SOCIÉTÉ AUDUBON HAÏTI

CRITICAL ECOSYSTEM PARTNERSHIP FUND

Geographic Profile of Grande Colline, Haiti

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ACRONYMS

ArcGIS	Arc Geographical Information Systems (ESRI software)
BPDA	Bureau pour le Développement de la Production Agricôle
CEPF	Critical Ecosystem Partnership Fund
CNIGS	Centre National de l'Information Géo-Spatiale
ESRI	Environmental Systems Research Institute
GE	Google Earth
IHSI	Institut Haïtien de Statistique et de l'Informatique
Kml	Keyhole Markup Language
MARNDR	Ministère de l'Agriculture des Ressources Naturelles et du Développement Rural
MDE	Ministère de l'Environnement
MINUSTAH	Mission des Nations Unies pour la stabilisation en Haïti
MPCE	Ministère de la Planification et de la Coopération Externe
NSF	National Science Foundation
SAH	Société Audubon Haïti
SIG	Système d'Information Géo-Spatiale

TABLE OF CONTENTS

Introduction

Grande Colline is located along the high elevation ridge of the Massif de La Hotte 9.4 km west of Pic Macaya in southwest Haiti. The presence of a relatively intact rainforest with an exceptional biodiversity of endemic plant and animal species makes Grande Colline a prime candidate as a protected area.

A series of maps were analyzed to study the political, socio-economic, biophysical parameters of Grande Colline. A fifty square kilometer study area was selected. The center of this area is the highest peak in the area (approximately 2020 m) and shown by the red triangle in **Figure 1**. The nearest large towns are Les Anglais and Chardonnières to the southeast.

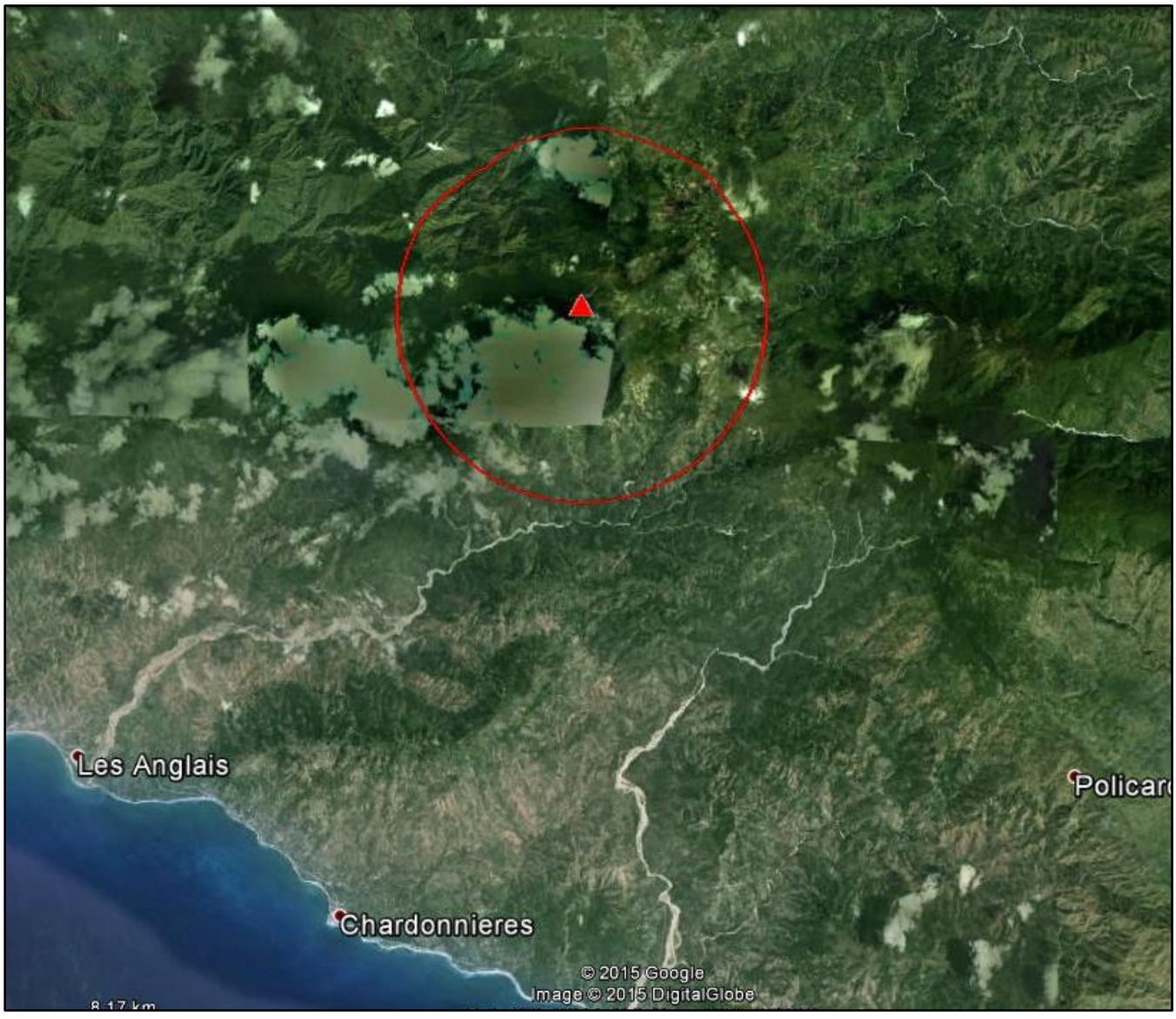

Figure 1. Grand Bois study area (Google Earth, 2015; SAH, 2015).

Administrative Boundaries

The study area is bounded on the north by the *Département de la Grande Anse* and on the south by the *Département du Sud.* The boundary between the departments passes north of the highest peak and follows the ridgeline of the mountain chain in an east-west direction (**Figure 2**).

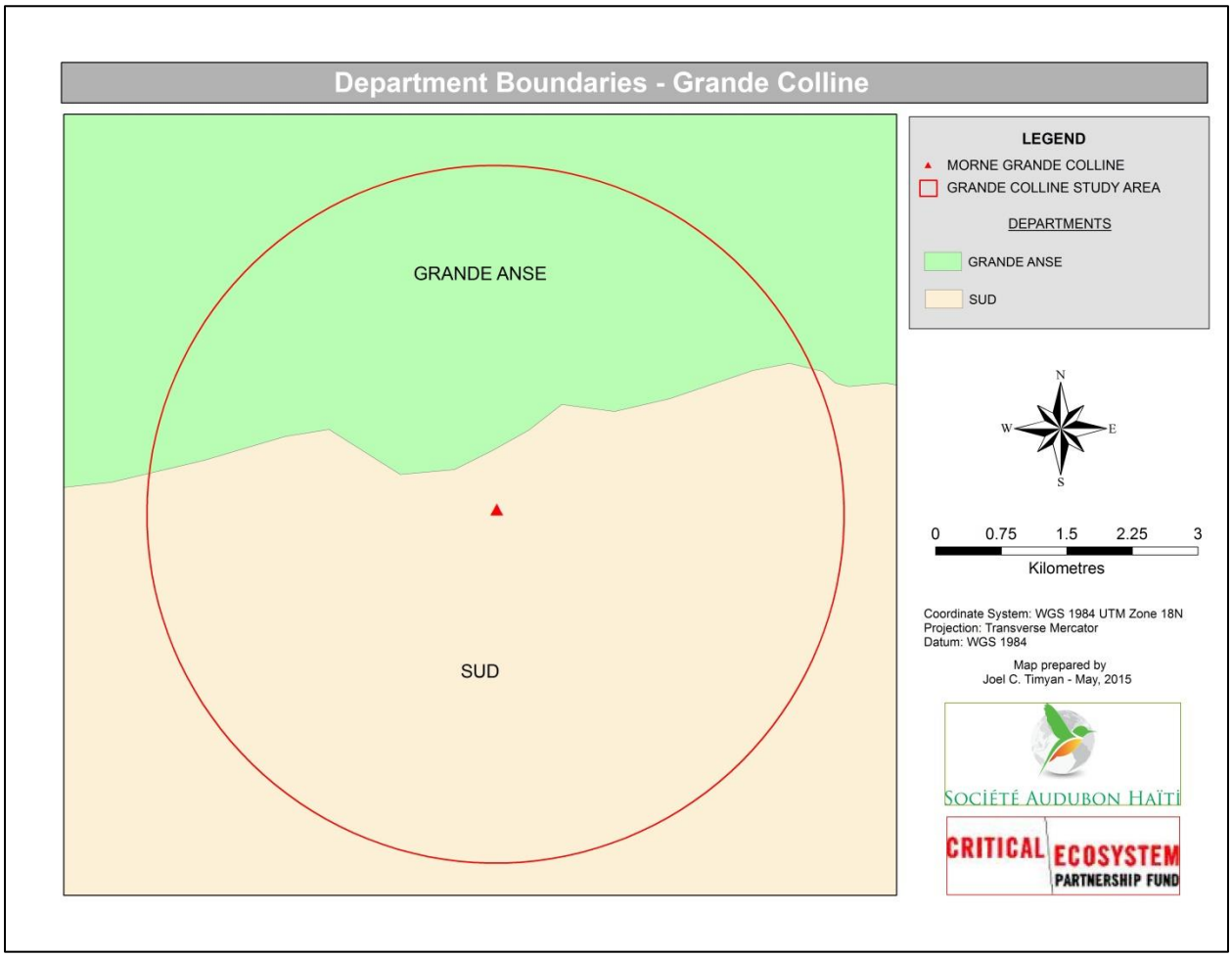

Figure 2. Department boundaries of the Grande Colline study area (CNIGS, 2001; SAH, 2015).

The Grande Anse department is represented in the study area by 2 communes – Jérémie and Roseaux. The Jérémie commune is represented by the communal section of *3ème Haute Guinaudée.* The Roseaux commune is represented by the communal section of *2ème Fonds Cochon.* The Sud department is likewise represented by two communes – Chardonnières and Les Anglais. Chardonnières has 2 communal sections within the study area: *1ère Randel* and *2ème Déjoie*. Les Anglais has one communal section - *2ème Edelin.* The communal section boundaries are shown in **Figure 3**.

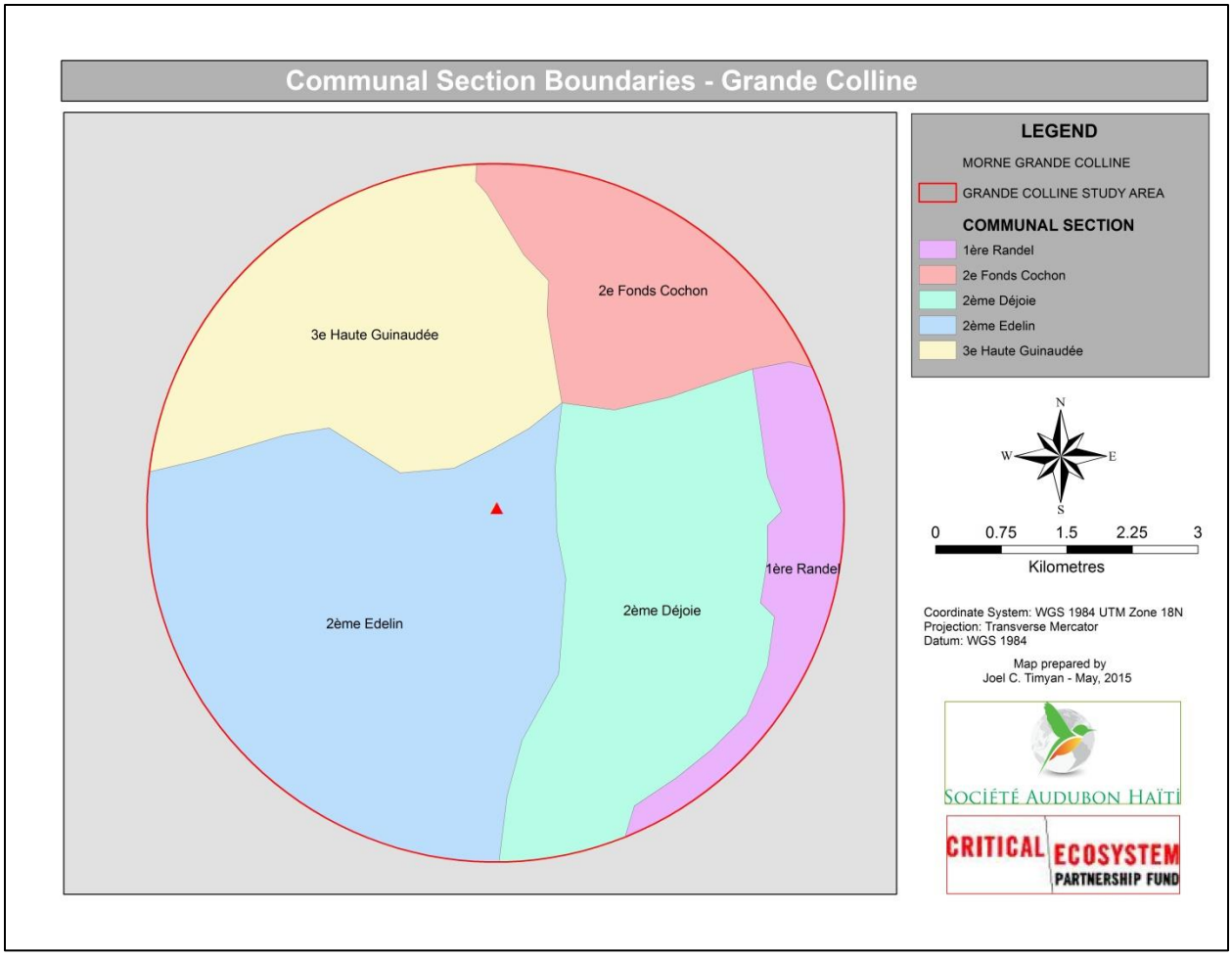

Figure 3. Communal section boundaries of the Grande Colline study area (CNIGS, 2006; SAH, 2015).

Population

The most recent census was conducted in 2003 (IHSI, 2003). The rural population of the communal sections estimated for the Grande Colline study area was 4211 (**Table 1**).

Table 1. Communal sections and their proportional rural population represented within the Grande Colline study area.

Section Communale	2003 Population	% Area in Study Area	Est. 2003 Population
3ème Haute Guinaudée	6450	9	565
2ème Fonds Cochon	8465	6	540
1ème Randel	6055	7	441
2ème Déjoie	5395	25	1334
2ème Edelin	3335	40	1331
Total	29700		4211

In general, rural population in Haiti has been decreasing by an annual average of -1.25% over the 10-year period of 2004-2013 (http://data.worldbank.org). Given these trends, a minimum estimate of 3594 is estimated in 2015 for the Grande Colline study area. Conversely, the data provided by IHSI for 2012 suggests that population rates have increased considerably since the 2003 census, ranging between 10.4 – 32.9 % for the 2003 – 2012 period (IHSI, 2012). Estimates based on these rates of increase would be considered maximum. The current 2015 population estimate is likely to fall between these two estimates (**Table 2**).

Table 2. 2015 population estimates based on World Bank (2015) and IHSI (2012) for the Grande Colline study area.

Section Communale	2003 Estimate	2015 Low Estimate	2015 High Estimate
3ème Haute Guinaudée	565	482	613
2ème Fonds Cochon	540	461	586
1ème Randel	441	376	478
2ème Déjoie	1334	1139	1447
2ème Edelin	1331	1136	1444
Total	4211	3594	4568

Habitat Density

Habitations were located on high-resolution orthophotos (2010) and compared to the most recent Google Earth images (September 27, 2013). The results are shown in **Figure 4**. An estimated 192 habitations occupy the 50 km^2 study area, as shown by the red dots. They are concentrated mostly in the lower elevations of the southern portion.

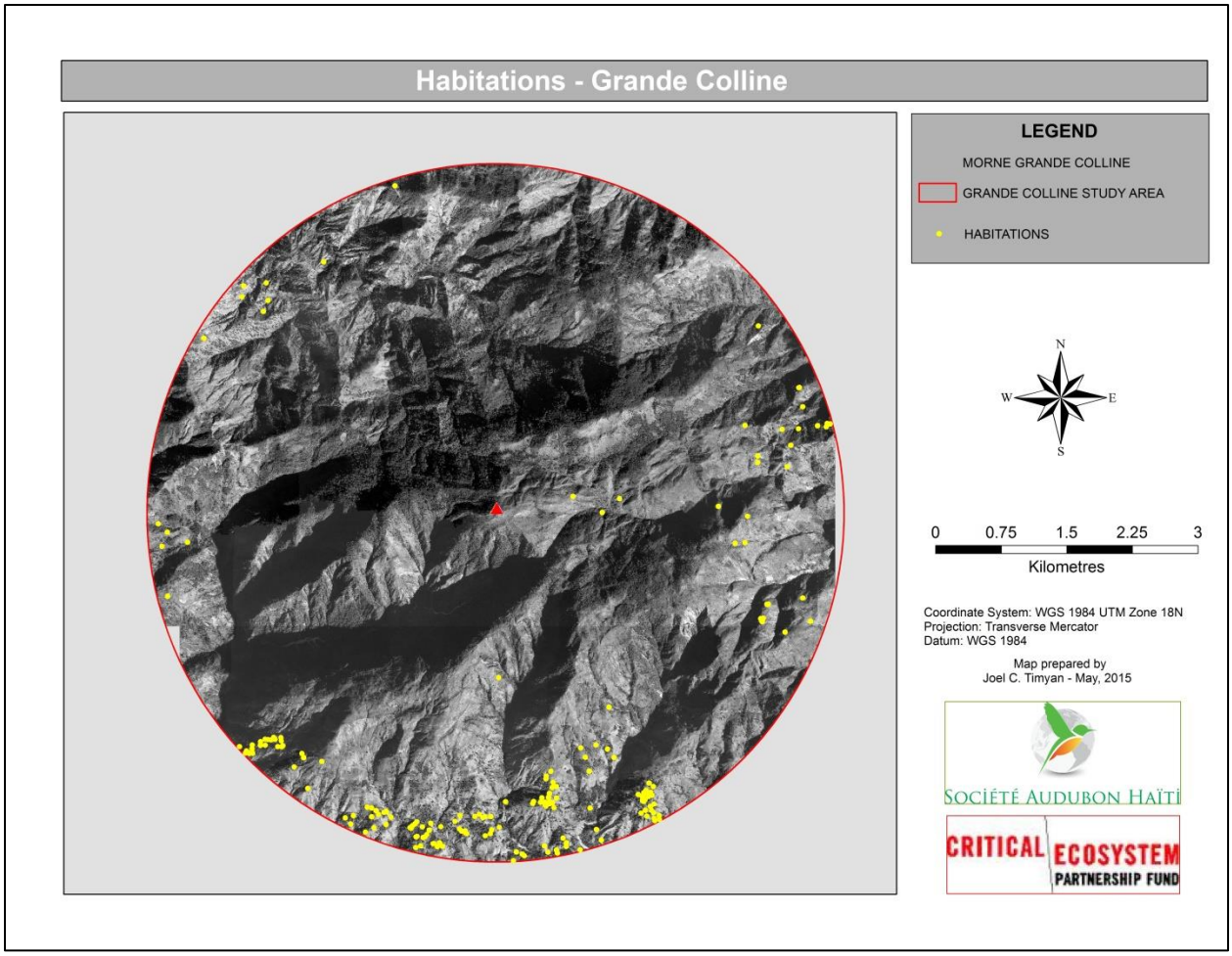

Figure 4. Habitation density in the Grande Colline study area (CNIGS, 2010; SAH, 2015).

Geology

The coarse scale geological map of the Grande Colline study area shows only one type of rock – hard limestone derived from marine deposits of calcium carbonate formed during the Cretaceous period approximately 88.5 – 65 million years ago (**Figure 5**, Butterlin, 1954). This rock stratum is part of the Macaya Formation and lifted out of the ocean due the collision between the North American and Caribbean plates along the Enriquillo Fault (**Figure 6**). The contours of Grande Colline are shaped by the east – west orientation of the faults with the major faults responsible for the highest peaks and ridges.

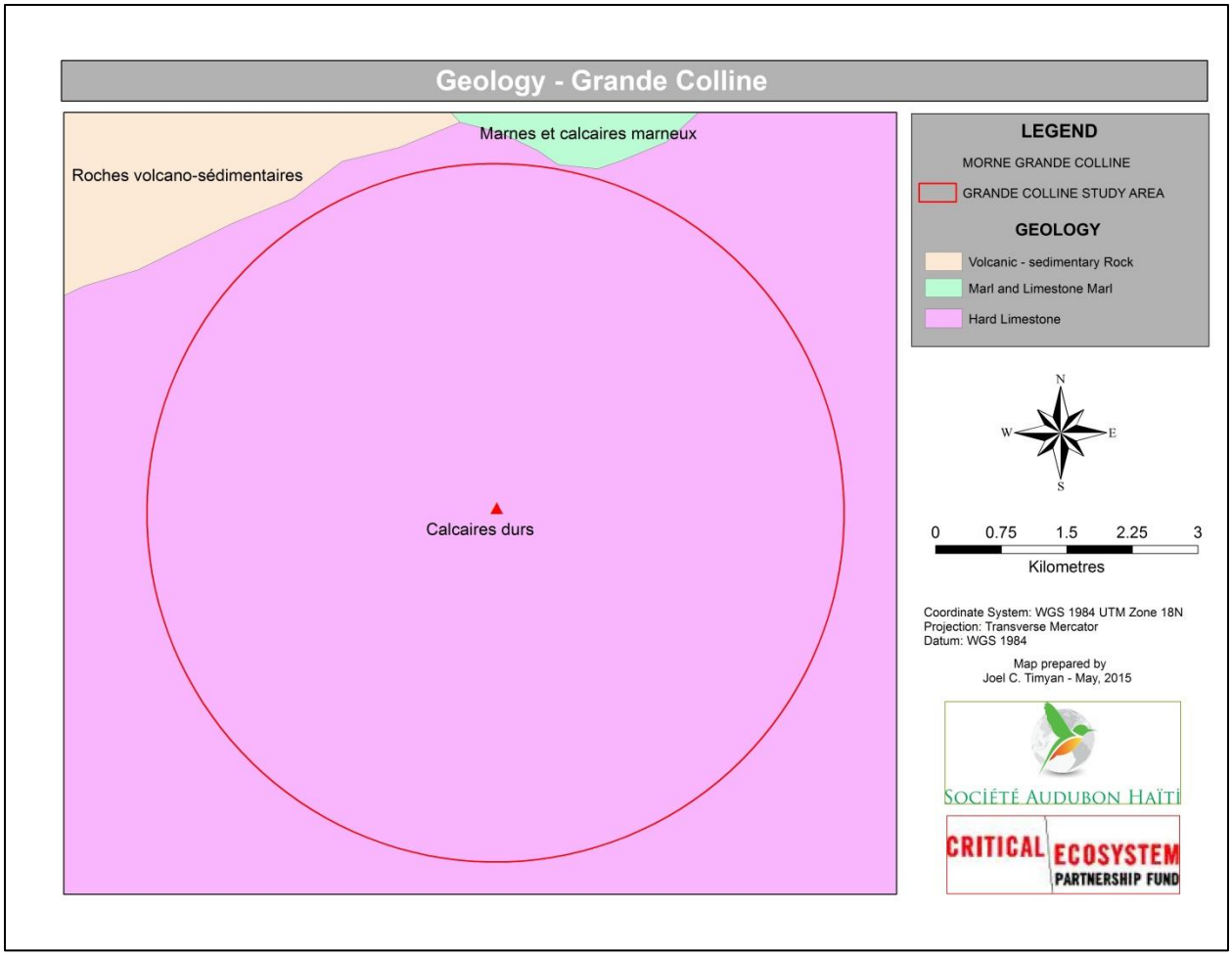

Figure 5. Geological map of the Grande Colline study area (CNIGS, 2003; SAH, 2015).

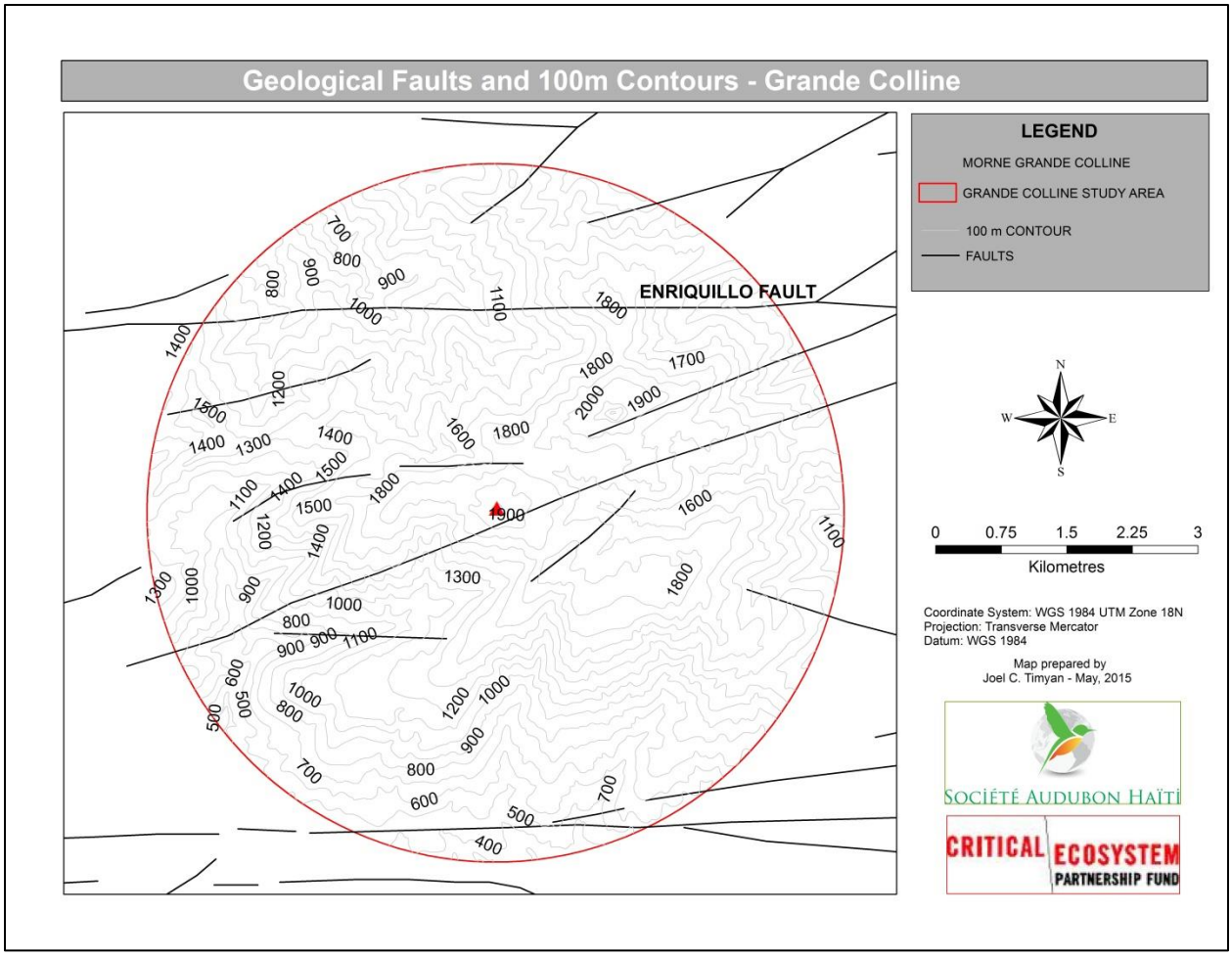

Figure 6. Map showing relationship between geological faults and 100-m contours of Grande Colline (MINUSTAH, 2010; CNIGS, 2014; SAH, 2015).

Hydrogeology

The entire study area is underlain by hard limestone deposits and characterized by fractured and compartmentalized carbonate aquifers of variable groundwater potential (**Figure 7**). It is notable that despite the high rainfall of the area, Grande Colline does not have an abundance of freshwater springs as in the case of Grand Bois and other areas characterized by karst limestone.

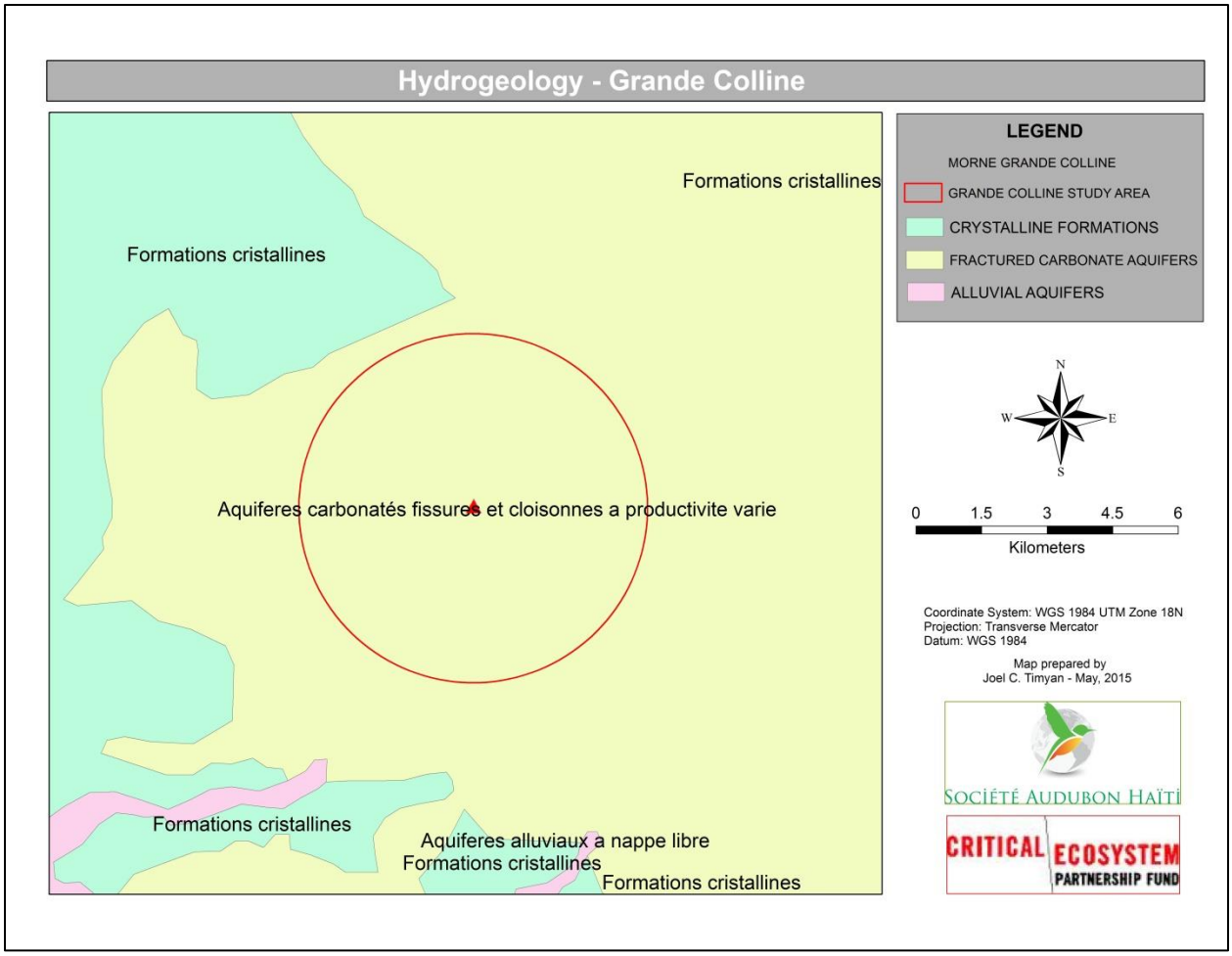

Figure 7. Hydrogeological formations of the Grande Colline study area (CNIGS, 2004; SAH, 2015).

Hydrography

There are two major watersheds shown in **Figure 8**: Voldrogue – Roseaux and Tiburon – Port Salut. There are three rivers that drain the Grande Colline study area: Les Anglais, Voldrogue and Roseaux. The tributaries of the Les Anglais River flow to the south, west and southwest of the peaks of Grande Colline. The tributaries of the Voldrogue flow to the north and northwest and those of the Roseaux flow to the east and northeast of the peaks.

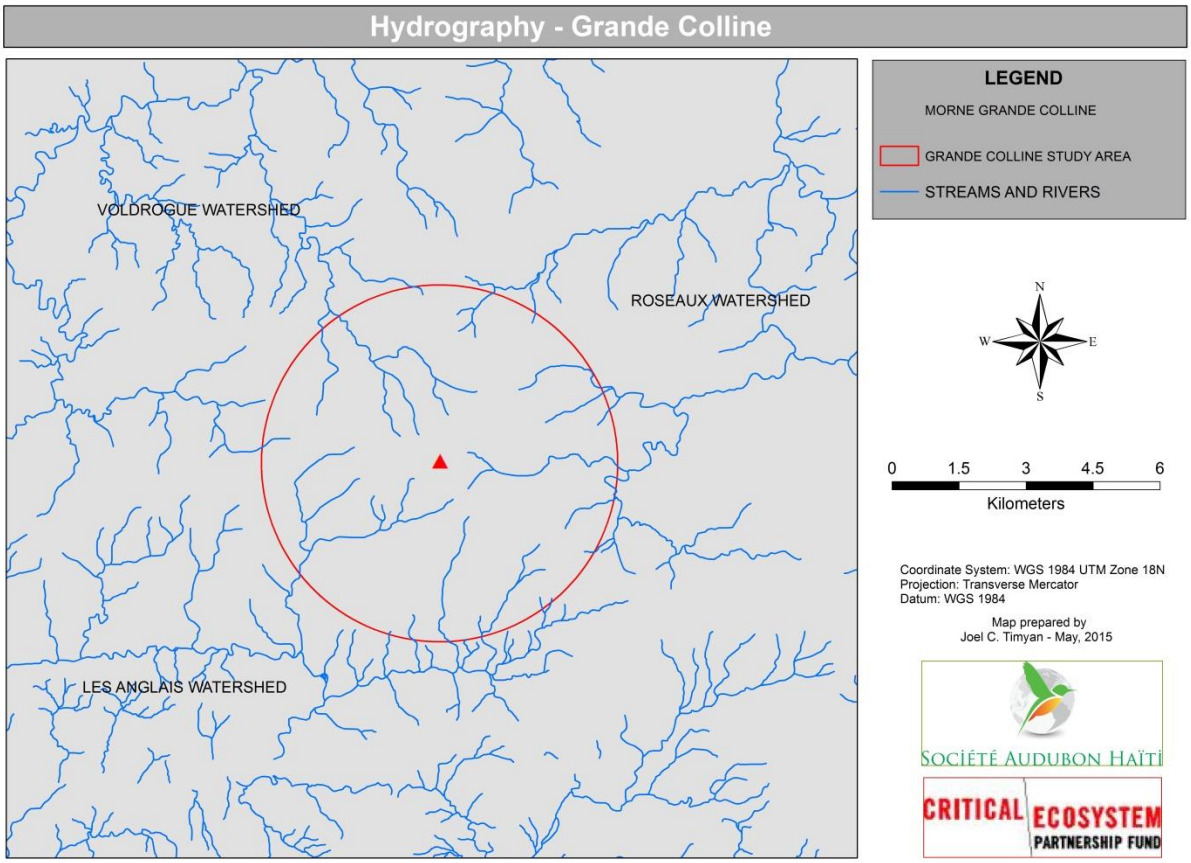

Figure 8. Hydrography of the Grande Colline study area (CNIGS, 2006; SAH, 2015).

Soils

Soil classification maps were not available for the Grand-Anse department. However, a recent study by Vilmont et al. (2013) for the South department describes the major soil types found in the region and these are shown for the Grande Colline study area (**Figure 9**). As shown, only part of the study area is available. The light tan is attributed to eroded poorly evolved soils (*sols peu évolvués d'érosion*) that occur due to the constant erosion and lack of time to develop true soils, absent of a differentiated soil horizon and consisting mostly of rock fragments on mountain slopes and near the summits. This soil lacks fertility and is very poor for any type of agriculture.

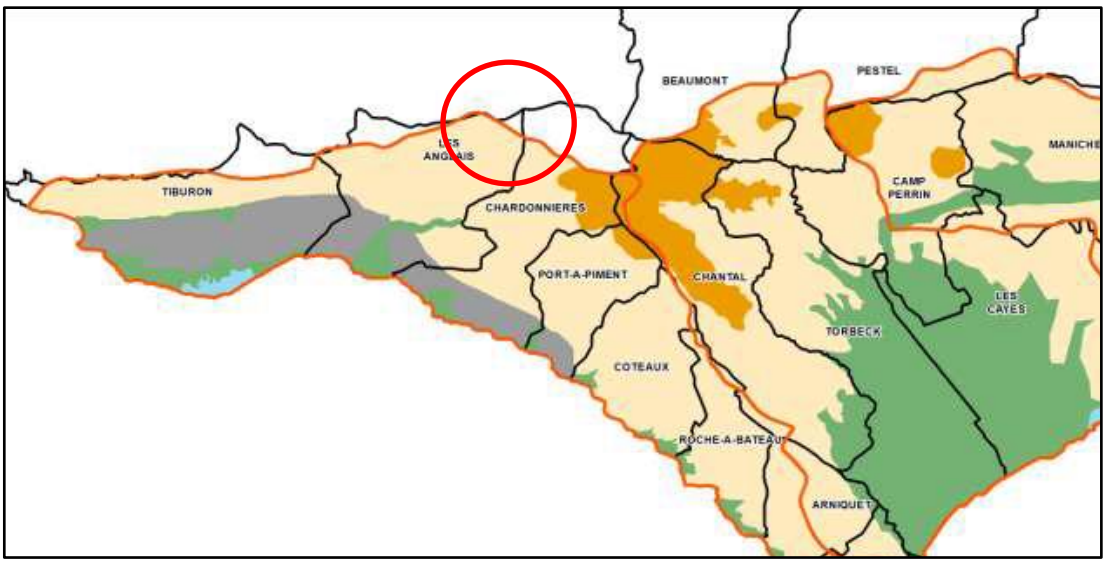

Figure 9. Soil map showing location of the Grande Colline study area (Vilmont, 2013).

Soil Erosion Risk

The risk of soil erosion map provided by CNIGS is based on an index that takes into account slope, soil properties and climate, principally rainfall (MPCE, 2002). The index has 6 categories ranging from zero or very low (0) to extremely high (5). The soil erosion risk map for the Grande Colline study area is shown below in **Figure 10**.

The highest risk category (5), extremely high, covers 41% of the 50 km^2 area, equivalent to 21 km^2. The next category (high = 4) covers 48% of the study area, equivalent to 24 km^2. The above average risk (category 3) covers the remainder of the study area, equivalent to 5 km^2. The map in Figure 10 shows the distribution of these 3 categories in the study area.

None of the 2 lowest risk categories are present in the Grande Colline study area suggesting that all the land occurs on mountain slopes. Over 97% of the study area exhibits slopes greater than 30%. Twenty-three percent (23%) of the study area has slopes greater than 60%.

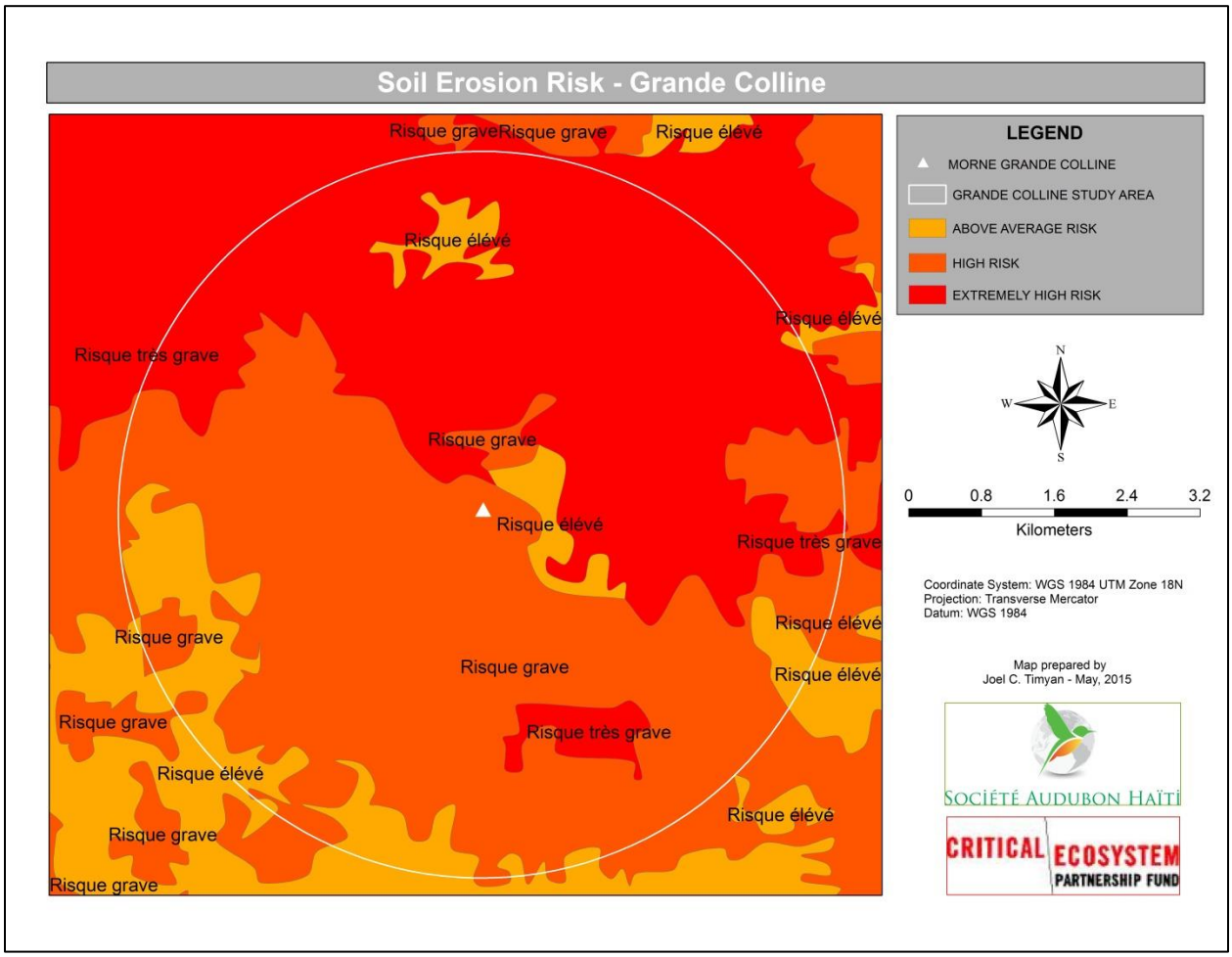

Figure 10. Soil erosion risk map for Grande Colline study area (CNIGS, 2004; SAH, 2015).

Soil Quality

As a result of the significant soil erosion risks, mostly due to slope but also to the high rainfall of the area, the potential of the soil to support agriculture is very poor (**Figure 11**). Most of Grande Colline (> 80 %) has the least arable category, shown in the map as "Très Limitées," after the method developed by BPDA (1982). These soils are characterized by steep slopes and shallow soil depths due to past erosion. The other category of soil potential, shown in the map as "Faibles," are also shallow soils but on less steep slopes.

Regardless of these conditions, the soils are cultivated anyway and once deforested and infertile, become dominated by ruderal grass, forb and shrub species that are continually grazed by cattle, goats and sheep or suffer from uncontrolled fires.

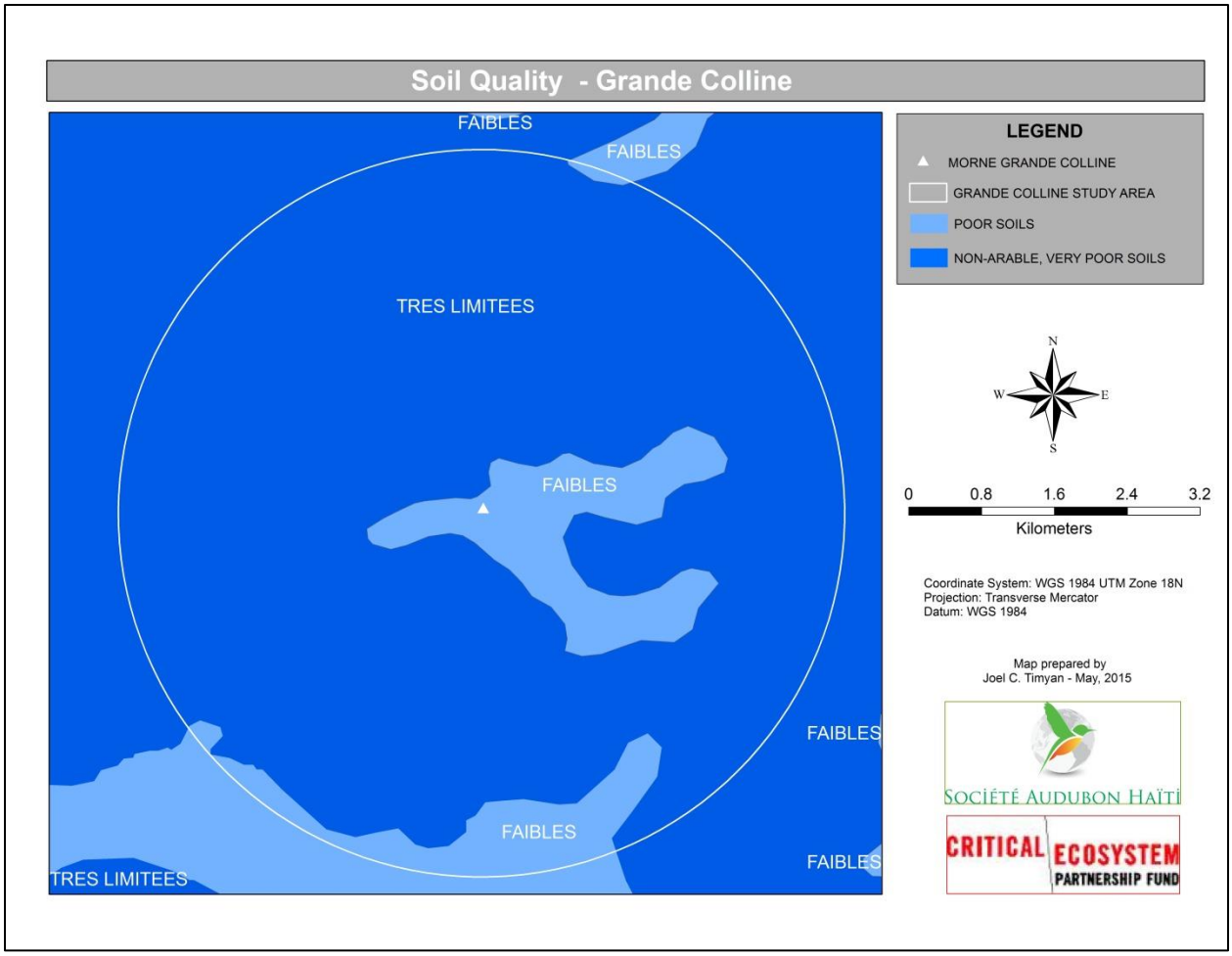

Figure 11. Map of soil quality in Grande Colline (CNIGS, 2002; SAH, 2015).

Precipitation

The Massif de La Hotte is among the wettest areas of Hispaniola. The mean annual rainfall can reach above 3800 mm in the higher elevations above 2000 m (Mora-Castro et al., 2012). The average isohyet in the Grande Colline area is approximately 3200 mm (**Figure 12**).

Most of the rainfall is due to the orographic effect of the mountainous terrain and the orientation of the mountains relative to prevailing winds and ocean currents in this western portion of the southern peninsula. In addition to rainfall, fog contributes a significant amount of moisture which decreases in importance as the land becomes deforested and no longer benefits from fog drip.

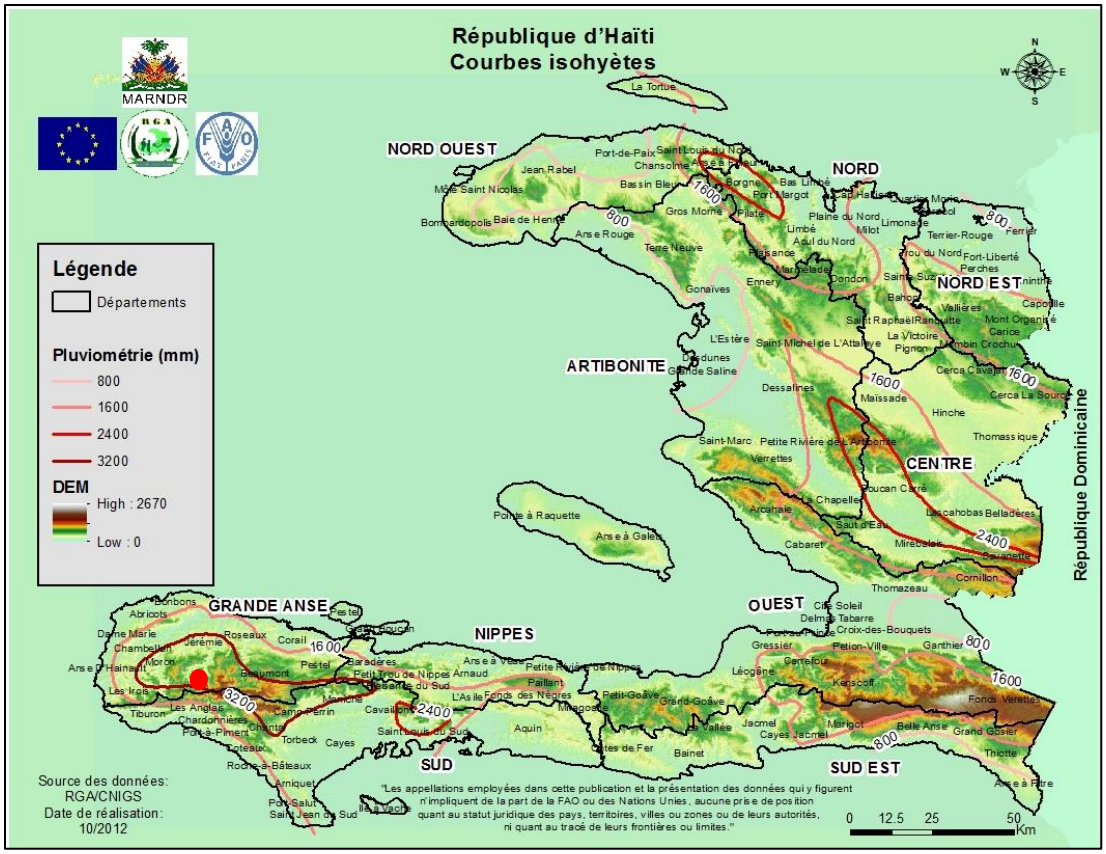

Figure 12. Map showing 3200 mm isohyete near Grande Colline (red dot). Source: RGA/CNIGS (2012).

Holdridge Life Zones

Life zones are determined as a function of climatic factors that determine the land cover type that occurs in a given area (Holdridge, 1967). These factors are principally precipitation and the precipitation:evapotranspiration ratio. Two life zones occur in the study area (**Figure 13**). The dominant life zone is Subtropical Lower Montane Rain Forest (92%) with a minor portion in Subtropical Rain Forest (8%). Most of the native forest remaining in the Grand Colline study area falls within the Subtropical Montane Rain Forest, occurring above the 1500 m elevation contour (Timyan, 2015).

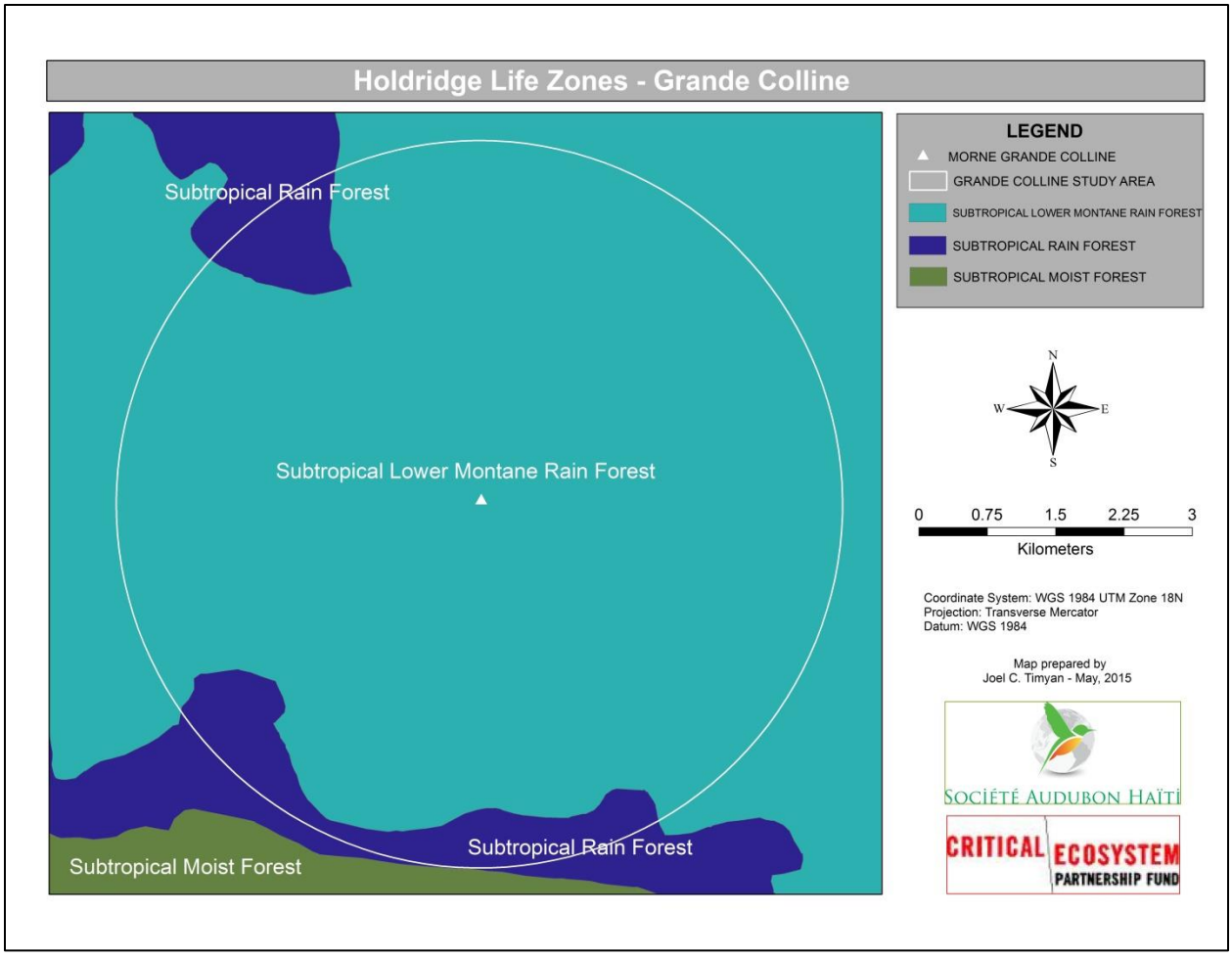

Figure 13. Holdridge Life Zones occurring in the Grande Colline study area (CNIGS, 2004).

Land Use

Land use categories were assigned to 1998 aerial photos of Haiti and analyzed for coverage in the study area (MPCE, 2002). The results for the Grande Colline study area are shown in **Figure 14**.

The largest category were grasslands that occupied 27.7 km^2 (55%) of the study area. The next most important land use category were gardens (14.3 km^2 = 29%), followed by forests (7.4 km^2 = 15%) and dense agroforestry (0.6 km^2 = 1%). The forest cover in 1998 is much less than the reported 32% forest cover (Timyan, 2015). This is likely due to a combination of two factors: 1) errors in either study associated with the classification and interpretation of the actual ground cover and/or 2) real differences between the 2 time periods due to a net accretion of forest cover.

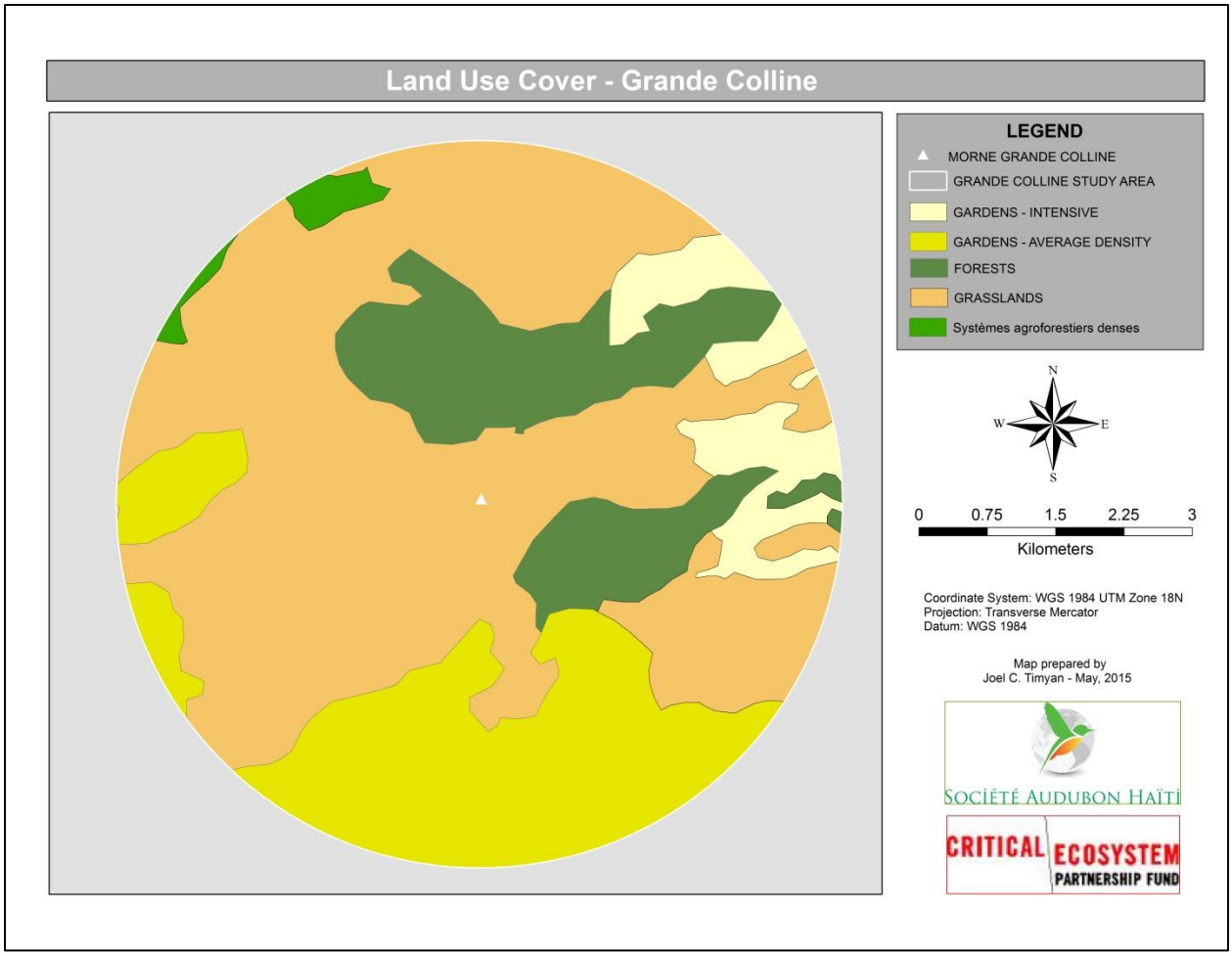

Figure 14. Land use categories in the Grande Colline study area from 1998 aerial photos (CNIGS, 2009; SAH, 2015).

Références

BPDA. 1982. Cartographie thématique d'Haïti. Bureau pour le Developpement de la Production Agricôle (Paris) et Secretaire d'Etat du Plan (Port-au-Prince). 66 pp.

Butterlin, J. 1954. *La Géologie de la République d'Haiti et ses rapports avec celle des régions voisines.* Publ. Comm. 150ème anniversaire de l'Indépendence d'Haiti, Port-au-Prince. 446 pp.

CNIGS. 2000 – 2012. Couches thématiques d'Haïti. Centre National d'Information Géo-Spatiale, Port-au-Prince.

Google Earth, 2015. Grande Colline. 18.3926˚ N, 74.1136˚ W, DigiGlobe September 27, 2013. May 15, 2015.

Holdridge, L. R. 1967. *Life Zone Ecology.* Tropical Science Center, San Jose. 206 pp.

IHSI. 2003. Le 4ème Recensement Général de la Population et de l'Habitat. Institut Haïtien de Statistique et d'Informatique, Port-au-Prince. http://www.ihsi.ht.

IHSI. 2012. Population Totale, Population de 18 ans et plus, Menages et Densités Estimés en 2012. Institut Haïtien de Statistique et d'Informatique, Port-au-Prince.

Lescroart M., 2014**.** Haiti – A world to save. *Terre Sauvage* No. 300 : 16-22.

MARNDR, 2012. *Courbes isohyètes d'Haïti*. Recensement Générale d'Agriculture et Centre National d'Information Géo-Spatiale, Port-au-Prince.

MCPE. 2002. Notes explicatives des cartes thématiques : Occupation du sol, Risque réel d'érosion. IGN France International – Aquater S.p.A. et Ministère de la Planification et de la Coopération Externe, Port-au-Prince. 33 p.

Mora-Castro, S., J. Saborio, J. P. Asté, C. Prepetit, V. Joseph& M. Matera. 2012. Slope instability hazard in Haiti: Emergency assessment for a safe reconstruction, pp. 153 - 172. *In* Eberhardt et al. (eds.), *Landslides and Engineered Slopes: Protecting Society through Improved Understanding.* Taylor & Francis Group, London. 2050 pp.

SAH, 2015. *ArcGIS geo databases of Haiti*. Société Audubon Haïti, Port-au-Prince.

Timyan, J. C. 2015. Forest cover analysis of Grand Bois and Grande Colline, Haiti. Société Audubon Haïti, Port-au-Prince. 16 pp.

Vilmont, E. J., R. Rozefort et N. Charles. 2013. *Etude Pédologique*. Projet de Réduction de la Vulnérabilité de la Population et des Infrastructures dans le Département Sud, Direction Départementale du Sud (Ministère de l'Environnement), Cayes. 41 pp.

World Bank. 2015. http://data.worldbank.org/indicator/SP.POP.GROW/countries/HT?display=graph.