 2010 from MAVDT. Annex 6 presents the full studies report of air quality made by: K2 Engineering and Environmental Monitoring High Technology Ltd. - MAHT, firms.

For the air quality study of the El Molino Hydroelectric Project were placed four monitoring stations located in the Veredas, Los Mangos, Campo Alegre, Las Playas and El Molino, and for the study of the El Popal hydroelectric project also monitored four stations, although out of the eight, there are only used the ones located in the Veredas, La Inmaculada and Los Mangos (see Table 3-1).

**Table 3-1 Air quality sampling stations**

| Sampling Station  | Description |  |
|---|-------------|--|
| <b>Station 01 - Vereda, Los Mangos<br/>(K2 engineering)</b> | Coordinates | N 06 ° 02 '49.6 "<br>W 75 ° 07 '54.1 " |
|   | Altitude    | 998 Meters a.s.l.                      |
|   | Equipments  | Hi-Vol HRV PM10, RAC, NDIR.            |

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| Sampling Station   | Description   |   |
|--|---|---|
|  | Description of the environment and the emission sources | Station located in rural areas, where vegetation predominates, located on the slopes of the river and in the vicinity of houses where it is cook with wood and close to a "trapiche", where artisanal panela is elaborated. |
| <b>Station 01 - Sector power house ( Playa Loca, Vereda, La Inmaculada) (MATH)</b> | Coordinates   | E 1159679<br>N 884809   |
|  | Description   | Presents a rough ground with abundant vegetation, also presented some rains, in the station were identified sources associated with the burning of wood of neighboring houses. The site presents high levels of moisture    |
| <b>Station 02 - Vereda, La Inmaculada (MATH)</b>                                   | Coordinates   | E 884227<br>N 1159544   |
|  | Description of the environment and the emission sources | Presents a mountainous area surrounded by sugar cane cultivation. Emission sources are associated with wood burning in the neighboring homes, and the operation of a trapiche.  |

The results obtained were compared with the maximum allowable levels for contaminants, criteria established in Article 4 of Resolution 610 of 2010 (see Table 3-2).

Based on the results obtained, it can be concluded that the influence area of the San Matias hydroelectric project, complies with the legislation requirements for the parameters PST, PM 10, SO<sub>2</sub>, NO<sub>2</sub> and CO, and therefore do not represent any problem for people health.

Below is a summary of the sampling main results, which full reports are presented in Annex 6.

- **PST y PM<sub>10</sub>: Total suspended particles and particular matter less than 10 micron**

During the monitoring days were no concentration values of PST exceeding 300 µg/m<sup>3</sup> in 24 hours, nor for PM 10 higher than the maximum limit of 100 µg/m<sup>3</sup> in 24 hours, given by Resolution 610 of 2010 from MAVDT.

**Table 3-2 Maximum permissible levels for criteria pollutants**

| Pollutant              | Maximum allowable level ( µg/m <sup>3</sup> ) | Exposure Time |
|------------------------|---|---------------|
| <b>PST</b>             | 100   | Annual        |
|                        | 300   | 24 Hours      |
| <b>PM<sub>10</sub></b> | 50  | Annual        |
|                        | 100   | 24 Hours      |
| <b>2.5</b>             | 25  | Annual        |
|                        | 50  | 24 Hours      |
| <b>SO<sub>2</sub></b>  | 80  | Annual        |
|                        | 250   | 24 Hours      |

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| Pollutant             | Maximum allowable level ( $\mu\text{g}/\text{m}^3$ ) | Exposure Time |
|-----------------------|--|---------------|
|                       | 750  | 3 Hours       |
| <b>NO<sub>2</sub></b> | 100  | Annual        |
|                       | 150  | 24 Hours      |
|                       | 200  | 1 Hour        |
|                       | 80   | 8 Hours       |
| <b>O<sub>3</sub></b>  | 120  | 1 Hour        |
|                       | 10,000   | 8 Hours       |
| <b>CO</b>             | 40,000   | 1 Hour        |

The maximum value of PM 10 at the station of Vereda, Los Mangos was of  $20.8 \mu\text{g}/\text{m}^3$ , which represents 20.98 % of the daily norm value. For the values of PST, the maximum was  $46.4 \mu\text{g}/\text{m}^3$  and  $23.8 \mu\text{g}/\text{m}^3$ , which represent 15.4 per cent and 7.9 per cent of the daily standard value.

In general, in the stations, were identified as sources of emission, the rural anthropogenic activities, given that it is common in the area the cooking with firewood, the transit of cargo animals, farming and production of artisanal panela.

- **SO<sub>2</sub> Sulphur dioxide**

The station located on the Vereda, Los Mangos does not report a greater value than the detection limit of the method<sup>2</sup>. For stations located in Vereda, La Inmaculada, average concentrations of  $16.1 \mu\text{g}/\text{m}^3$  and  $16.4 \mu\text{g}/\text{m}^3$ , which are equivalent to 6.5 % and 6.6 % of the daily norm.

- **NO<sub>2</sub> Nitrogen dioxide**

For the station Los Mangos, only two records were obtained above the detectable value from the computer ( $8.26 \mu\text{g}/\text{m}^3$  and  $16.07 \mu\text{g}/\text{m}^3$  October 2 and 4, respectively), which represents 5.5 per cent and 10.7 per cent compared with the daily value norm.

For stations located in the Vereda, La Inmaculada are present concentrations that vary between  $5.5 \mu\text{g}/\text{m}^3$  and  $6.7 \mu\text{g}/\text{m}^3$ , which accounts between 3.7 % and 4.5 % of the standard daily value

- **CO Carbon Monoxide**

The only station with detectable concentrations of carbon monoxide (CO) was the one located at the Vereda, Los Mangos, where the average daily value was  $110.33 \mu\text{g}/\text{m}^3$ , which represent less than 0.5 % of the standard daily value

### 3.2.1.2 Noise

For this paragraph, as well as for the characterization of air quality, for noise monitoring made by the firm K2 Engineering and Environmental Monitoring High Technology Ltd. - MATH-, in the influence area of El Molino and El Popal hydroelectric projects, whose results are presented in Annex 7.

<sup>2</sup> The method used to assess the OS 2, have as minimum detectable value  $0.77 \mu\text{g}/10 \text{ ml}$  of solution  
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The study of environmental noise was held in the same places where we assessed the air quality. The monitoring carried out by K2 was developed on September 29 (regular day) and October 9 of 2011 (holiday), the MATH was executed between 18 and 19 May 2011.

In accordance with the provisions of Resolution 627 of 2006, the project influence area is classified as Sector D: Suburban, or rural area of tranquility and moderate noise, where there are inhabited sub-rural areas, intended for farming.

Table 3-3 Shows the predominant generating sources of noise in each monitoring point, in addition to allowable levels according to the current environmental regulations for the sector and subsector in diurnal and nighttime hours.

All measurements were taken in three thirds of octaves for 15 minutes each, with frequency weightings A and temporary weightings F (Fast). With respect to adjustments, the measurements were corrected by tone (KT) and pulse (KL) adjustments were made in 3 to 6 dB in the various measurements.

**Table 3-3 Sources Identification and permissible levels**

| Measuring point                      | Daytime limit | Night limit | Dominant sources identified   |
|--------------------------------------|---------------|-------------|---|
| Station 01 - Vereda, Los Mangos (K2) | 55            | 45          | Noise of wild and domestic animals, noise on pastoral activities, music in neighboring houses, noise from the flow of the San Matias River. |
| PM7 - Vereda, La Inmaculada (MATH)   | 55            | 45          | Sound of Animals day and night and sound of the Cocorná River . 15 Meters to the east   |
| PM8 - Vereda, La Inmaculada (MATH)   | 55            | 45          | Sound of Animals day and night and sound of the Cocorná River . TO 250 m to the east of the point 7   |
| PM9 - Vereda, La Inmaculada (MATH)   | 55            | 45          | Sound of Animals day and night and sound of the Cocorná River . TO 200 m to the east of the point 8   |
| PM10 - Vereda, La Inmaculada (MATH)  | 55            | 45          | Sound of Animals day and night and sound of the Cocorná River . Playa Loca  |
| PM11 - Vereda, La Inmaculada (MATH)  | 55            | 45          | Sound of Animals day and night and sound of the Cocorná River . TO 200 m south of Playa Loca  |
| PM12 - Vereda, La Inmaculada (MATH)  | 55            | 45          | Sound of Animals day and night and sound of the Cocorná River . TO 230 m to the south of the point 11 school Vencedores de Vargas           |

The results were not corrected for low frequencies (facilities of ventilation and air conditioning) due to the nature of the sources identified, and they were not corrected by schedule, since the calculated value of the Leq was conducted for daytime and nighttime independently and not as a single value of Leq for day and night.

The values reached in these stations are:

- For the Vereda, Los Mangos, the average values in daytime were 88.53 dBA in holiday and 63.82 dBA in ordinary day. For the nocturnal hours was 55.8 dBA in holyday 60.56 dBA in ordinary day.
- For the Vereda, La Inmaculada, in the six sampled points, the values ranged between 57.1 and 69.9 dBA dba.

It can be concluded, in accordance with the results presented in the previous vignettes, in the influence area of the San Matias hydroelectric project, the sound pressure is always above the established in Decree 627 of 2006, whose origin is the noise of wild creatures, insects,

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and the flows of San Matias and Cocorná rivers. This is evidenced by the values obtained in the station of Vereda, Los Mangos, where there are no roads, and ancient paths should be used for its access.

### 3.3 SOCIOECONOMIC ENVIRONMENT

#### 3.3.1 Demographic Dimension

##### 3.3.1.1 Direct influence area

- **Characterization of population groups:**

The Vereda, that are included in the direct influence area of San Matias hydroelectric project are: the municipality of Cocorná, Los Mangos, La Inmaculada and San Lorenzo. The municipality of Granada, Las Faldas and La Arenosa.

- **Population dynamics:**

Although the data presented below correspond to the year 2006 and are based on the 2005 general census DANE (see Table 3-103), its important to take into account the characteristics of the armed conflict in the area, which generated forced displacement and the depopulation or abandonment of some houses from the Vereda, of its inhabitants.

**Table 3-1 Territorial units affected by the San Matias Hydroelectric Project in the municipalities of Cocorná and Granada**

| Municipal<br>ity | Veredas       | Km <sup>2</sup> | Populatio<br>n | Hab/km <sup>2</sup> | NBI        |            | N°. housing | With aqueduct | With sewerage |
|------------------|---------------|-----------------|----------------|---------------------|------------|------------|-------------|---------------|---------------|
|                  |               |                 |                |                     | In Poverty | In Misery  |             |               |               |
| Cocorná          | La Inmaculada | 1.83            | 26             | 14.75               | 27         | 2          | 6           | 0             | 0             |
|                  | San Lorenzo   | 10.31           | 488            | 45.78               | 445        | 166        | 96          | 47            | 11            |
|                  | Los Mangos    | 2.93            | 65             | 22.18               | 65         | 47         | 18          | 0             | 0             |
| <b>Sub Total</b> | <b>3</b>      | <b>15.07</b>    | <b>564</b>     | <b>----</b>         | <b>537</b> | <b>215</b> | <b>120</b>  | <b>47</b>     | <b>11</b>     |
| Granada          | Las Faldas    | 2.95            | 94             | 31.86               | 94         | 25         | 21          | 0             | 0             |
|                  | La Arenosa    | 2.75            | 44             | 16                  | 44         | 32         | 9           | 0             | 0             |
| <b>Sub total</b> | <b>2</b>      | <b>5.7</b>      | <b>138</b>     | <b>---</b>          | <b>138</b> | <b>57</b>  | <b>30</b>   | <b>0</b>      | <b>0</b>      |
| <b>Total</b>     | <b>5</b>      | <b>20.77</b>    | <b>702</b>     | <b>---</b>          | <b>675</b> | <b>272</b> | <b>150</b>  | <b>47</b>     | <b>11</b>     |

Source: Government of Antioquia Department administrative planning. 2007. Vereda, Atlas Department of Antioquia. Second edition

In accordance with the data presented in total five Veredas will be affected by the San Matias hydroelectric project; similarly, the total population which is of 702 people, out of what 564 are in the municipality of Cocorná, which accounted for 3.73 % of the total population of the municipality, which are 15,119 persons. For its part, in the municipality of Granada there are 138 people, which correspond to a 1.40 % of the total population of the municipality (9,789). As can be seen in the table above, almost 100% of the population of the Vereda, is located in a state of poverty, which reflects very difficult living conditions. Of the 150 homes, only 47 have aqueduct and only 11 sewer systems. This percentage represents 31.3 per cent and 7.33 per cent.

- **Age/gender composition**

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Tables 3-104 and Table 3-105 show the main features of the population from the Vereda, of the direct influence area, in terms of the composition by age and gender.

**Table 3-104 Composition by age and gender for Vereda, municipality of Cocorná influence area in the year 2007**

| Zonal Center | Vereda,       | Population 2007 | Distribution by gender |           |       |
|--------------|---------------|-----------------|------------------------|-----------|-------|
|              |               |                 | N°. Men                | N°. Women | Total |
| El Jordán    | La Inmaculada | Number          | 13                     | 13        | 26    |
|              |               | %               | 50                     | 50        | 100   |
| La Piñuela   | San Lorenzo   | Number          | 248                    | 240       | 488   |
|              |               | %               | 50.82                  | 49.18     | 100   |
| El Molino    | Los Mangos    |                 | 39                     | 34        | 73    |
|              |               |                 | 53.42 %                | 46.57%    | 100%  |

Source: Our Municipality. General Information. Territories-Vereda, Los Mangos. Available in <http://cocorna-antioquia.gov.co/municipioinforma.shtml?apc=mtVereda-1-&x=1490543>. Consulted on 2 November 2011

**Table 3-105 Composition by age and gender for Vereda, of the influence area of the municipality Granada, in year 2007**

| Vereda     | Population 2007 | Distribution by age ranges |        |       |       |       |       | Distribution by gender |           |       |
|------------|-----------------|----------------------------|--------|-------|-------|-------|-------|------------------------|-----------|-------|
|            |                 | < 1 Year                   | 1-4    | 5-14  | 15-44 | 45-59 | > 60  | N°. Men                | N°. Women | Total |
|            |                 | Las Faldas                 | Number | 0     | 8     | 20    | 38    |                        |           |       |
|            | %               | 0                          | 8.69   | 21.73 | 41.30 | 17.39 | 10.86 | 48.91%                 | 51.08%    | 100%  |
| La Arenosa | Number          | ND                         | ND     | ND    | ND    | ND    | ND    | 22                     | 22        | 44    |
|            | %               |                            |        |       |       |       |       | 50                     | 50        | 100   |

Source: Database of Sisben municipality of Granada

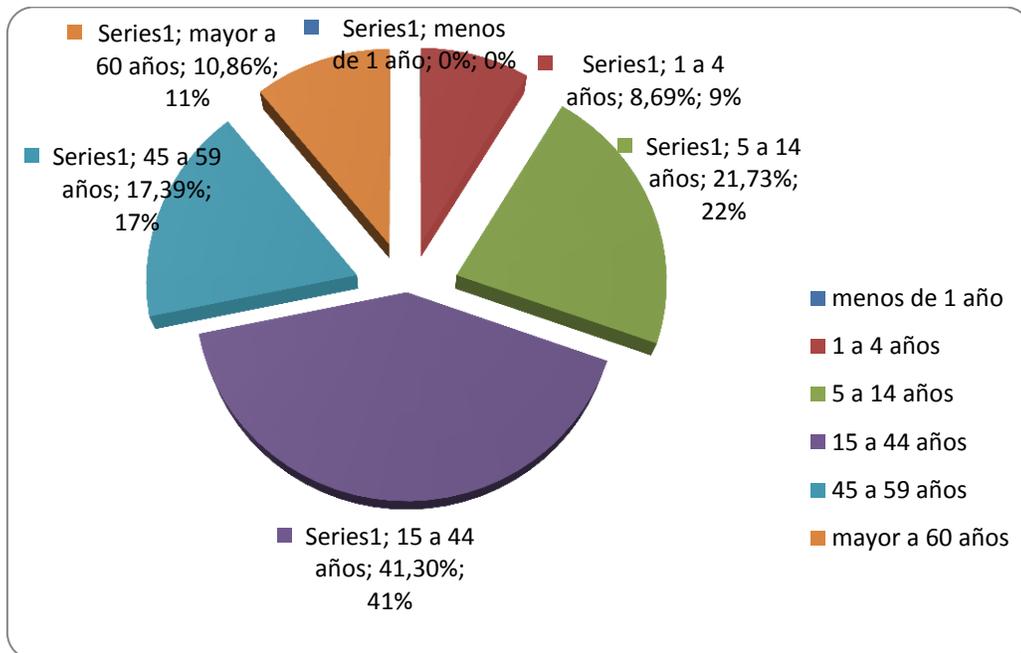
In accordance with the data presented in table 3-104, is comparable the population of men and women, because respectively each segment of the population by gender represents 50 %, which differs from the situation of the municipality, where the number is higher for women than for men. In accordance with data reported by the Atlas Veredal, of the Department of Antioquia, 2006, in the Vereda, there are two children between 0-5 years. According to information gathered during the field work conducted in the month of December 2011, out of the total of the current population, approximately 52 people, there are 18 children from 0 to 14 years and 8 teenagers 14 to 20 years.

According to the data expressed in table 3-104, in Vereda San Lorenzo there are more men than women, coinciding with the situation of the Municipality, In regard to age groups, in the Veredal Atlas of the Department of Antioquia, 2006, 38 children are reported between the 0-5 years.

On the Vereda, Los Mangos, the behavior repeats itself in front of the rest of the Veredas, in the municipality of Cocorná, in terms of the composition by gender, likewise replicates the

pattern in relation to the total population of the municipality, where the number is higher for women than for men (see Table 3-104). With regard to the age groups in accordance with the data of the Veredal Atlas of the Department of Antioquia, 2006, in Los Mangos there are 9 children between 0-5 years, and according to the information collected during the field work conducted in the month of December of 2011, there are approximately 8 children from 0 to 12 years; 3 teenagers from 14 to 18; 62 adults and 3 people over 60 years.

According to Vereda, Las Faldas there are a greater number of women than men, contrary to the pattern shown on the Veredas already mentioned of the municipality of Cocorná. In regard to the age composition, the group of 15-44 years is the one which evidences a greater number with 38 people, and the minor, the group of the ones between 1-4 years with 8 children.



**Figure 3-88 Age Composition in %, on the Vereda, Las Faldas of the municipality of Granada.**

Source: Home processing, social team SAG, based on the data base of Sisben municipality of Granada.

In accordance with the data presented, in the Vereda, la Arenosa of the municipality of Granada the number of men and women is comparable. No data were collected on age groups, however, in the Veredal Atlas of the Department of Antioquia, 2006, on the Vereda there are 3 children between 0-5 years.

In accordance with the existing figures of the municipality of Granada, including the Vereda, Las Faldas, age groups with the largest populations are those that range between 5 to 14 years and 15 to 44 years; this means that the working-age population and the children are significant groups, same as the group over 60 years old.

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This fact speaks of aspects such as the need to attend a child population in services such as education, health, nutrition and everything that involves a proper growth and development. The adult population originates demands at social assistance level, an important concern for the authorities and financial planners of the state. This in direct relation to the demand for goods and services on the part of this population. In regard to the people of working age, impose the need of thinking in addition to other issues in the supply of labor offer in this group.



**Photo 3-56 Housing at the edge of the road on the Vereda, Las Faldas**

Source: field work conducted in the month of February 2012

### **3.3.2 Spatial Dimension**

#### **3.3.2.1 Direct area of influence**

The information presented in this numeral is excerpted from the Vereda, elaborated for the study, and presented in Annex 10

- **Granada**
- **La Arenosa**

The road that leads from the center of Granada to La Arenosa through Galilea is in a critical condition; in fact, in rainy times it is impossible to be transited. Before the conflict a road was being built, but with the escalation of the conflict, this work was interrupted. The walking time is of 1½ hours for people who take this trail. There are also two roads, leading to the points La Mañosa and El Tablazo, but these are also found in a critical state of disrepair. As it can be seen the mobility of the inhabitants of La Arenosa is one of the most obvious problem of the Vereda.

There is a school that offers the grades from 1° to 5° of primary, being in charge of it a professor, where seven children are attended. In the school there is a sport plate that is also found in poor condition.

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In case of health care need, they must to go to the Health Center of the Santa Ana district; there is a permanent nurse; but to go up to Santa Ana, people must walk for two hours. So when the symptoms are severe, they go to the Hospital of the municipality of Granada. The inhabitants of La Arenosa are affiliated to the subsidized health regime in levels 1 and 2.

Currently collect the water directly from the springs using a hose. Previously there were three places where the water could be taken, but at the time two of them are abandoned and the other continues to provide the service to the school.

The wastewater is disposed in open field through pipes and there are no septic tanks. The garbage is thrown into a place that is known as "organetera" or open gaps in the glens.

In several homes there is no energy service, because the transformer burned out and they decided not to pay anymore; in the rest of the area they have the service, but it is deficient.

### 3.3.3 Economic Dimension

#### 3.3.3.1 Direct influence area

The Veredas, of the direct influence area are: San Lorenzo, La Inmaculada and Los Mangos of the municipality of Cocorná; Las Faldas and La Arenosa of the municipality of Granada.

- **Property Structure**

In this item it will be presented the data for Veredas, in accordance with the information gathered during the field work conducted in December 2011. It is important to highlight the local history of forced displacement, which has influenced the structure of property. At present, in large part of the Veredas, are abandoned farms in poor condition and in other cases, the site of settlement housing is fully invaded by vegetation; while, by the Program Return, jointly developed by Social Action of the Presidency of the Republic and the municipal administrations, good part of the population has returned, several families have expressed their intention to not return because they have established and developed economic activities of their own in other parts of the department and of the country.

As it can be seen in the Veredas, of the influence area small property dominates, with farms ranging between half and one hectare, although there are a few cases of land of 20 ha.

**Table 3-121 A form of land possession and ownership structure in the influence area.**

| Vereda, Name               | Data Source | N° of families* | N° of housings* | Form of tenure* |          |       |                   | N°. Sites" | Size Sites" |
|----------------------------|-------------|-----------------|-----------------|-----------------|----------|-------|-------------------|------------|-------------|
|                            |             |                 |                 | Own paying      | Own paid | Lease | Another condition |            |             |
| La Inmaculada <sup>1</sup> | Sisben      | 11              | 10              | SD              | 5        | SD    | 5                 | 13         | 1-5 Has     |
|                            | T. field    | 13              | 13              |                 |          |       |                   |            |             |
| San Lorenzo <sup>2</sup>   | Sisben      | 121             | 118             | 13              | 234      | 34    | 129               | 132        | 1-2 Has     |
|                            | T. field    | 146             | 146             |                 |          |       |                   |            |             |
| Los Mangos                 | Sisben      | 14              | 14              | 5               | 35       | SD    | 8                 | 105        | 1-6 Has.    |
|                            | T. field    | 13              | 13              |                 |          |       |                   |            |             |
| Las Faldas                 | Sisben      |                 |                 | 19              | 59       | 4     | 10                | 90         | ½- 4 has.   |
|                            | T. field    | 30              | 30              |                 |          |       |                   |            |             |

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|            |          |    |    |   |    |   |    |    |          |
|------------|----------|----|----|---|----|---|----|----|----------|
| La Arenosa | Sisben   |    |    | 4 | 22 | 4 | 14 | 15 | 1-4 Has. |
|            | T. field | 16 | 16 |   |    |   |    |    |          |

Source: Own social development team SAG, December 2011

<sup>1</sup>: There is a site of 100 ha

<sup>2</sup>: There are several farms which have between 20 and 30 has

\*Data reported by the database of Sisben of the Municipality of Cocorná

•Data based on field work conducted in the month of December 2011

SD: no data

### • Productive and technological processes

In the Veredas of the influence area, the agricultural activity is the mainstay of the economy, in which protrude the production of sugarcane, bananas, coffee, beans, maize, cassava and citrus fruits. In the Veredas in the municipality of Granada, protrude the tomato and cucumber. As well the cattle rising for milk and meat production, this does not cover local demand and the milk is usually for their own consumption and for the manufacture of cheese and butter, which is marketed inside the Veredas. Similarly, in low proportion, presents the breeding of pigs and chickens.

In almost all cases, the field work is done by their owners as farmers that cultivate their land, in a subsistence type of economy. Therefore, the technology used is in its infancy in most cases; depending on the crop type apply traditional knowledge or techniques that have been implemented with the advice of the UMATA and SENA to the improvement of the cultivation of sugarcane. In almost all the crops agrochemicals are applied, such as Lorban, to counteract the pests and diseases and to increase the performance, although in some cases, due to the cost, these are not available for the farmer.

Within the techniques and technology used for the different crops, processing of sugarcane in the small livestock and energy sources used in the various Veredas, were mentioned by the peasants during the field work conducted in December 2011, the following.

### • Vereda, La Arenosa

Agriculture is the main economic activity of the inhabitants of the Vereda usually around the cultivation of sugar cane and the production of panela. In this work the entire family group including the women, which is her contribution to sustaining the economy of the family even though man is the one who assumes leadership of the household.

The cane is planted at any time of the year, which is cut weekly. The processing of this and the production of panela are done using an electric motor or CMPA, in some cases there are also used hauling beasts; the sugarcane bagasse is also an important fuel in this process; generally the cane is cracked with machete. Used agrochemicals are colloquially known as "weed killers" and some fertilizers to increase crop yields.

In the Vereda, hunting of some animals for personal consumption occasionally occurs, among these: guagua, gurre, and some birds like guacharaca. The weapons and techniques most commonly used are the shotgun, hunting with bait or "primes" and with dogs.

With regard to the structure of production, in sum, a strong support of the economic activity in the Vereda, of the influence area is the agricultural activity and in this the cultivation and processing of the cane for the production of panela. At the same time, other crops such as bananas, beans, coffee, potato, Mora, wild fruit citrus fruits, such as tangerine, guava and to

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a lesser extent other fruit trees as guanabana, Zapote, Borojo and avocado and vegetables such as cucumber and tomato.

In Cocorná, the Vereda, Los Mangos stands out in the production of sugarcane, which has a 9% share. In Granada the Vereda that harvest the most of this crop is La Arenosa with 20% participation. The cultivation of bananas without technification associated with coffee is another item that stands out in some Veredas of the influence area; among these is Las Faldas with a 25% and La Arenosa with a 15% (see Photo 3-72). Los Mangos is also considered a major producer of coffee.

In a widespread manner in these Veredas, of the two municipalities the crops present a low level of technology, which represents high costs and low profitability. Despite this situation, the coffee and bananas have a representative market in the area.

In accordance with the outline and structure of production established in the area, the greater amount of coffee is produced by small independent producers, who generally cultivate in lands of 0.5 ha to 1 ha. And depend on the family labor force, the characteristic of peasant production system.



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**Photo 3-72 Cultivation of sugar cane and bananas in the project influence area**

Source: field work during the month of December 2011

The marketing of these products is usually done in the urban center of Cocorná and Granada, where they are transported to other municipalities in the sub region as El Santuario, Rionegro and Marinill, and to Medellin. This process demands a great deal of effort and costs for the peasants of the Veredas, due to damaged roads, which in turn affect the frequency of the transport service. It is not strange to find that in times of abundant production of citrus fruits, such as mandarin and guava, these fruits are lost because of the difficulties mentioned above, sometimes the peasant collecting orchids prefer not to harvest them, given that the price offered for these does not compensate for the cost of transportation and the production time.



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**Photo 3-73 Marketing of products.**

Source: field work during the month of December 2011



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**Photo 3-74. Guava Trade with the middle man**

Source: field work during the month of December 2011

In a general way, we can say that the articulation levels for the marketing of their products, is low among the peasants of the various Veredas, of the direct project influence area. Because on one hand, the state of the roads and paths, and on the other hand to the existing customs versus the level of family income, where there is not seen the possibility of introducing changes as an opportunity.

- **Private, public or community programs or ongoing planned projects.**

– **Vereda, La Arenosa**

At the present time, the Community Action Board is processing with the municipal UMATA a project for the cultivation of cocoa; and with the Presidential Agency for Social Action and International Cooperation, Social Action, a project was carried out in where contributions were received for the families displaced by the armed conflict.

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### 3.3.4 Cultural Dimension

#### 3.3.4.1 Direct influence area

- **Cultural modifications, potential, resistance and capacity to adapt to change.**
  - **Vereda, La Arenosa**

The first settlers of La Arenosa came from the same region and neighboring municipalities. The armed conflict caused a significant impact, given that in the year 2002 many families left in the Vereda looking to safeguard their lives, some of these families have returned.

- **Databases of the socio cultural system**

Without doubt, the cultural references, support of the population cultural system of the Vereda, that make up the influence area, are based on aspects inherent to the Antiochian culture, such as food, shelter, economic activities, the festivity and religiosity elements crossed by a conception of the work and productivity very particular of the Antioquia peasant. Another element that adds value to the people's identity of the area is the family as integrating axis and identity carrier (see Photo 3-75).



**Photo 3-75 Population of the project influence area**

Source: field work during the month of December 2011

|   |   |                            |            |
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In this item, there will be a brief description to Vereda level, about cultural practices that have an effect of cohesion between communities, and also show a relationship with the cultural identity of the inhabitants of the direct influence area.

– **Vereda, La Arenosa**

In La Arenosa predominates the family union, with some cases of mono parental families; the most common surnames in the Vereda are González and Galeano. The first settlers came from the same area and neighboring municipalities, in concordance with the process of settlement in the sub region and the municipality. Many families in the Vereda were displaced in 2002 because of armed conflict; of these families some have returned and others prefer not to do so, because they have been established and created bonds in other places.

The people who now inhabit in La Arenosa, mostly profess the Catholic faith, emphasizing the cult of the Holy Virgin and the Divine Child, these are the images that are found at home.

The site that represents the most important territorial referent is the school; there are celebrated different events of collective and community character, the meetings of the Board of Communal Action, mass and meetings directed by missionaries of the Catholic doctrine.

On the other hand, on the Vereda, there are people who have some knowledge about the medicinal properties of certain plants, using for example the elderberry to relieve the discomforts of flu, lemon grass with the same purpose, the salvia to treat people and cattle wounds, the aloe Vera for refreshment and the matarraton for baths in cases of fever, among others (see Photo 3-76).



**Photo 3-76 knowledge about the properties and healing power of some plants**

Source: Field work during the month of December 2011

**3.3.5 Information on population resettlement**

In the present item is a description of the family that possibly, according to the current designs at feasibility level, demand relocation of the house because of the construction of some of the facilities of the San Matias hydroelectric project, on the Vereda, La Inmaculada of the municipality of Cocorná (see Table 3-131 and Table 3-132 and Annex 12).

**Table 3-131 Population to resettle by the San Matias hydroelectric project**

|   |   |                            |            |
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| Municipality | Vereda        | Number of dwellings | Number of people |
|--------------|---------------|---------------------|------------------|
| Cocorná      | La Inmaculada | 1                   | 4                |
| <b>Total</b> | <b>1</b>      | <b>1</b>            | <b>4</b>         |

Source: Fieldwork carried out during the month of December 2011

**Table 3-132 Total population by age and gender**

| Age ranges        | Women    | Men      |
|-------------------|----------|----------|
| 0-5 Years         | 0        | 0        |
| 6-11 Years        | 0        | 0        |
| 12-17 Years       | 0        | 0        |
| 18-23 Years       | 0        | 0        |
| 24-29 Years       | 0        | 0        |
| 30-35 Years       | 0        | 1        |
| 36-41 Years       | 0        | 1        |
| 42-47 Years       | 0        | 0        |
| 48-53 Years       | 0        | 0        |
| 54-59 Years       | 0        | 0        |
| 60 Years and more | 1        | 1        |
| <b>Total</b>      | <b>1</b> | <b>3</b> |

Source: Fieldwork carried out during the month of December 2011

- **Roots Level**

The level of rooting is directly related to the time spent on the Vereda,, in addition to other factors such as the ties of kinship and neighborliness.

The family to be relocated, inhabitant of the Vereda la Inmaculada, presents a high level of social roots, given that they have remained in it for approximately 15 years. However, it should be taken into account, the massive displacement that occurred as a result of the conflict between the years 2000 and 2004, a situation that led some people not to return, and the situation was more evident among young people. Out of this family at the moment the two sons permanently inhabit the house and the parents spend more time in Medellín, though occasionally the father works in the venue that possibly will be affected by the project.

- **Dynamics of kinship ties and neighborly relations with other inhabitants of the area.**

In the area required for the construction of the relief pipeline, is located the home of a family, which has a close neighbor, also dedicated to the cultivation of sugar cane and processing of the same for panela production, with whom they maintain good neighboring relations, who is also the president of the Community Action Board of the Vereda. As it was mentioned, at the present in this house to resettle, remain two members of the family and the parents are in it occasionally.

- **Economic Base**

A general feature of the sector, where the family to be resettled lives, is the cultivation of cane and the production of panela, as the base of the family economy, which is carried out by men. In addition, there are other crops such as plantain, cassava and some citrus fruit, papaya,

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and guanabana, which also contribute to the upkeep of the group. These products are marketed in the town of Cocorná, although they are also intended for domestic consumption.

With regard to the economic activity of the men that make up this family, it is important to clarify that at the present time, one of the sons is working for the Consortium that built the Project El Popal and the other works as a farmer; the father is occasionally linked to the existing cane crop in the venue, because as mentioned earlier now lives in Medellín

- **Origin Site and mobility**

As it has been said, the family to be resettled is composed by natives of the same area. Its capacity of mobility in production times of panela is reduced to the journeys for marketing purpose or for the purchase of products for the family support, and application of medical or administrative services in the urban center of the town. One of the members of the family, who lives in the house, goes to to the site known as El Ocho to get to his work place as it can be seen in table 3-133.

**Table 3-133 Reasons of mobility**

| Municipality | Vereda,       | Mobility              |                 |  |
|--------------|---------------|-----------------------|-----------------|--|
|              |               | Provenance            | Destination     | Reason   |
| Cocorná      | La Inmaculada | Vereda, La Inmaculada | The Eight       | Access to transportation service and work          |
|              |               |                       | Town of Cocorná | Marketing of products, access to medical services. |

Source: Fieldwork carried out during the month of December 2011

- **Family Structure**

The family to be resettles is composed of 4 members, as can be seen in:

**Table 3-134 Family Structure of the families to resettle**

| Name                    | Age | Sex | Marital Status | Relationship with the head of household |
|-------------------------|-----|-----|----------------|---|
| Aristizabal Argemiro    | 65  | M   | Married        | Chief                                   |
| Blanca Rosa Quintero    | 67  | F   | Married        | Wife                                    |
| Daniel Jair Aristizabal | 37  | M   | Single         | Son                                     |
| Edgar Aristizabal       | 32  | M   | Single         | Son                                     |

|   |   |                            |            |
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Source: Fieldwork carried out during the month of December 2011

- **Level of vulnerability**

To establish the level of vulnerability of families to be resettled were taken into account criteria such as:

- If the heads of household are small landowners or day workers
- If there are in the zone high rates of unmet basic needs.
- If families have high dependence on the environment, both natural as well as family and neighborhood.
- If it is native population or with seniority in the area.
- If the family has previously suffered displacement (for any reason)
- If the livelihood depends on the activity at the premises or in the immediate environment

To qualify the vulnerability, was established the following scale:

- High Vulnerability: if the family meets more than four of these criteria
- Medium Vulnerability: if the family meets between one and three criteria
- Low Vulnerability: if the family does not meet with any of the criteria.

In the case of the family to be resettled by allocation of the facilities in the San Matias hydroelectric project, this family presents high vulnerability.

- **Construction characteristics, spatial distribution and housing allocation.**

The house to be resettled is located in a semi scattered way in the territory of the Vereda, this house is of one floor, has its walls built of brick without plastering, with asbestos tile and cement floor. It has electricity and water from a spring conducted through a PVC line. Near the house is located a trapiche for milling sugarcane and a cane crop of approximately 1.5 ha.

- **Expectations that the family has on the project and possible transfer.**

In general terms, there is not expressed rejection or opposition to the transfer of the house. However, the person who supplied the information expressed concern about the transfer of the panela facilities, which provides much of the support of the family.

- **Linking of the members to some community-based organizations at the veredal level and position occupied at the moment.**

The owner of the affected house is a member of the Community Action Board of Vereda, la Inmaculada.

- **Cultural Networks**

A fact to highlight in this case, is the process of forced displacement lived by the population of the area, as a result of the armed conflict between the years 2000 and 2004; in this Vereda,, families are devoted to the agricultural activity, basically the processing of sugar cane for the

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production of panela. These are farming families, whose livelihood depends on family labor and in some cases of the journal job in neighboring lands. In the case of this family, one of the sons is linked to the consortium that built the current Hydroelectric Project El Popal. Its main interactions are set out with the Vereda of the center zone El Jordan, which is composed by the same Veredas La Inmaculada, El Jordan, El Coco, and Aurora. The inhabitants of these Vereda are related to organization level and community participation and some neighborhood networks are established.

The residents of the Vereda, la Inmaculada have as a territorial important benchmark the school and the puddles of the river, in which a few years back, in high season, 2,000 people got together in a bathing place; at that time, the people went in family, or groups of teenagers and made stews or cooked chickens, after the bath they play on the court.

- **Transfer Alternatives and receptor population**

It should be borne in mind that at the filling the identification tab of potential families to resettle, just a preliminary survey took place on the transfer alternatives, for this reason, when it gets well defined the planning and design of the project, it will be necessary to talk again with that family, to make a consultation process in an optimal manner about the chosen site to relocate the housing facilities.

The procedure to follow to complement this information, is proposed in the Environmental Management Plan of this study, in the relocation program for Infrastructure and Housing

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## 7 ENVIRONMENTAL MANAGEMENT PLAN

### 7.1 BIOTIC ENVIRONMENT

#### 7.1.1 Affection Compensation for woodlands hedges - Formation of a biological corridor

##### 7.1.1.1 Objective

Compensate for the damages to the forest coverage, with the establishment of a biological corridor along the San Matias River in the project influence area.

##### 7.1.1.2 Justification

For the construction of the project it is necessary to affect areas with forest cover that in addition contain species of flora with ecological importance and in some degree of threat, make up a fauna habitat dependent on this forest coverage because of its offer of resources and which are in some category of threat precisely because of the reduction of their habitats.

The establishment of a biological corridor that joins the one proposed for the El Molino Hydroelectric Project and to which it is been formed as part of the compensation of the El Popal hydroelectric project, under construction, improving habitat conditions for fauna and favoring the presence of species of flora that are threatened by the pressure that is exerted on them by their commercial value and by the expansion of the agricultural and livestock frontiers.

##### 7.1.1.3 Regulations

- Law 2811 of 1974 Code of Natural Resources
- Decree 1449 of 1977. Provisions on the protection and conservation of water, forest, terrestrial and aquatic flora.
- Law 165 of 1994. Convention on Biological Diversity (CBD). Recognizes the importance of biological diversity in the evolution and the life of the biosphere, as well as their ecological, economic and scientific values.

##### 7.1.1.4 Stage

Construction and operation

##### 7.1.1.5 Impacts to check

- Changes in vegetative covering
- Loss or fragmentation of habitats
- Increased pressure on natural resources

##### 7.1.1.6 Type of measure

Mitigation and compensation

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#### 7.1.1.7 Goals and monitoring indicators

| Description   | Measured parameter control   |
|---|--|
| Increase the coverage of forested areas (forests and high vegetation) | Increase in area by coverage type  |
| Improving the connectivity of the forested coverage                   | Modification in the connectivity indexes   |
| Evaluate changes in composition and structure                         | Diversity indexes<br>Diametric classes   |
| Carry out studies of plant succession                                 | 1 In the first year of operation<br>1 In the fifth year of operation<br>1 In the tenth year of operation |
| Involve the community surrounding the process                         | People in the community who are participating in the process $\geq 3$                                    |
| Disseminate the results of the studies of succession                  | 1 Publication in the sixth year of operation<br>1 Publication in the tenth year of operation             |
| Projects Formulation or productive alternative activities             | No. of projects $\geq 3$ in the second year of construction  |
| Implementation of productive activities                               | No. of projects implemented $\geq 3$ in the second year of operation                                     |

#### 7.1.1.8 Actions to develop

- **Areas to compensate**

To compensate for the damages to the forest coverage the corridor shown in figure 7-6 was delimited. The project will make the compensation in the basin of the San Matias River, connecting the relicts located in the study area that according to the characterization, represent important corridors for the movement of wildlife. As noted in the justification, this corridor joins the one projected for the El Molino Hydroelectric Project and that is taking shape as part of the compensation of the El Popal hydroelectric project, currently under construction.

- **Purchase of land**

The purchase of land will have a team of negotiators in which there will be a land surveyor with topography, a lawyer and a professional in the biotic area. This group will have the support of the social area to give clear and timely information to the community and to the owners of the land.

For the purchase of land are provided for the following stages:

- **Stage 1. Definition of the buying criteria and valuation of the land and a closer approach to the community**

At this stage the negotiating team will define the criteria for land purchase and payment for the same, considering aspects associated with the method of valuation, which documents are needed, the state of progress in tax upgrading in Cocorná and Granada, with emphasis on the area of interest.

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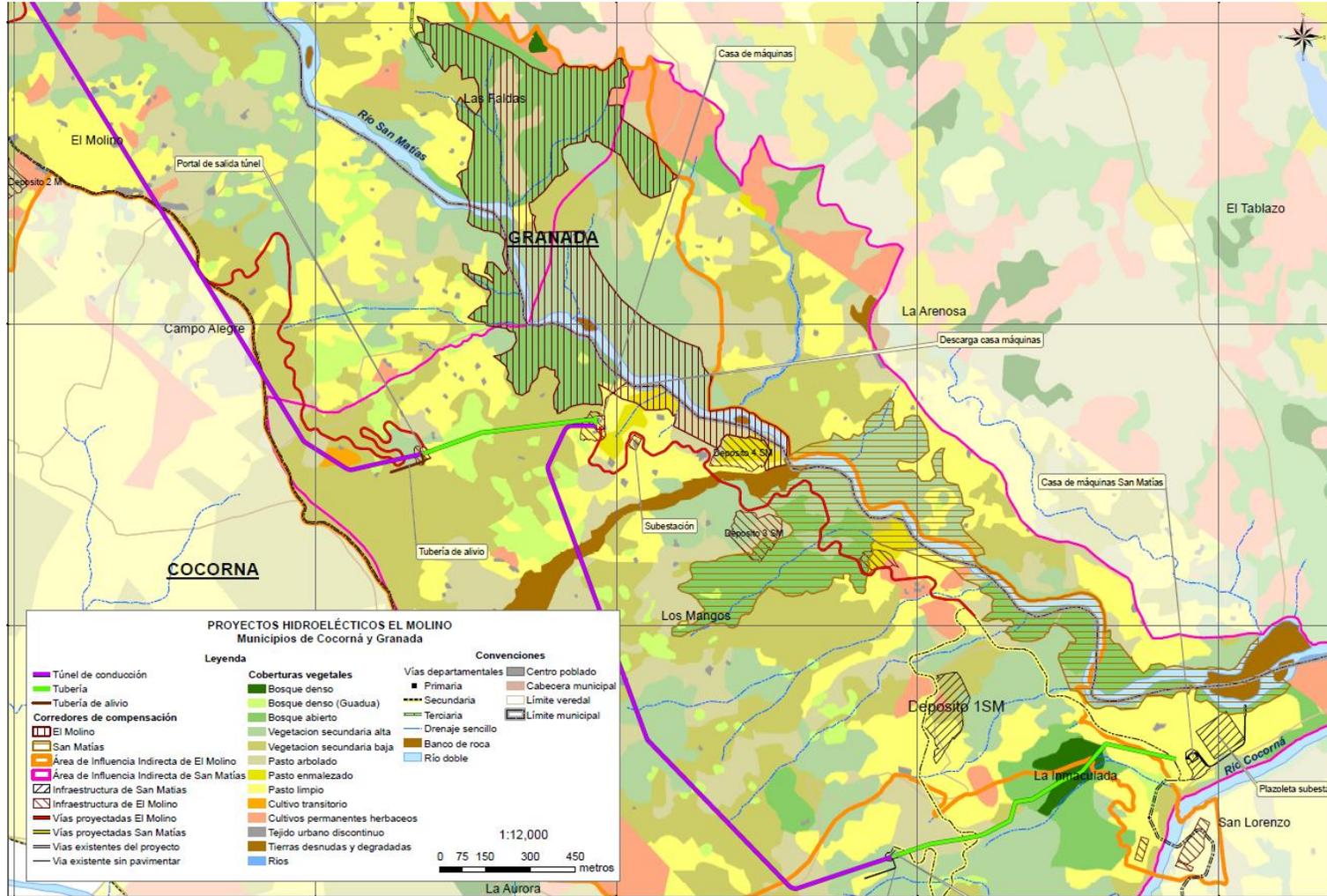


Figure 7-6 Areas planned for the biological corridor

|   |   |                            |            |
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By means of the land registration records inquiries will be made about the size of the plots and planning standards of both municipalities regarding the minimum size, with the purpose of not affecting the owners, fragmenting their property to areas where they may not make use of the soil.

With this information, it will be determine a clear picture of the negotiation that will be presented to the owners through meetings, in which additionally will be explained the purpose of the formation of the biological corridor.

The panorama will include the steps to follow in the negotiation and the responsibilities of both parties

– **Stage 2. Farms Measurement**

Given the case that the registration office does not have updated the area of the venue, it will be measured, along with the owner or his representative; the area object of purchase shall be demarcated to submit this information to the municipal tax office to verify it in the Departmental tax system.

– **Stage 3. Land Purchase**

Once obtained the complete documentation the negotiation will take place

The 1 and 2 will be essential before starting.

• **Isolation and enrichment of areas**

As the land purchase progresses, the isolation is done and begins the transfer of rescued flora individuals to the areas of the biological corridor, considering their ecological requirements.

As explained in the flora rescue program, there will be temporary nurseries which will be located close to the planting sites identified in the biological corridor.

• **Alternative projects Formulation**

The Environmental Management Group will work with the community in the identification of projects or alternative activities that improve and optimize productivity, so it can decrease the pressure on the forest resources. Out of the identified projects, it shall be elected at one showing viability and future projection, prioritizing those which are community type, as a way to strengthen community management and improve the ability for the identification and formulation of projects, including the search for funding sources.

Under this perspective, the formulation of alternative projects will go hand in hand with the program of rural entrepreneurship.

The formulation of projects will depart from the complementation of the aspects covered in the characterization of the baseline with respect to the productive systems, by means of Participatory Rapid Diagnostics, done with the community around the project, where it will be identified: local patterns of production, limiting factors (physical and chemical characteristics of the soil, slopes, weather conditions), strategies of production planning used by the traditional knowledge of the communities settled in the area, weaknesses of the current systems, limitations by market and transport, producer associations, spatial distribution of the uses of the soil, and to what this distribution responds, alternative

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activities, including the extraction of forest products, policies and programs of national and local government that have an impact on the production and whether they are known to farmers or unknown to them, but can positively or negatively affect the productivity of the systems; international programs that can be applied to the area and promote the development of alternative projects, taking into account that this is a region in which the forced displacement has called the attention of different agencies.

With these diagnostics it is intended to have a complete picture of the current state of the social systems of the area, to facilitate the formulation of projects and the framing on the local reality, including the logic of the producers, allowing to perform a joint analysis between the technicians and the community, of the economic and technical feasibility of the projects.

Once this analysis is completed it will follow the implementation phase and precise goals will be defined allowing the follow up.

#### 7.1.1.9 Application place

The media will be implemented in the basin of the San Matias River

#### 7.1.1.10 Schedule

##### Construction

| ACTIVITY                            | CONSTRUCTION<br>(Year/quarter) |    |    |    |        |    |    |    |        |    |    |    | OPERATION<br>(Year) |   |   |   |   |   |   |   |   |    |
|-------------------------------------|--------------------------------|----|----|----|--------|----|----|----|--------|----|----|----|---------------------|---|---|---|---|---|---|---|---|----|
|                                     | Year 1                         |    |    |    | Year 2 |    |    |    | Year 3 |    |    |    | 1                   | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|                                     | T1                             | T2 | T3 | T4 | T1     | T2 | T3 | T4 | T1     | T2 | T3 | T4 |                     |   |   |   |   |   |   |   |   |    |
| Land Purchase                       |                                |    |    |    |        |    |    |    |        |    |    |    |                     |   |   |   |   |   |   |   |   |    |
| Insulation                          |                                |    |    |    |        |    |    |    |        |    |    |    |                     |   |   |   |   |   |   |   |   |    |
| Enrichment                          |                                |    |    |    |        |    |    |    |        |    |    |    |                     |   |   |   |   |   |   |   |   |    |
| Maintenance Monitoring and Tracking |                                |    |    |    |        |    |    |    |        |    |    |    |                     |   |   |   |   |   |   |   |   |    |
| Results publication                 |                                |    |    |    |        |    |    |    |        |    |    |    |                     |   |   |   |   |   |   |   |   |    |
| Formulation projects                |                                |    |    |    |        |    |    |    |        |    |    |    |                     |   |   |   |   |   |   |   |   |    |
| Projects Implementation             |                                |    |    |    |        |    |    |    |        |    |    |    |                     |   |   |   |   |   |   |   |   |    |

#### 7.1.1.11 Budget

| Concept | Unit | Quantity | Unitary value (\$) | Total value (\$) |
|---------|------|----------|--------------------|------------------|
|---------|------|----------|--------------------|------------------|

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| Concept   | Unit    | Quantity | Unitary value (\$) | Total value (\$)   |
|---|---------|----------|--------------------|--------------------|
| <b>Direct Costs</b>   |         |          |                    |                    |
| Professional 1. Lawyer for land purchase                              | Month   | 5        | 1,200,000          | 6,000,000          |
| Professional 2 Assistant lawyer                                       | Month   | 5        | 1,200,000          | 6,000,000          |
| Surveyor  | Month   | 5        | 1,000,000          | 5,000,000          |
| 1 Professional biotic area  | Month   | 6        | 1,900,000          | 11,400,000         |
| 1 Field auxiliary for measuring sites                                 | Month   | 6        | 566,700            | 3,400,200          |
| Purchase land   | Hectare | 49       | 2,000,000          | 98,000,000         |
| 2 Auxiliary for enrichment and isolation                              | Month   | 36       | 566,700            | 20,401,200         |
| <b>Subtotal</b>   |         |          |                    | <b>150,201,400</b> |
| <b>Indirect Costs</b>   |         |          |                    |                    |
| Tools: Stakes, wire, staples and paint                                | Global  |          |                    | 30,000,000         |
| Field Staffing *  | Global  |          |                    | 20,000,000         |
| Publications  | Global  |          |                    | 10,000,000         |
| Formulation and implementation of alternative projects or activities. |         |          |                    | 200,000,000        |
| Transport   | Trip    | 50       | 250,000            | 12,500,000         |
| Allowances  | Day     | 250      | 50,000             | 12,500,000         |
| <b>Subtotal</b>   |         |          |                    | <b>285,000,000</b> |
| <b>TOTAL</b>  |         |          |                    | <b>435,201,400</b> |

**7.1.1.12 Responsible**

Owner of the project

**7.2 SOCIOECONOMIC ENVIRONMENT**

**7.2.1 Environmental Education to the community**

**7.2.1.1 Environmental education Project**

**• Objectives**

- Train the population from the Vereda of the direct influence area of a project on different environmental issues, in order to help them make better use of natural resources of their environment and appreciate the natural assets of their territory.
- Reduce effects which due to the anthropic activities that have been developed over a period of time in the area, have influenced the disappearance of species of fauna and flora, in the pollution of the water, in the emergence of erosive processes, among other effects, which are reflected in environmental problems identified in the area.

**• Justification**

The environmental education program to the community is important, to the extent that makes it possible for the inhabitants of the project influence area so they become more aware of their own relationship with the environment, in addition to that can acquire and provide knowledge that will enable a better interaction and proper use of natural resources. On the other hand, any environmental education process should be undertaken with communities, favors the adoption of practices that although on a small scale, can be

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the steps to a more balanced relationship with the environment, which provides the subsistence resources. In addition, the importance of the environmental education program lies in the fact that a well-focused process contributes to treat integrally aspects related to a conception of the human being as part of the environment that surrounds it and hence, the educational process may include elements that favor an integral formation.

In accordance with the characterization, the main environmental problems that are currently identified in the project influence area are:

- Use of land not suitable for cultivation of cassava, sugar cane and paddocks
  - Existence of a significant number of illiterate population or with low schooling levels
  - Existence of a low level of self-esteem among a portion of the population, especially among the women
  - The basin is understood as a stream of water, but not as a territory that involves multiple interactions with multiple effects
  - Family labor is used intensively for the production of panela in traditional way, technologically sophisticated and community presses (trapiches), which brings high desertion rates in schools.
  - Illegal Logging
  - Erosion associated with inadequate agricultural practices.
  - Wastage of water, associated with the idea that this is inexhaustible
  - Excessive spending of electrical energy by the low cost
  - Validity of the practice of hunting of birds and mountain animals by the local inhabitants and people who come from other municipalities or other paths of the same municipality
  - Use of agrochemicals and fungicides to increase the performance of the production and pest management in different crops
  - Low opportunities of access to education, by isolation or by low population density, there are paths where they attend 5 children at school
  - Early dropout of school children
  - Teachers with provisional charges with expectations of proper assignment in urban areas, usually from different regions.
- **Regulations**
    - Political Constitution of Colombia 1991.
    - National Policy on Environmental Education of the Ministry of Education.
    - Law 2811 of 1974 or code of renewable natural resources and environment protection.
    - Law 99 of 1993: Article 5, paragraph 9: Adopt jointly with the Ministry of National Education outreach programs and non-formal education.

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– Law 134 of 1994: Citizen Participation.

- **Stage**

Preliminary stage and construction

- **Impacts to check**

- Generation of expectations
- Generation of nuisances to the community
- Empowerment of conflicts
- Increase in the concentration of particulate matter and gases
- Increase in sound pressure levels
- Changes in the water quality
- Changes in vegetative covering
- Death and displacement of terrestrial fauna
- Increase pressure on natural resources

- **Type of measure**

Mitigation and compensation.

- **Goals and monitoring indicators**

As goals of the Environmental Education Program to the community, are defined the following:

- Perform two environmental education workshops per year with adults of each one of the Veredas, of the influence area, with 8 hours duration each and a minimum participation of 15 people in each workshop.
- Meet, one year later, with the environmental workshop participants performed in each one of the Veredas, to exchange experiences and adopt practices in the project influence area, defined through consultation with participants in the workshops by Vereda, with a duration of eight hours.
- Perform three environmental education workshops per year, with six hours duration, with students and teachers in the schools of the Vereda of the project influence area.
- Set a yearly meeting with school children and teachers who are part of the environmental education process carried out.
- Revive and strengthen the existing environmental group in the Vereda, of San Lorenzo (“Recover what is ours”), and facilitate by means of the celebration of an agreement, the accompaniment and advice as part of a competent and expert organization or institution on the subject (Universidad Católica de Oriente or Universidad de Antioquia), to these groups. In addition logistically support the creation of these groups on the Vereda in which they do not exist.

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- Implement or strengthen a school vegetable garden for the school in the Vereda La Arenosa, with products that help balancing children's diet such as tomato, celeriac, chive, beans, carrot, and breeding of smaller animals such as chickens for fattening and laying hens. 3

**Monitoring indicators are:**

- Number of adults participating per workshop /Adults convened
- Summation of workshops conducted with adults /summation of participating adults
- Record number of students and teachers participating in the workshops x school
- Practices, values and attitudes promoted for a better relationship with the environment/registration of at least one practice adoption, a change of attitude and a value promoted and saved during and after the formative process between adults and children.
- Environmental groups reactivated and strengthened with a friendly intervention with the environment in their Vereda.
- A school vegetable garden implemented on the Vereda La Arenosa

• **Actions to develop**

The environmental workshops with adults will have duration of 8 hours each and will be coordinated by their representatives of every Vereda, under the guidance of the environmental team. The minimum of participants will be of 15 attendants.

By means of the Boards of Communal Action or environmental groups from the Vereda, it will be established the number of persons per Vereda, the place for the workshop and the date. With the school teachers, it will be defined the day, time, and the group of students to attend.

It is proposed the implementation of eighteen workshops a year, with the communities in the influence area, two (with each Vereda, with adult population; and twenty-seven, three by each school, with school population).

Broadcast a monthly radio program of 10 minutes, to complement the training cycle in the topics they have chosen. This will be transmitted by the Stereo Cascade Station, which is the only one in the municipality. This must be designed in a comic strip format with the population language of the area and broadcast at a time of extensive tuning by the rural population.

In these environmental workshops and radio programs should at least be developed the following topics:

- Exposure and disclosure of the Environmental Management Plan approved by CORNARE.

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3 The method used to assess the NO<sub>2</sub>, have as minimum detectable value 0.03 µg/ml of solution

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- To publicize the project specifications.
- Management, conservation and protection of water sources, in the basins of the San Matias and Cocorná Rivers
- Waste Management and source separation
- Dissemination of the existence and importance of the flora and fauna species of the project influence area, emphasizing the need to avoid the hunting of these species.
- Meaning and representation of road signs
- Meaning of the signals in work sites
- Elaboration of the duel by losses associated with the armed conflict
- Self-image, self-concept, self-esteem
- Sexual and Reproductive Health
- Nutrition, balanced diet and preparation of recipes with basic ingredients of the area
- Importance of school gardens and the raising of small animals as an alternative for the enrichment of the family diet, because it will be implemented a school garden in the schools of every Vereda, with small animal husbandry as fattening chicken and laying hens.

- **Application place**

The Environmental Education Program to the Community will apply between the communities and school population of the Veredas, Los Mangos, La Inmaculada, San Lorenzo, and Las Faldas y La Arenosa.

- **Schedule**

The workshops with the adult and scholar population must be performed during the first year of the project construction, as well as implementation of the school garden and the revival or creation of environmental groups and other proposed activities, in order to ensure the continuity in the remaining time and its sustainability after construction is completed. Table 7 -12 presents the proposal for an Action Plan for the first 12 months, taking into account that completed the first year, it should be made the adjustments and the relevant programming agreement with the results of the executed until the end of this first period.

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**Table 7-12 Schedule for the environmental education program for the community**

| Objectives   | Goal   | Activity   | Responsible   | Timetable |   |   |   |   |   |   |   |   |    |    |    |
|--|--|--|---|-----------|---|---|---|---|---|---|---|---|----|----|----|
|  |  |  |   | 1         | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Train the population in the Vereda of direct influence area of a project on different environmental issues | Perform two environmental education workshops per year with adults for each of the Vereda of the influence area. | 10 Workshops per year in total, with the communities in the area of influence. Two workshops for each Vereda with adult population | Company owner of the project - environmental management team  |           |   |   |   |   |   |   |   |   |    |    |    |
|  | Meet every year with the workshop participants of the environmental analysis conducted in each of the Vereda     | Hold a meeting with adult participants of the Environmental Education Program  | Company owner of the project-team of environmental management |           |   |   |   |   |   |   |   |   |    |    |    |

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**Table 7-12 Schedule for the environmental education program to the community.  
(Continued)**

| Objectives | Goal   | Activity  | Responsible   | Timetable |   |   |   |   |   |   |   |   |    |    |    |  |
|------------|--|---|---|-----------|---|---|---|---|---|---|---|---|----|----|----|--|
|            |  |   |   | 1         | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |  |
|            | Perform three environmental education workshops per year, with duration of six hours, with students and teachers in the schools of the Vereda of the project influence area. | Implement twenty seven workshops (27), three (3) by each school with school population. | Company owner of the project - environmental management team  |           |   |   |   |   |   |   |   |   |    |    |    |  |
|            | Meet every year, with the students and teachers  | Perform an encounter of schoolchildren participating in the PEA of the project          | Company owner of the project-team of environmental management |           |   |   |   |   |   |   |   |   |    |    |    |  |
|            | Revive and strengthen the existing environmental groups and support the creation of these groups on the Vereda where they don't exist  | Establish an agreement with an institution responsible for the revival, strengthening   | Company owner of the project-team of environmental management |           |   |   |   |   |   |   |   |   |    |    |    |  |
|            | Implement or strengthen a school garden by school from each Vereda   | Implement the project of reading-writing on the Vereda La Arenosa.                      | Company owner of the project-team of environmental management |           |   |   |   |   |   |   |   |   |    |    |    |  |

• **Budget**

The budget presented below is an estimate, which must be adjusted after the first year of its implementation.

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|   | Unit      | Value (\$)  | Quantity | Month | Total value (\$)   |
|---|-----------|-------------|----------|-------|--------------------|
| <b>Personal Cost</b>  |           |             |          |       | <b>27,000,000</b>  |
| Agronomist with professional training in agriculture - ecology  | H-month   | 1,500,000   | 1        | 18    | 27,000,000         |
| <b>Direct Costs</b>   |           |             |          |       | <b>129,000,000</b> |
| Cost of workshop with adults (refreshments in the morning, lunch, material)                                     | Workshop  | 100,000     | 10       |       | 1,000,000          |
| Cost encounter with adults (transportation to the community, lunch, refreshments, material)                     | Meeting   | 800,000     | 1        |       | 800,000            |
| Cost of workshop with children (material, lunch, snack)   | Workshop  | 100,000     | 15       |       | 1,500,000          |
| Cost of encounter with children (transportation to the community, refreshments in the morning, lunch, material) | Meeting   | 800,000     | 1        |       | 800,000            |
| Cost school garden <sup>4</sup>   | Huerta    | 800,000     | 1        |       | 800,000            |
| Outreach materials (posters, flyers, folding)   | SG        |             |          |       | 2,000,000          |
| 10 minutes Radio Program  | Programs  | 300,000     | 1        | 28    | 8,400,000          |
| Paper work  | SG        |             |          |       | 700,000            |
| Allowances  | 2 People  | 50,000      | 50       |       | 2,500,000          |
| Staff Transport   | Vehicle 1 | 350,000     | 30       |       | 10,500,000         |
| Convention for reactivation, accompaniment, and advisory services to environmental groups                       |           | 100,000,000 | 1        |       | 100,000,000        |
| <b>Total Cost</b>   |           |             |          |       | <b>156,000,000</b> |

<sup>4</sup> El costo de la huerta escolar se calculó de la siguiente manera:

| Componente animal         |                | Componente vegetal |               |
|---------------------------|----------------|--------------------|---------------|
| Ítem                      | Valor          | Ítem               | Valor         |
| 15 gallinas               | 300.000        | Hortalizas         | 30.000        |
| 1 gallo                   | 30.000         | Herramientas       | 40.000        |
| Corral                    | 50.000         | <b>Sub total</b>   | <b>70.000</b> |
| 2 comederos para gallinas | 50.000         |                    |               |
| Cuidos                    | 300.000        |                    |               |
| <b>Sub total</b>          | <b>730.000</b> |                    |               |

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### 7.2.1.2 Reading and writing project for adults

This project is considered within the Environmental Education Program, given that in almost all the Veredas, it has been detected that a part of the population cannot read or write, an important aspect to undertake the formative process in environmental education.

- **Objectives**

- Articulate the process of environmental education, with other elements that are important for the integral education of the population from the Veredas, of the project influence area.
- Provide basic tools of literacy to the inhabitants of the Vereda in the project influence area with the relevant methodology, in order to facilitate the integration between this process and the needs of daily activities.
- Acquire theoretical tools and practices about the importance of good nutrition, how to have a balanced diet with the right combination of food that the environment offers, and how to achieve the sustainability of school gardens, as a principle of food security and opportunity for the enrichment of the daily diet.

- **Justification**

The project of reading - writing must articulate and bind the process of environmental education, with other elements that are important (such as acquire theoretical practices tools about the importance of good nutrition, how to have a balanced diet with foods of the environment, sustainability of school vegetable gardens as a principle of food security and opportunity for the enrichment of the daily diet) for the integral education of these people, who by the circumstances as a result of the armed conflict, presents a high level of vulnerability.

During the workshops of information and identification of impacts and management measures, it was identified that a majority of its population are functionally illiterate even if they know how to sign, they do not dare to write or read in public, and have difficulties to do mathematical calculations. It is well known that those with functional illiteracy can be manipulated or intimidated easily and with greater probability are exposed to risks associated with health, stress, can receive unfair wages and be more vulnerable to another type of threat.

Training in nutrition, school vegetable gardens and to a small-scale animal husbandry, allows them to share experiences for educational development from the contents of the courses in sciences, mathematics and social, in adults and children, giving them the opportunity to acquire the skills and abilities necessary for the development in the daily life and with the necessary relevance, in accordance with the environment and the culture of the local population. In addition improving the levels of existing nutrition and lay the foundation for promoting initiatives that promote the food security of the inhabitants of the various Veredas, of the influence area.

Finally, *“education for the rural population is crucial to achieve the goals of Education for All (EFA) and the Millennium Development Goals (MDGS) to eradicate extreme poverty and hunger, ensure the fulfillment of primary education in 2015, promote gender equity*

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*and ensure the sustainability of the environment. In 1996, the World Food Summit (Rome) emphasized the expansion of access to education for the poor and members of disadvantaged groups, including the rural population, as a key factor in achieving the eradication of poverty, food security, a lasting peace and sustainable development. In 2002, the World Summit on Sustainable Development (Johannesburg) also emphasized the role of education "*<sup>5</sup>

- **Goals and indicators**

- Train at least 40% of the population of Vereda, La Arenosa that may not be able to read or write.
- Ensure that at least 40% of the population of Vereda, La Arenosa does basic math calculations necessary to the development in their daily lives.
- Achieve that at least 50% of the population of Vereda, La Arenosa provide in their daily diet, foods with new preparations, which may enrich and balance their diet to reduce the level of malnutrition among children and adults.
- Make a connection with the MANÁ program of the government of Antioquia, to make a diagnosis of the nutritional status of the school-age children in the Vereda, La Arenosa, and subsequently, in the formative phase of the process to be determined depending on expert criteria, do a follow up about the adoption of practices to improve the nutritional status of children.

The indicators to be used, shall be the following

- Number of adults, young people and children by Vereda, that know how to read and write after the literacy program/ Number of adults project, young people and children who can read and write before the literacy program.
- At least 40 classes of literacy a year.
- At least 20 adults of all the Vereda of the influence area that may learn to read and write with the literacy project of the WFP of the hydroelectric project.
- Adoption of at least one practice for preparing variety food and balance the usual diet.
- Introduction of at least one food preparation that allows the improvement of the nutritional status of children and adults.
- At least 10 lectures or nutrition classes per year for each Vereda,

- **Actions**

Implement the project of reading and writing on the Vereda La Arenosa. These classes will be conducted once a week, with previous consultation with the interested people.

Integrate the contents of the literacy project with the contents of nutrition and balanced diet and the school garden orchard.

<sup>5</sup> This program will be implemented on the Vereda La Arenosa, since the other Vereda shall be covered by the Management Plan for the hydroelectric project. El Molino

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Prepare classes where any recipe that by means of practical demonstration could link contents of mathematics, nutrition and the school vegetable garden.

The professional in education should support the activities of the school vegetable garden, seeking to integrate the educational process of literacy taking advantage of the vegetable garden as a practical space for teaching and learning.

• **Schedule**

This project must be carried out in parallel with the Environmental Education Program and in accordance with the planning required to achieve the proposed objectives.

• **Budget**

This budget is made for 10 months, considering that during this time, it is feasible to achieve the objectives of the project of reading and writing, otherwise, the corresponding adjustment should be done.

|   | Unit     | Value (\$) | Quantity | Month | Total value ( \$) |
|---|----------|------------|----------|-------|-------------------|
| <b>Personal Cost</b>  |          |            |          |       | <b>19,800,000</b> |
| Professional in education with experience in working with peasant population  | H-month  | 1,500,000  | 1        | 10    | 15,000,000        |
| Professional in nutrition and dietetics with experience working with communities  | Day      | 200,000    | 24       |       | 4,800,000         |
| <b>Direct Costs</b>   |          |            |          |       | <b>12,600,000</b> |
| Literacy class materials (drafts, notebooks, pencils, sheets of notepad, flip charts, scissors, colors, sticky tape, glue, card stock, colored paper, draft board, markers) | Workshop | 100,000    | 30       |       | 3,000,000         |
| Allowances for a professional nutritionist  | Day      | 50000      | 24       |       | 1,200,000         |
| Vehicle for the mobilization of professional nutritionist   | Day      | 350000     | 24       |       | 8,400,000         |
| <b>Total Cost of 10 months</b>  |          |            |          |       | <b>32,400,000</b> |

• **Responsible**

The implementation of the reading and writing project is the responsibility of the company that owns the hydroelectric project.

**7.2.2 Allocation of infrastructure and housing**

**7.2.2.1 Objectives**

- Identify and list the infrastructure and housing that must be relocated because of project works

|   |   |                            |            |
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- Relocate all the infrastructure and housing, within a clear and transparent negotiation between the parties, taking into account not only the physical aspect but also the economic and social.
- Reduce the expectations generated by the future moving through a clear and efficient management of the information about the whole relocation process.

#### 7.2.2.2 Justification

When hydroelectric projects are being developed, it is usual to have losses or detriment of elements that can be an important part of the territory, by being referents of guidance, identity, religion, community infrastructure (communal house, school, tennis courts, old houses, a tree, a rock formation, a path, a source of communal water or Veredal aqueduct), or the need of the relocation of homes affected by the construction of a project.

The disappearance of these elements involves a setback with respect to the territoriality built over time, which in turn, may affect how relationships of belonging and roots with the territory are established. It is important to bear in mind, that sometimes, even when restitution is done, the community infrastructure does not recover its historical and relational value for the communities. Therefore, the process of restitution must be made judiciously as possible, and in accordance with the symbolic value and economic infrastructure that represents the affected infrastructure for the community.

For the construction of the facilities of the San Matias hydroelectric project, a house and a trapiche (small press), located on the Vereda, La Inmaculada of the municipality of Cocorná will have to be relocated (see Table 713).

**Table 7-13 Families to resettle**

| <b>PROJECT DESCRIPTION</b>                    | <b>Type of property</b> | <b>Owner or possessor</b> |
|---|-------------------------|---------------------------|
| Exit Portal of the tunnel and relief pipeline | Housing                 | Argemiro Aristizabal      |
| Exit Portal of the tunnel and relief pipeline | Trapiche                | Argemiro Aristizabal      |

#### 7.2.2.3 Regulations

- Political Constitution of Colombia 1991. Article 1 and 2.
- Law 99 of 1993.
- Law 134 of 1994.
- Law 143 of 1994.
- Decree 1818 of 1998.
- Decree-law No. 2811 of 1974. Title XII.
- Decree 1715 of 1978.
- Law 388 of 1997.

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- Law 3 of 1991.
- Decree 1420 of 1998. Method of valuing the property affected

#### **7.2.2.4 Stage**

Preliminary stage and construction

#### **7.2.2.5 Impacts to check**

- Displacement of infrastructure and housing
- Changes in population dynamics.
- Generation of expectations
- Empowerment of conflicts
- Affectation of economic activities.
- Generation of inconvenience to the community

#### **7.2.2.6 Type of measure**

Mitigation and compensation.

#### **7.2.2.7 Goals and monitoring indicators**

The goals for this program are:

- Establish the necessary conditions for the family to relocate, perceive an ongoing support and a good flow of information by the company, which allows them to be as comfortable as possible during the entire process.
- Relocate the venues in an optimal way, complying with the economic, social and physical criteria demanded for the wellbeing of the family, so that its inhabitants are in a better or equal situation that they had in terms of infrastructure, access to public and social services and access to communications.
- To reach an agreement for both parties and where all the parties involved are satisfied.
- Reimburse 100% of the affected infrastructure by the project in the first quarter of the construction phase.

This may be assessed using the following indicators:

- Housing conditions in terms of infrastructure, communication channels and access to public and social services before the project / housing conditions in terms of infrastructure, communication channels and access to public and social services after the project.
- Satisfaction Survey.

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#### 7.2.2.8 Actions to develop

- Perform a diagnosis of recognition of the state of the family that was affected by the construction of the project.
- Through a survey of farms and homes, identify the demographic, social, economic and cultural characteristics that allow defining a vulnerability scale to select the best alternative for negotiation.
- Define in conjunction with those affected, the territorial space of resettlement. In addition to the way in which will take place the resettlement, to select which they believe is the most convenient (relocation or direct negotiation).
- The owner of the project will be responsible for acquiring the land for resettlement, when is not direct negotiation. As well as to make the relocation to the new site.
- The owner of the project, within this program, will encourage the sustaining of the dominant economic activity in the area, which in this case is the agricultural. Simultaneous with the negotiation process of the property, he will develop a program to support the production and support of the family unit.

#### 7.2.2.9 Application place

Housing and infrastructure to relocate is located in the Vereda, La Inmaculada, Cocorná.

#### 7.2.2.10 Schedule

For this program have been defined three stages, which are described in Table 7-14.

**Table 7-14 Schedule of the relocation infrastructure program**

| Phase | Actions   | Time  |
|-------|---|---|
| 1     | Perform a diagnosis of recognition of the state of the family that will be affected by the construction of the facilities.<br>By means of a survey of farms and homes, identify the demographic, social, economic and cultural characteristics that allow defining a vulnerability scale to select the best alternative for negotiation.<br>Define in conjunction with those affected, the territorial space of resettlement. In addition to the way in which will take place the resettlement, to select which one is more desirable (relocation or direct negotiation). | It is proposed to carry out this phase during the first month of project construction |

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|   |  |  |
|---|--|--|
| 2 | Acquiring the land for resettlement provided it is not direct negotiation. As well as to perform the transfers to the new sites. Activity that will be the responsibility of the project owner | This phase will start at the beginning of the project construction and will end when families are fully relocated in the new housing, and stabilized its agricultural production capacity. |
|---|--|--|

#### 7.2.2.11 Budget

Table 7-15 shows the relocation costs o of the housing and Trapiche, considering the value of a new home, as one of *social interest*. The accompaniment will be done by the Environmental Management Group.

**Table 7-15 Budget for direct costs and the social professional**

|                       | Unit  | Value (\$) | Quantity | Month | Total value ( \$)  |
|-----------------------|-------|------------|----------|-------|--------------------|
| <b>Direct Costs</b>   |       |            |          |       | <b>101,003,000</b> |
| Relocation trapiche 1 | SG    |            | 1        |       | 50,000,000         |
| Relocation housing    | House | 51,003,000 | 3        |       | 51,003,000         |
| <b>Cost</b>           |       |            |          |       | <b>101,003,000</b> |

#### 7.2.2.12 Responsible

The company owner of the project.