Land Degradation Vulnerability Assessment Through Soil Erosion Susceptibility Within Mt. Guiting-Guiting Natural Park Using Geographic Information Systems (GIS) and the Revised Universal Soil Loss Equation (RUSLE) Model

Andrei Yvone R. Ricohermoso

College of Architecture, University of the Philippines-Diliman

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Prof. Jaclyn Alexandra Marie Brillantes

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Abstract

Mt. Guiting-Guiting's rich biodiversity, dense forest cover, natural water system, and mountaineering peaks provide its environmental, ecotourism significance. Though with its expected conservation as a protected area under the National Protected Areas System (NIPAS), MGGNP is degrading at an alarming rate (Tumaneng, et al.; 2015). The Philippine Key Biodiversity Area Booklet of 2019 included illegal logging, land conversion (kaingin), and collection of forest products as major threats in the protected area. Through an analysis of MGGNP's soil erosion susceptibility, the study aimed to assess the protected area's vulnerability to land degradation using GIS and the Revised Universal Soil Loss Equation (RUSLE) Model to identify the implications of existing environmental threats and determine the necessary action towards biodiversity conservation. The study followed a systematic process of data collection through existing data as supplementary to GIS-generated thematic maps and data extracted from Google Earth Engine. The maps generated through the RUSLE Model are a result of an overlay of the rainfall erosivity factor map, soil erodibility factor map, slope length and steepness map, land management factor map, and conversion practice factor map. Results showed a significant increase in the average mean soil loss in Mt. Guiting-Guiting Natural Park from 2015 to 2017. In total, there had been an increase of 2,624.75 trees per hectare per year in MGGNP's average soil loss in a span of three (3) years. There is also a significant increase in annual forest loss, preceding annual forest gain, implying a large-scale forest cover change form forest to non-forest each year. In summary, there is an annual increase in land degradation vulnerability in Mt. Guiting-Guiting Natural Park in Sibuyan Island, Romblon. Every year, MGGNP is at constant risk of diminishing forest value and biodiversity authenticity. Existing environmental threats within MGGNP must be regulated and resolved. Thus, there is an intensified demand for an effective system of management both through local efforts and government policies and programs. GIS mapping is an effective technology for land vulnerability assessment and soil loss susceptibility, but accuracy is dependent on the availability of data and the limitations of datasets and GIS software.

Keywords: biodiversity conservation, environmental threats, forest loss, GIS, land degradation, protected area, RUSLE model, soil erosion, soil loss susceptibility

Introduction

Background of the Study

Mt. Guiting-Guiting, the ‘saw-toothed’ core of Sibuyan Island in Romblon, is one of the few remaining biodiversity hotspots with complete terrestrial habitats on its precipitous slopes and series of jagged peaks. Mt. Guiting-Guiting Natural Park (MGGNP) covers 15,475.21 hectares, boasting a peak that stands at 2,058 meters above sea level. Because of its remarkable intact chain of undisturbed, biodiversity-rich ecosystems, it is often referred to as the Galapagos of Asia.

The National Museum’s 1995 Forest Inventory of Mt. Guiting-Guiting, as the densest forest in the country, revealed an approximate number of 1,551 trees per hectare. It is the only remaining mountain with a full range of forest gradients along its elevation gradients, ranging from summit heathland and grasslands, mossy forests, montane forests, lowland evergreen forests, and forests over ultrabasic rocks. Mt. Guiting-Guiting’s thick forests support the life system of the island as a carbon sink and protection against soil erosion and flooding. It has a significant contribution to climate change mitigation and disaster risk reduction. Mt. Guiting-Guiting’s rich biodiversity, dense forest cover, natural water system, and mountaineering peaks provide its environmental, ecotourism significance.

Though with its expected conservation as a protected area under the National Protected Areas System (NIPAS), MGGNP is degrading at an alarming rate (Tumaneng, Monzon, Pales, & De Alban; 2015). The Philippine Key Biodiversity Area Booklet of 2019 included illegal logging, land conversion (kaingin), and collection of forest products as major threats in the protected area.

In the year of 2010, the government placed a total of 1,580.80 hectares of the island under mineral production sharing agreements (MPSA) to attract foreign investments (Alave, 2011). Rodne Galicha, MGGNP Environmentalist, also stated that the island's old-grown timbers drew logging firms that induced activities that softened slope soil and increased landslide susceptibility in the area. Three years later, Mt. Guiting-Guiting’s forest cover had decreased by 16%, threatening the existence of vital watersheds such as Cantigas and Palangcalan (Tongson & Balasinorwala, 2013). Evangelista (2007) estimates a total erosion rate increase for both watersheds by 28 percent in a span of 25 years.

MGGNP is currently protected through local efforts and park staff that help with its management and security from illegal logging and mining activities. Starting only from local initiative, the protected area had full time staff and funding in 2015. Funding and staff members increased in 2016 (Pearlman, 2017). Despite local efforts, the high-volume lumber poachers and illegal miners continue to pose socio-economic, public threat, and increased risk of soil vulnerability and land degradation to the protected area. Thus, there is a need for public awareness, support, and accountability from the national government to address the issue.

Land degradation is a complex environmental problem associated with the decline of ecosystems and natural resource quality. It occurs through biophysical processes such as the depletion of soil nutrients, reduction in soil organic matter (SOM), and soil erosion (Chalise, Kumar, & Kristiansen, 2019). An area's vulnerability must be assessed to determine significant natural resource management and conservation activities towards land redevelopment. Though there are existing research studies regarding forest loss and land use management utilizing Geographic Information Systems (GIS) involving the area, there is a lack of studies specific for land vulnerability assessment in Mt. Guiting-Guiting Natural Park.

Through an analysis of MGGNP's soil erosion susceptibility, the study aims to assess the protected area's vulnerability to land degradation using GIS and the Revised Universal Soil Loss Equation (RUSLE) Model to identify the implications of existing environmental threats and determine the necessary action towards biodiversity preservation.

Statement of the Problem

The study aims to effectively assess the vulnerability of Mt. Guiting-Guiting Natural Park to land degradation through an analysis of soil erosion susceptibility within its area using GIS and RUSLE Model. The study focuses on the comparison of soil loss and forest cover changes in 2015, 2016, and 2017. Specifically, the study will seek to answer the following research questions.

Main Problem

How vulnerable is Mt. Guiting-Guiting Natural Park to land degradation in terms of soil erosion susceptibility?

Sub-Problems

1. Is there a significant difference in the average soil loss in Mt. Guiting-Guiting Natural Park in 2015, 2016, and 2017?

2. Is there a significant change in forest cover in Mt. Guiting-Guiting Natural Park?

3. How does the analysis of soil loss susceptibility through the RUSLE Model and annual forest gain/loss indicate land degradation vulnerability in Mt. Guiting-Guiting Natural Park?

4. How effective are geographic information systems (GIS) in the reproduction of accurate data for landscape analysis?

Goals and Objectives of the Study

This study identifies the possible impacts of existing environmental threats to Mt. Guiting-Guiting Natural Park in Sibuyan Island, Romblon in terms of forest cover and land management. Specifically, the study will seek to accomplish the following objectives.

1. To collect data and generate maps through an overlay of five (5) RUSLE factors and estimate the average annual soil loss within MGGNP including factors such as soil type, rainfall erosivity, topography, forest cover management, and soil support practice for soil programming and soil loss approximation based on available GIS data.

2. To assess MGGNP’s Annual Forest Loss/Gain and mapping other biophysical indicators to cross reference for a more accurate interpretation of land degradation vulnerability.

3. To determine MGGNP’s soil erosion susceptibility and relevant implications of existing illegal activities in the protected area.

4. To increase local and national awareness of biodiversity threats to MGGNP as a call for action.

Significance of the Study

This study of Mt. Guiting-Guiting Natural Park's land degradation vulnerability assessment is significantly aligned towards the biodiversity conservation and protection of protected areas. Identified implications of environmental threats in this research are geared towards public, local, and government awareness and action. The study specifically benefits the following themes.

Hazard Mitigation and Adaptation. The study will help the LGU to visualize the impacts of illegal activities to the protected area and will help them to employ appropriate mitigation measures.

Biodiversity Preservation. MGGNP will be protected from further land degradation through the results of the RUSLE model and GIS mapping.

Environmental Management. The study will help the national government to realize the need for better management and employment of the necessary programs and policies for MGGNP's biodiversity sustainability.

GIS-Based Research. The study will be a significant addition to Protected Area design and studies and will help highlight the advantages of using GIS for similar future studies.

Scope and Limitations of the Study

This study focuses on the land degradation vulnerability assessment of Mt. Guiting-Guiting Natural Park in Sibuyan Island, Romblon. Land degradation is specific on biophysical indicators such as soil loss and forest cover change. The study used readily available online information from 2015, 2016, and 2017, and the contents of the Final MGGNP Management Plan for 2022-2032. No onsite inspection of the MGGNP was conducted.

The study is only limited to the boundaries of the Core Zone of the MGGNP and will not cover the buffer zone or any adjacent areas within the Island. The Revised Universal Soil Loss Equation (RUSLE) model only accounts for soil loss through sheet and rill erosion, and only estimates erosion for topsoil.

Review of Related Literature

Impacts of Soil Degradation

Forest degradation puts the landscape in a self-organizational decline and lack of environmental adaptation, and it involves processes that are either reversible or irreversible. Irreversible forest degradation, specifically, starts with soil damage. Quantitative soil degradation includes irreversible soil loss, erosion, or desertification while qualitative degradation consists of reversible results of soil disintegration, leaching, acidification, salinization, and intoxication. Such irreversible changes in an ecosystem's processes alter potential natural vegetation and prompt land degradation (Samec, Kučera, & Tomášová, 2022).

GIS-Based Land Degradation Assessment

Land vulnerability indicators are classified into biophysical, chemical, and socioeconomic indicators. These biophysical indicators are land use and land cover, soil erosion and vegetation cover which are identified through Landsat images. Land use and land cover are classified into agriculture, shrubland, bare land, grassland, and forest. Soil adjusted vegetation index (SAVI) can be used to compute the vegetation index and interpret vegetation cover. On the other hand, the annual soil loss rate can be modeled through the revised universal soil loss equation (RUSLE) Model. Using these GIS methods, a landscape area's vulnerability to land degradation can be determined (Wodaje, 2016).

Forest Degradation Assessment of Mt. Guiting-Guiting Natural Park (MGGNP) from 2007 to 2009 through Radar Imaging

Mt. Guiting-guiting Natural Park (MGGNP) in Sibuyan Island, Romblon is one of the identified protected areas that are being degraded at an alarming rate. Through Synthetic Aperture Radar (SAR) technology, the extent of deforestation and forest degradation in MGGNP was assessed. Dual-polarised L-band ALOS/PALSAR mosaic data at 25-meter spatial resolution, specifically, provided data on forest cover and habitat change in Sibuyan Island in 2007 and 2009.

The result of SAR imaging revealed that the forest cover was maintained in a span of two years but there has been a significant increase in the rate of degradation (see Figure 1). Identified factors of forest degradation in the island are caused by unregulated harvesting of forest resources such as fuel wood, charcoal and poles/post, unregulated logging, and unsustainable collection of non-timber forest products (Tumaneng, et al.; 2015).

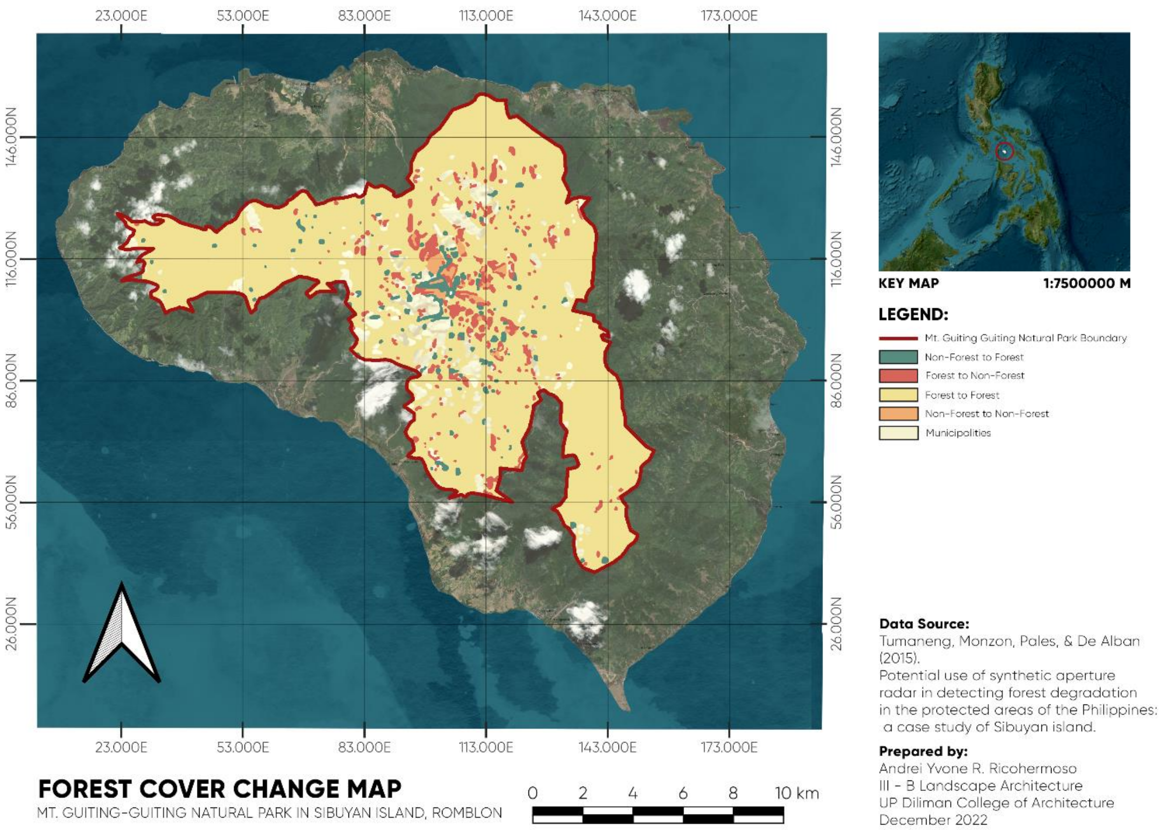


Figure 1. Forest Cover Change Map of Mt. Guiting-Guiting Natural Park from 2007 to 2009.

Impacts of Illegal Logging to Soil Erosion

Logging activities cause direct impact of forest cover loss and an increase of soil erosion rates during heavy rainfall. Logging implied direct increase in surface runoff and soil erosion, focused on timber felling, skidding trails establishment and log skidding and/or hauling from the logging compartments through feeder roads to the temporary log yard. This increase in soil erosion rate is dependent on the slope and its length. Likewise, forest cover is a significant factor in minimizing the occurrence of surface runoff and soil erosion (Kobayashi, Turnbull, Toma, Mori, & Majid; 2001).

Impact of Lack of Funds on Biodiversity Conservation

Indigenous and community conserved areas (ICCA) are often provided with conservation grants, a form of funding for monitoring and evaluation of biodiversity conservation. The ancestral domain of the Sibuyan Mangyan Tagabukid (SMT) in Romblon was assessed through the modified threat reduction assessment (MTRA) to determine the impact of grants to mitigate environmental threats. This quantitative approach utilizes such threats as indicators of conservation success. Results showed that low threat mitigation and reduction was caused by the lack of funding. It is also due to the lack of monitoring and evaluation (M&E) in the ICCA that hinders their full understanding of the impacts of environmental threats to help effectively address them (Marasigan, 2021).

Table 1. Summary of Related Literature Review on Land Degradation Vulnerability Assessment through Soil Loss Susceptibility Using GIS in Mt. Guiting-Guiting Natural Park.

NAME	COUNTRY	RESEARCH METHODOLOGY	FOCUS
Pavel Samec, Aleš Kučera and Gabriela Tomášová (2022)	Czech Republic	Qualitative approach	Impacts of soil/land degradation to forested areas
Sileshi Tadesse Wodaje (2016)	Norway	Spatial multicriteria analysis	GIS-based land degradation assessment
Roven Tumaneng, Angelica Kristina Monzon, Joanne Rae Pales , and Jose Don de Alban (2015)	Philippines	Synthetic Aperture Radar (SAR) imaging and analysis	Forest Degradation Assessment through Radar Imaging
Kobayashi, S., Turnbull, J.W., Toma, T., Mori, T., Majid, N.M.N.A. (2001)	Indonesia	Field survey	Impacts of illegal logging to soil erosion
Marjorie Marasigan (2021)	Austria	Secondary data review, focus group discussion, informal interviews,	Modified Threat Reduction Assessment (MTRA), impact of lack of funds and government support on biodiversity conservation

Methodology

Study Area

Mt. Guiting-Guiting Natural Park (MGGNP) is known to tourists and locals for its picturesque nature and pristine beauty, but it offers more than visual and ecotourism significance. It was proclaimed as a Protected Area on February 20 of 1996 through Presidential Proclamation No. 746. The main objective of its establishment as a natural park is to preserve its biological integrity through sustainable and community-based programs, to protect the endemic and existing flora and fauna within the area.

Note: All information stated in this portion of the research paper is derived from the Mount Guiting-Guiting Natural Park Protected Area Management Plan (2022-2032).

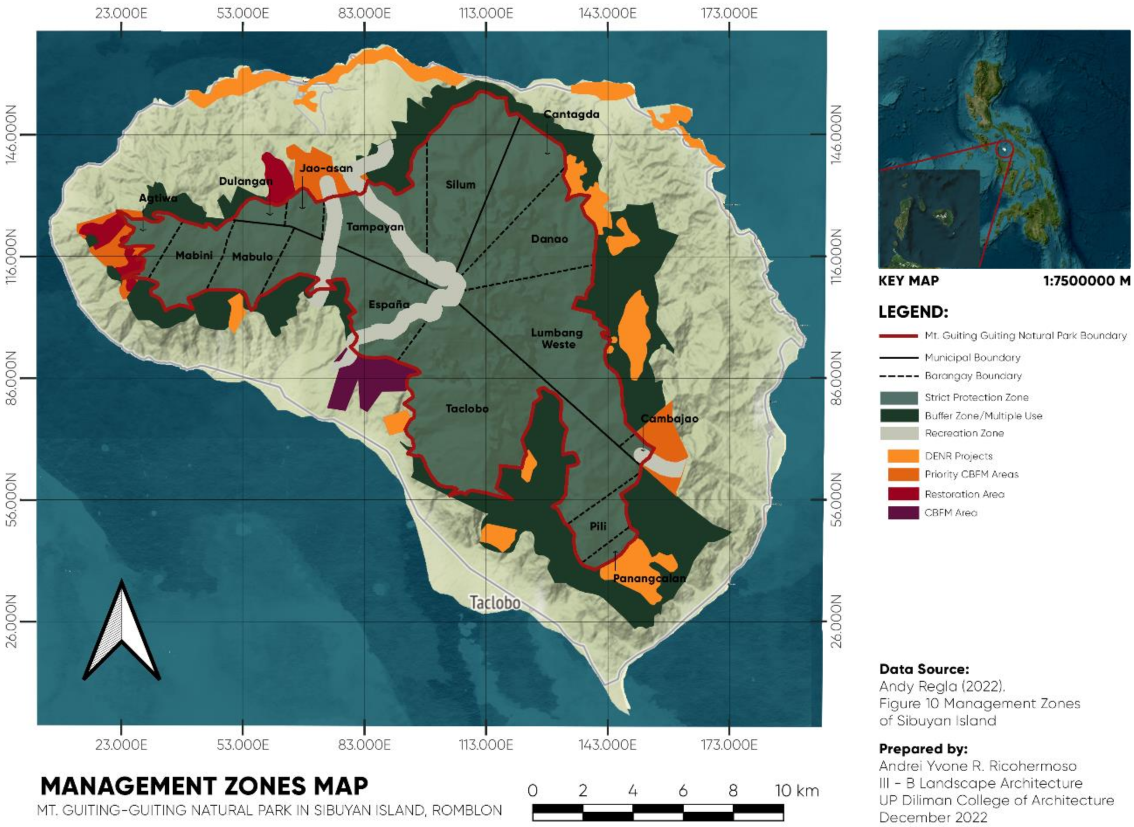


Figure 2. Management Zones Map of Mt. Guiting-Guiting Natural Park.

Mt. Guiting-Guiting Natural Park covers 15, 475,21 hectares with approximately 10,000 hectares of buffer zone, boasting a peak at 2,058 meters above sea level (see Fig. 3). MGGNP boasts precipitous slopes and several jagged peaks (see Fig. 4). It is a mountain with a full range of forest gradients from summit heathland and grasslands, mossy forests, montane forests, lowland evergreen forests, and forests over ultrabasic rocks (see Fig. 5).

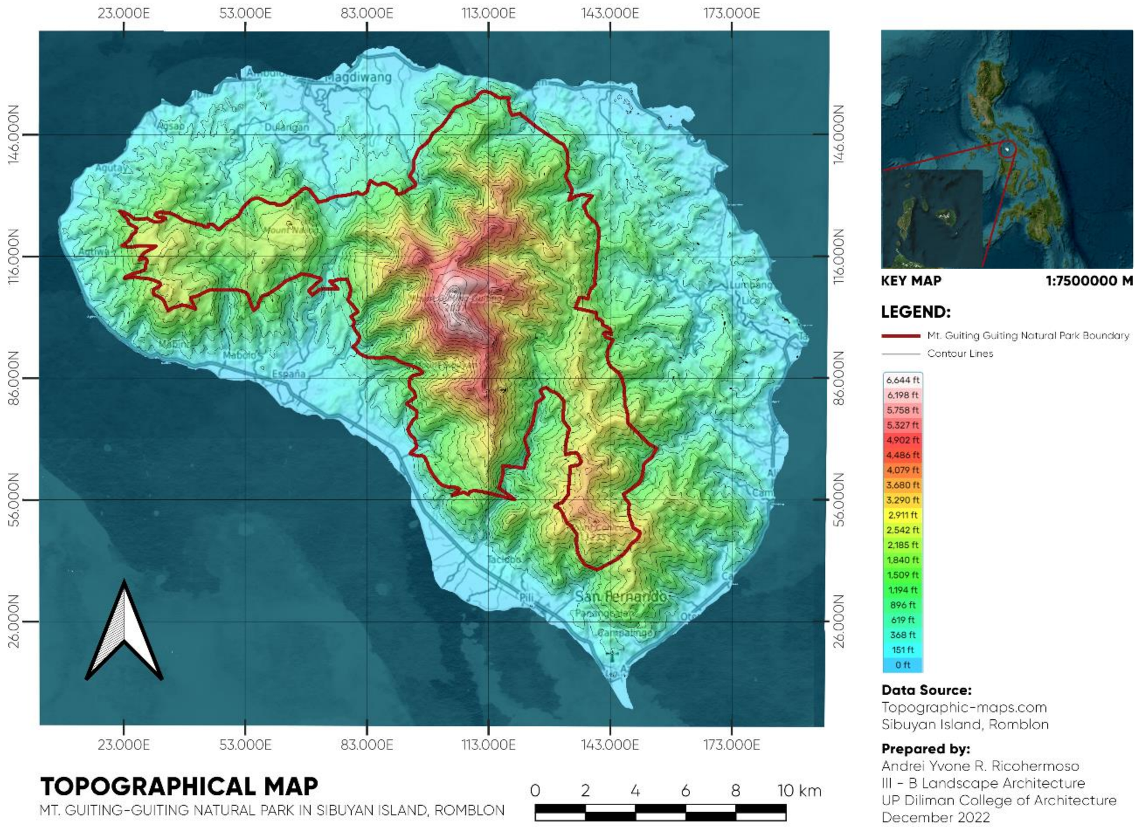


Figure 3. Topographical Map of Mt. Guiting-Guiting Natural Park.

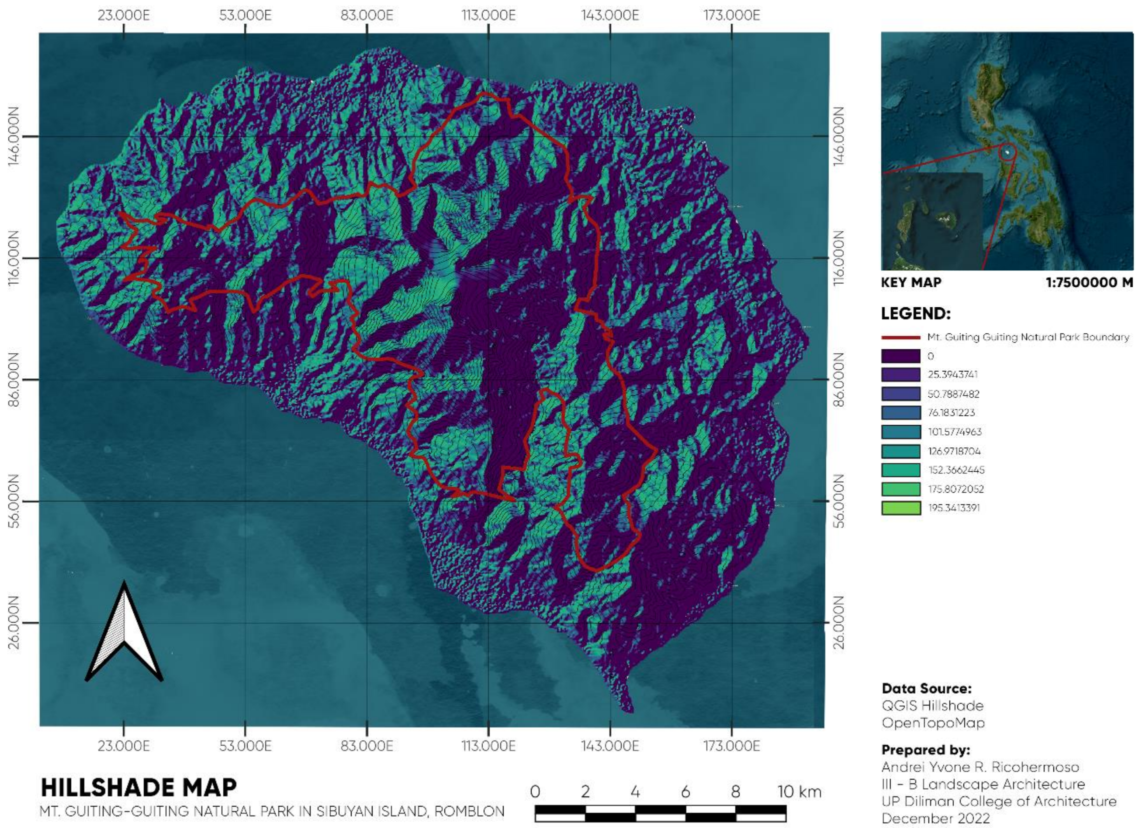


Figure 4. Hillshade of Mt. Guiting-Guiting Natural Park.

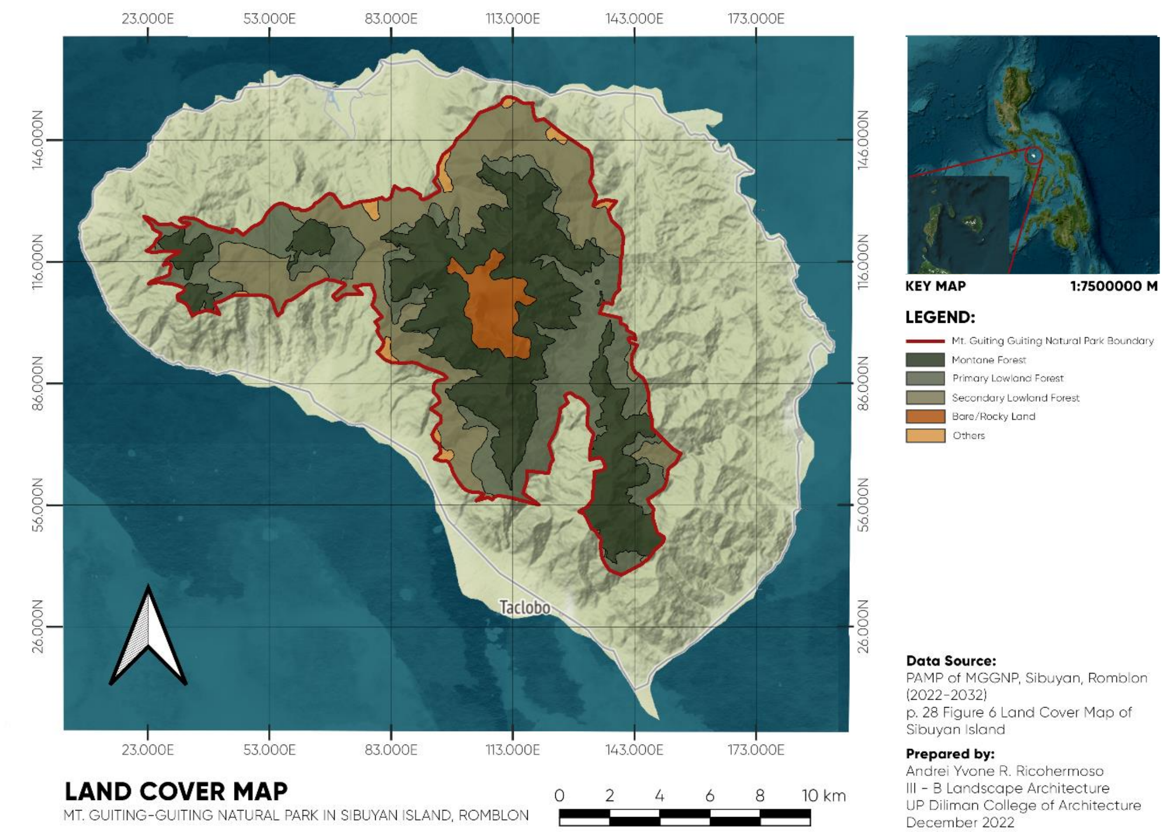


Figure 5. Land Cover Map of Mt. Guiting-Guiting Natural Park.

Administrative

Mt. Guiting-Guiting Natural Park is in the center of the island, enveloped by three municipalities namely Magdiwang, Cajidiocan, and San Fernando (see Fig. 5). The Natural Park is accessible through trails from surrounding barangays which also serves as exit points of timber and non-timber forest products. The trails connect with the established barangay roads (see Fig. 6).

It is also an excellent source of water with waterfalls, springs, streams, lakes and rivers streamed towards different tributaries, irrigating farms, providing potable water, and for recreational purposes (see Fig. 7). The rivers draining the largest watersheds are Nailog-Dulangan-Cataja-Pato-o and Pawala both in Magdiwang, the Guinalan-Cambulayan-Lumbang River in Cajidiocan, and the Cantingas River (see Fig. 8). The Cantingas River of the park is recognized with a Presidential Award for being the cleanest inland body of water in the Philippines for five consecutive years (1995-1999) in Region IV-A.

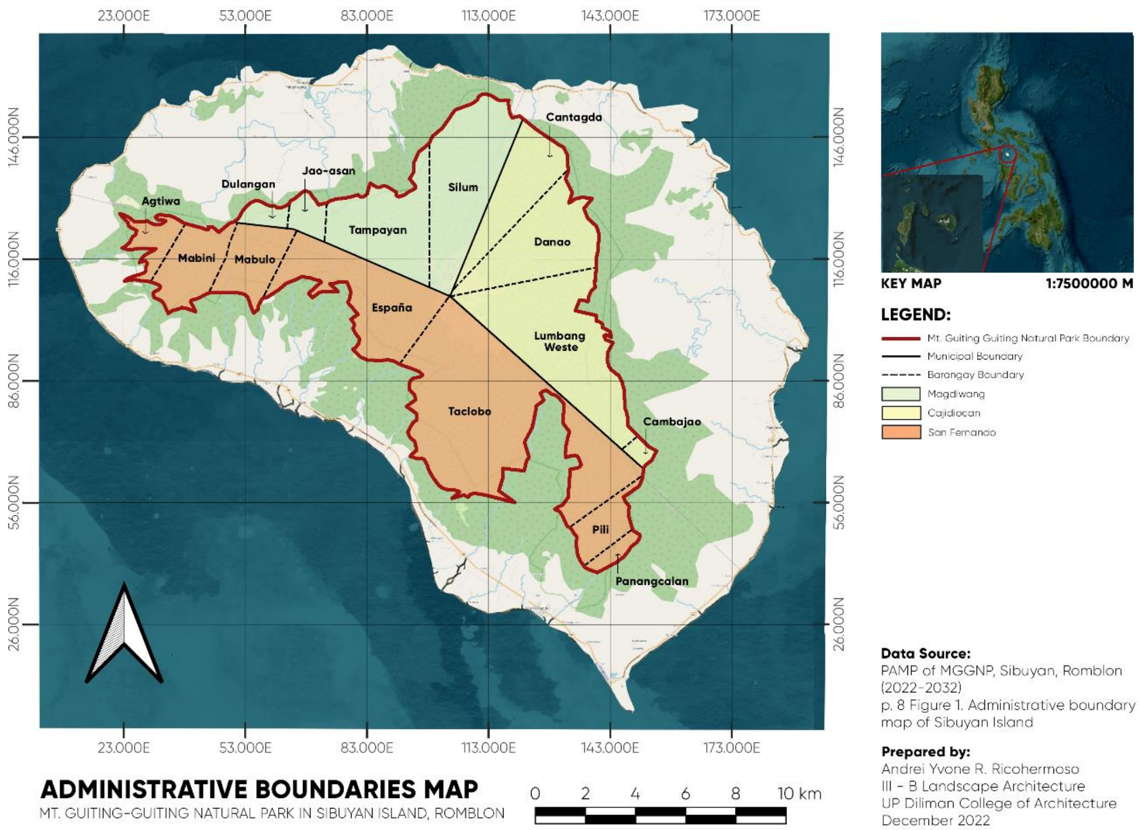


Figure 6. Administrative Boundaries Map of Mt. Guiting-Guiting Natural Park.

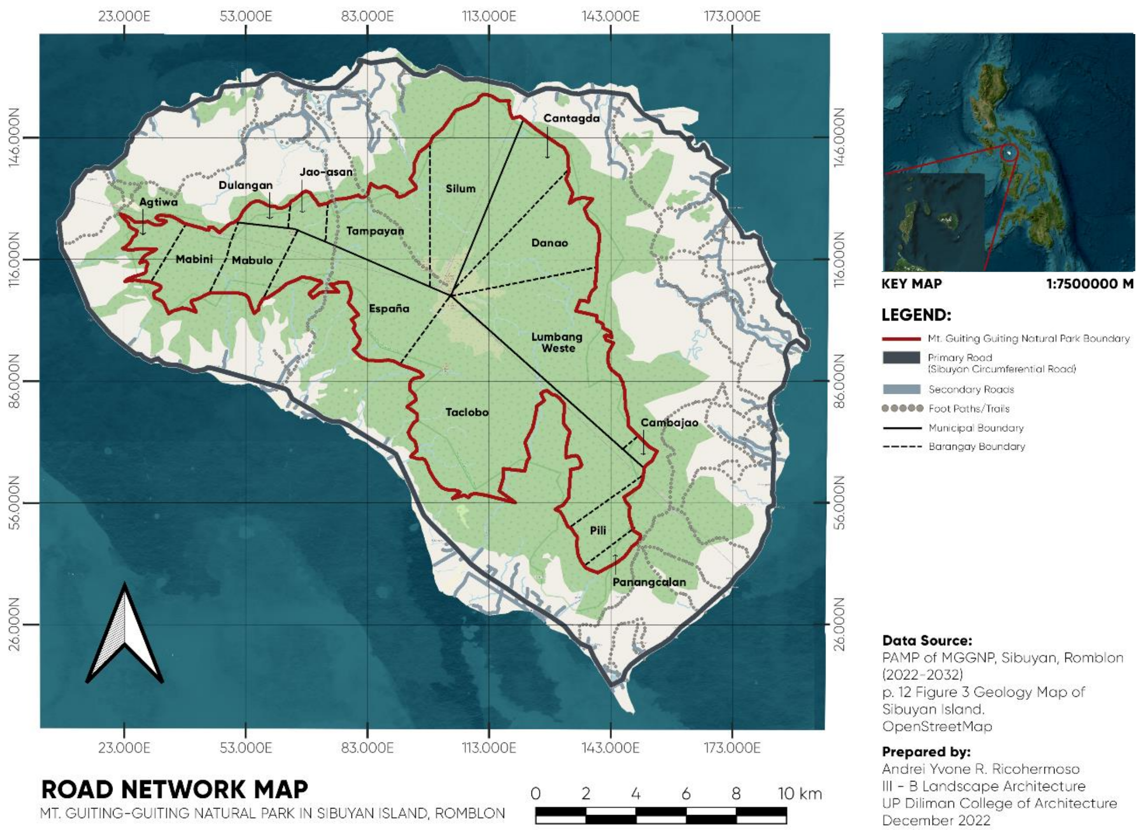


Figure 7. Road Network Map of Mt. Guiting-Guiting Natural Park

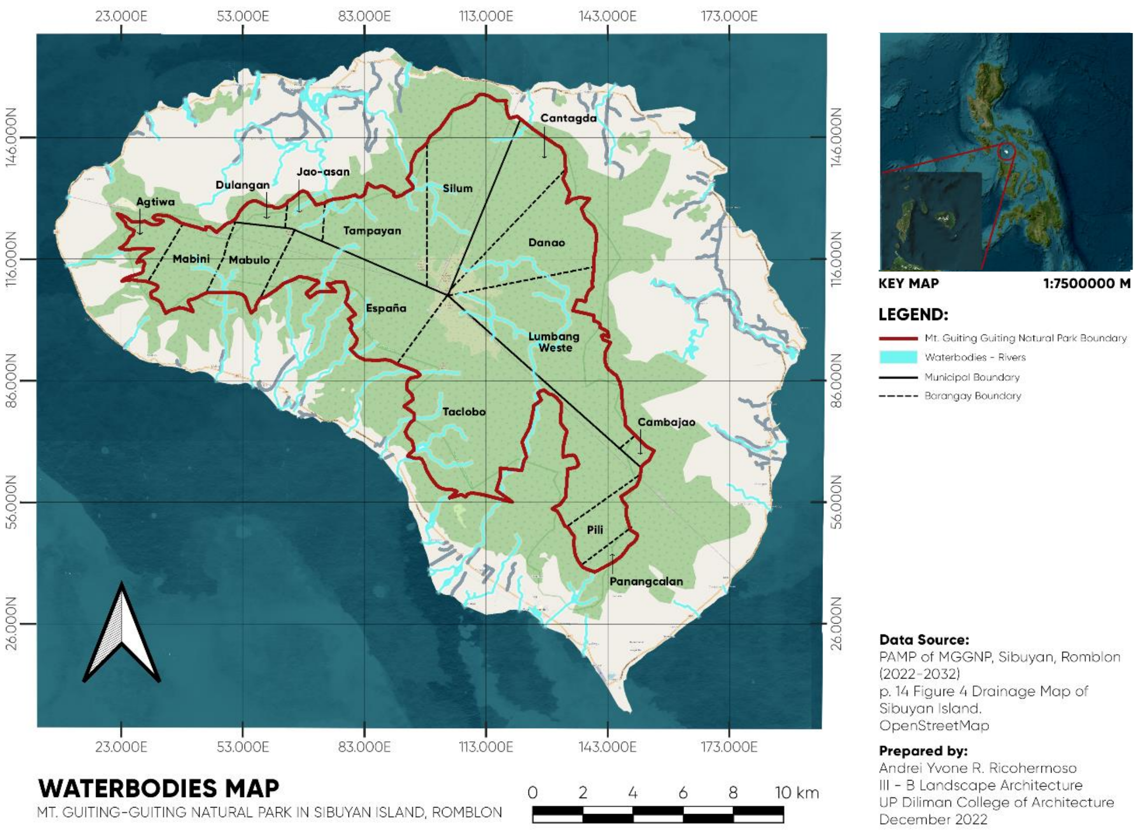


Figure 8. Waterbodies Map of Mt. Guiting-Guiting Natural Park

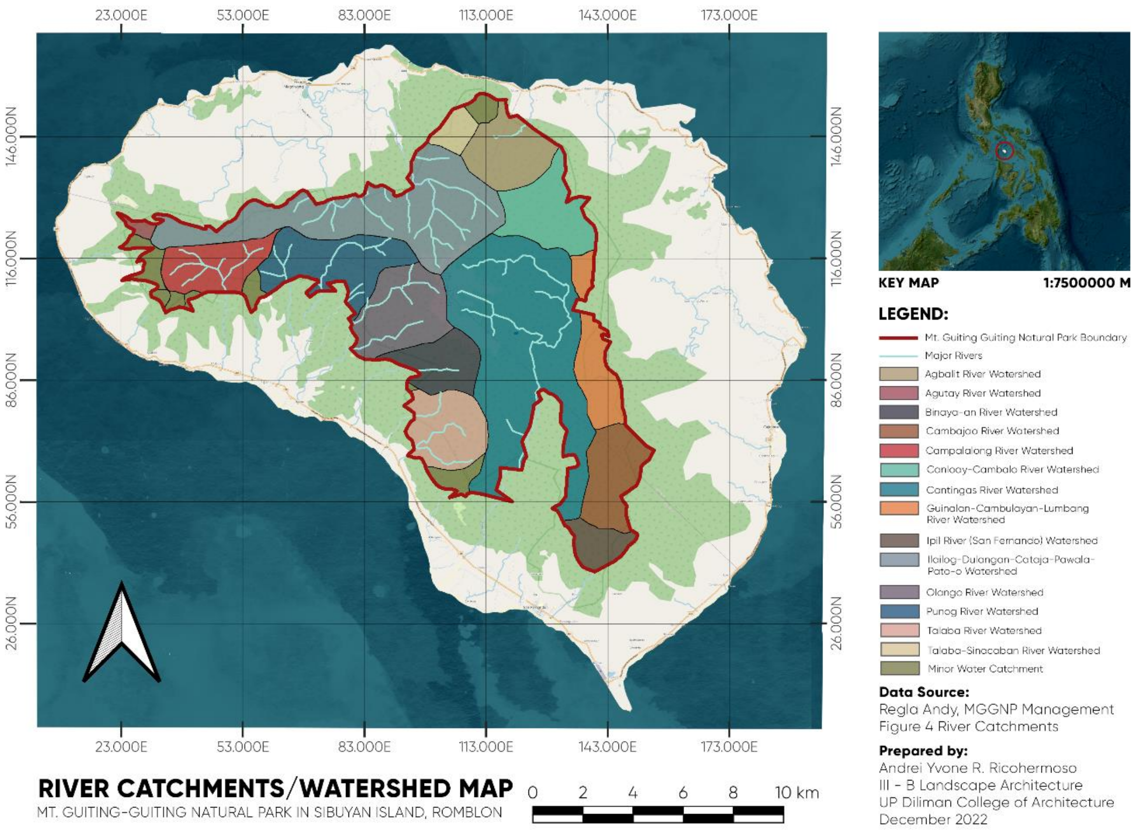


Figure 9. River Catchments/Watershed Map of Mt. Guiting-Guiting Natural Park

Geological

The park’s geological composition is dominated by intrusive Sibuyan ultramafics, also including small areas of Romblon metamorphic rocks in its eastern and western extremities (see Fig. 9). Sibuyan contains deposits of manganese, gold, iron ore, nickel, jadeite, limestone (red and white) and silica quartz; based on the 1986 record of the Department of Agriculture.

The soils of Mt. Guiting Guiting Natural Park range from sandy clay-loam to metamorphic sandy and stony soil and loam, to underlain coarse sand and gravel. Mountain soils covers a total area of 149 kilometers.

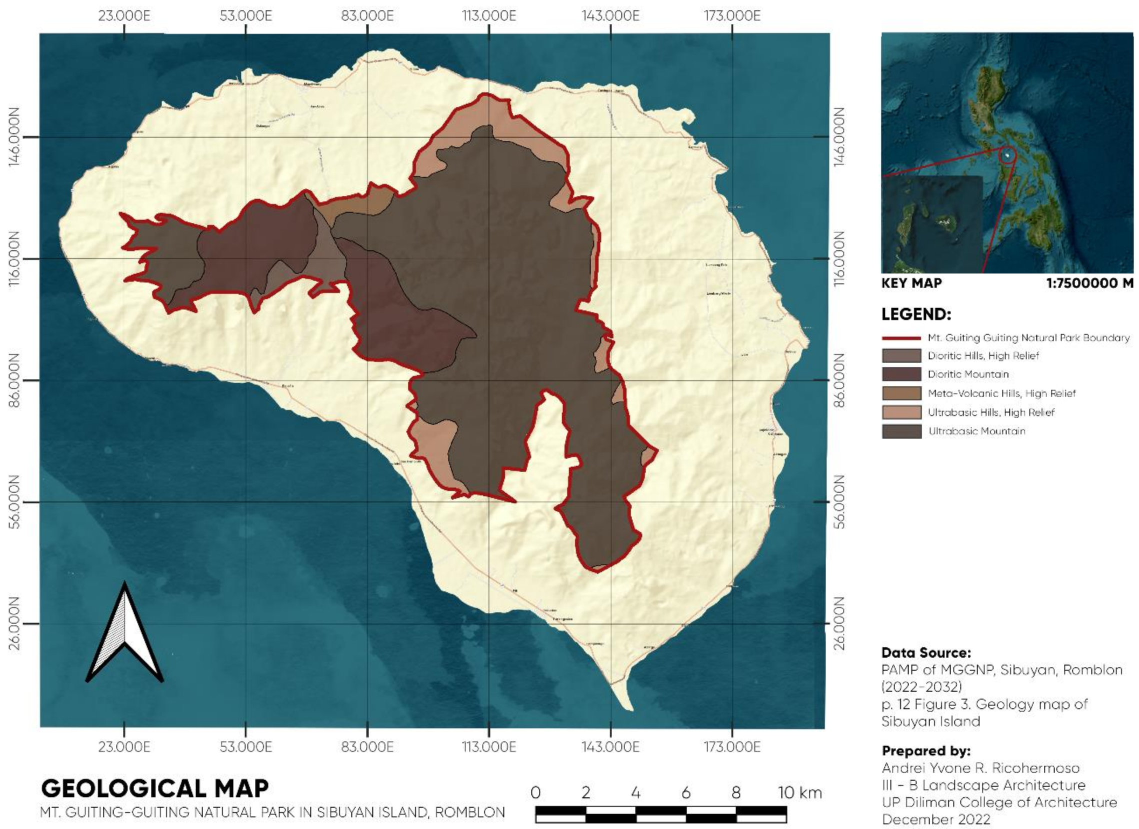


Figure 10. Geological Map of Mt. Guiting-Guiting Natural Park

Demographic

MGGNP is a great heritage and blessing to its 50,000 inhabitants (see Fig. 10), supplying their needs. The number of residents in Sibuyan Island is relatively stable, with an annual mean increase of less than one percent (see Fig. 11). Most of them live along the coastal plains and in the lower slopes of Mt. Guiting-Guiting.

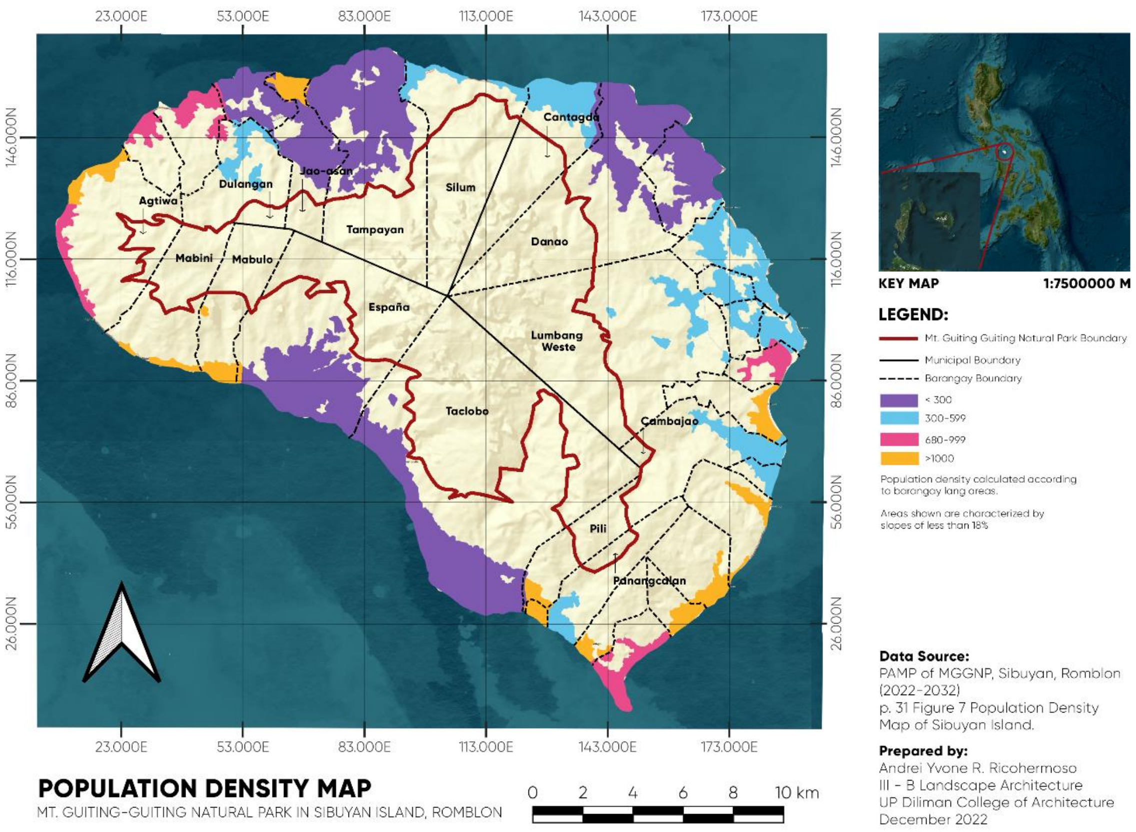


Figure 11. Population Density Map of Mt. Guiting-Guiting Natural Park

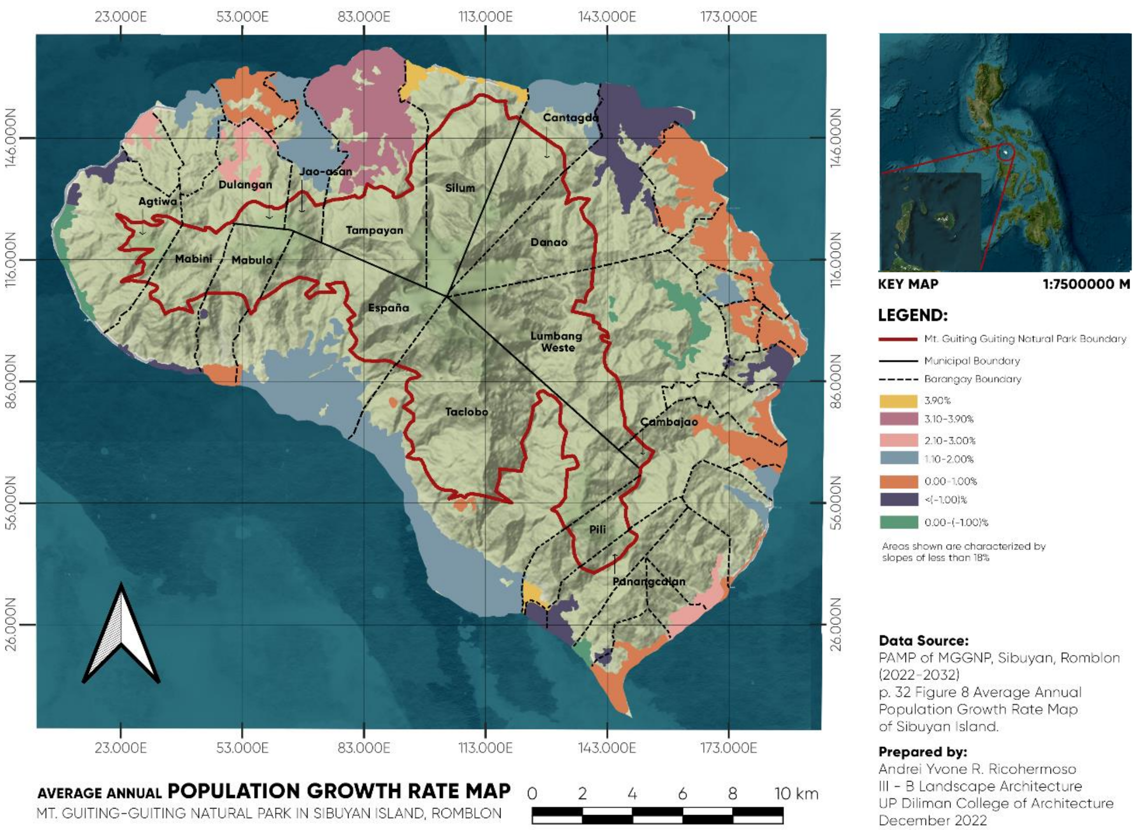


Figure 12. Population Growth Rate Map of Mt. Guiting-Guiting Natural Park

Socio-Economic

Livelihood within the island depends on near subsistence level in agriculture and in fishing. Most residents depend on the park's natural forests for timber and non-timber products such as rattan and vines, practicing illegal logging, which puts the forest under constant risk of overexploitation.

Research Design

The study utilized a quantitative approach through scientific analysis and visualization of GIS-generated and available geospatial data. The study is divided into three parts: (1) the generation of necessary thematic maps through QGIS, (2) the extraction of geospatial data and quantitative analysis in Google Earth Engine, and (3) thorough assessment and comparison of the results for interpretation.

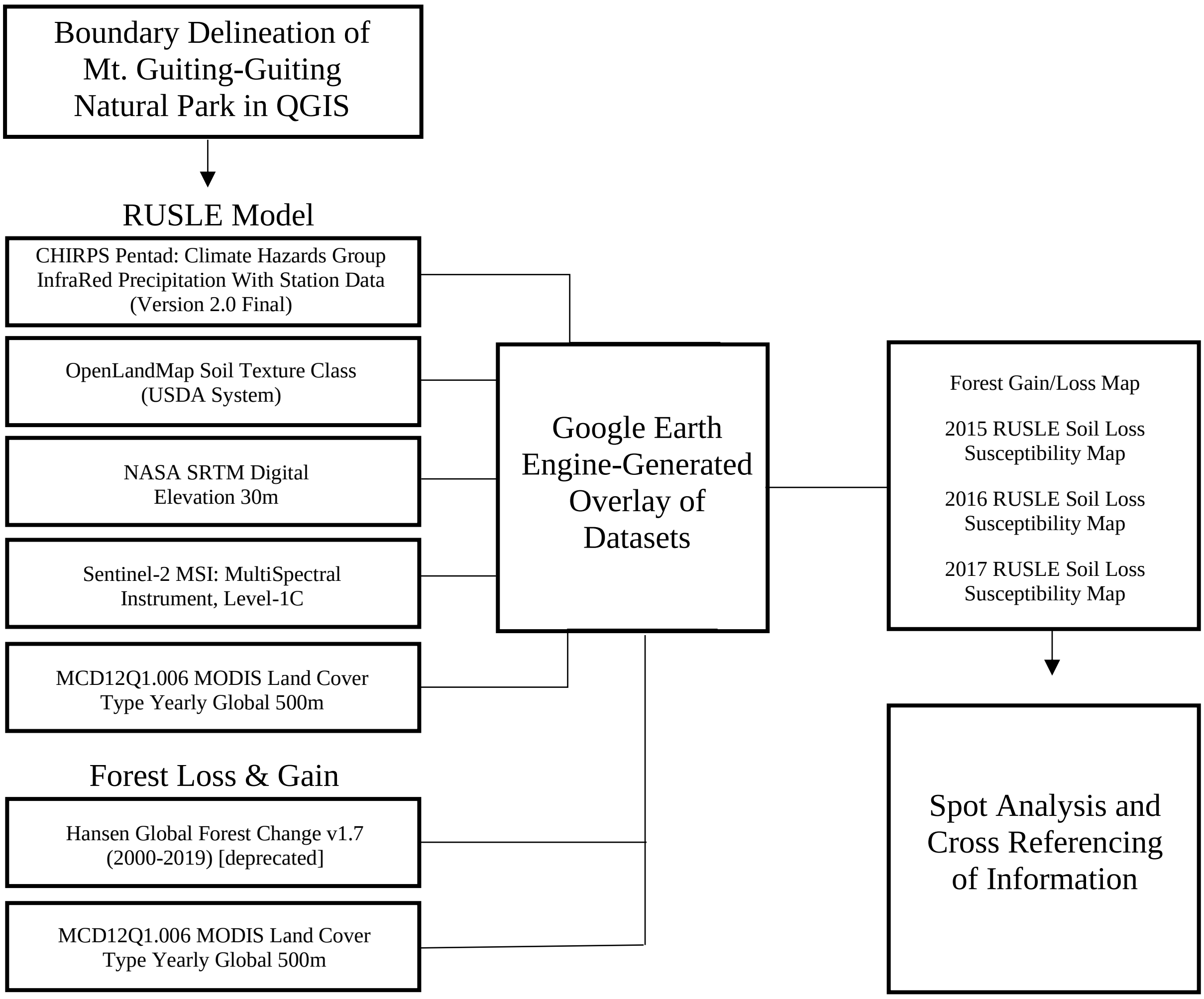


Figure 13. Research Methodology for Geospatial Data Collection and Analysis

Data Collection

The study followed a systematic process of data collection through an initial compilation of existing data regarding the site as a supplementary to GIS-generated thematic maps and data extracted from Google Earth Engine, which will be significant in formulating analysis on soil erosion susceptibility and land degradation vulnerability. The following datasets were utilized in Google Earth Engine to produce Soil Loss Maps through the RUSLE Model and the Annual Forest Gain/Loss Map.

Table 2. Datasets Used in Google Earth Engine for Soil Loss Susceptibility and Annual Forest Gain/Loss Assessment.

DATASET	DESCRIPTION	AVAILABILITY	GENERATED DATA
CHIRPS Pentad: Climate Hazards Group InfraRed Precipitation With Station Data (Version 2.0 Final)	Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS) is a 30+ year quasi-global rainfall dataset. CHIRPS incorporates 0.05° resolution satellite imagery with in-situ station data to create gridded rainfall time series for trend analysis and seasonal drought monitoring.	1981-01-01T00:00:00Z–2022-11-26T00:00:00	Rainfall Erosivity Factor (R)
OpenLandMap Soil Texture Class (USDA System)	Soil texture classes (USDA system) for 6 soil depths (0, 10, 30, 60, 100 and 200 cm) at 250 m. Derived from predicted soil texture fractions using the soil texture package in R.	1950-01-01T00:00:00Z–2018-01-01T00:00:00	Soil Erodibility Factor (K)
NASA SRTM Digital Elevation 30m	The Shuttle Radar Topography Mission (SRTM, see Farr et al. 2007) digital elevation data is	2000-02-11T00:00:00Z–2000-02-22T00:00:00	Slope Length and Steepness (LS)

	an international research effort that obtained digital elevation models on a near-global scale. This SRTM V3 product (SRTM Plus) is provided by NASA JPL at a resolution of 1 arc-second (approximately 30m).		
Sentinel-2 MSI: MultiSpectral Instrument, Level-1C	Sentinel-2 is a wide-swath, high-resolution, multi-spectral imaging mission supporting Copernicus Land Monitoring studies, including the monitoring of vegetation, soil and water cover, as well as observation of inland waterways and coastal areas. The Sentinel-2 data contain 13 UINT16 spectral bands representing TOA reflectance scaled by 10000	2015-06-23T00:00:00Z–2023-01-06T14:01:54	Land Management Factor (C)
MCD12Q1.061 MODIS Land Cover Type Yearly Global 500m	The Terra and Aqua combined Moderate Resolution Imaging Spectroradiometer (MODIS) Land Cover Type (MCD12Q1) Version 6.1 data product provides global land cover types at yearly intervals.	2001-01-01T00:00:00Z–2021-01-01T00:00:00	Conversion Practice Factor (P)
Hansen Global Forest Change v1.7 (2000-2019)	Results from time-series analysis of Landsat images in characterizing global forest extent and change.	2000-01-01T00:00:00Z–2019-01-01T00:00:00	Forest Change

RUSLE Model

The modelling approach used in the study is the revised universal soil loss equation which is used to estimate soil loss measurement for net rill and sheet erosion in a specific area. It is characterized by this equation:

$$\mathbf{A = R \times K \times LS \times C \times P}$$

Where:

R – Rainfall Erosivity Factor

LS – Slope Length and Steepness

K – Soil Erodibility Factor

C – Land Management Factor

P – Conversion Practice Factor

Results and Discussion

The maps generated through the RUSLE Model are already a result of an overlay of the rainfall erosivity factor map, soil erodibility factor map, slope length and steepness map, land management factor map, and conversion practice factor map.

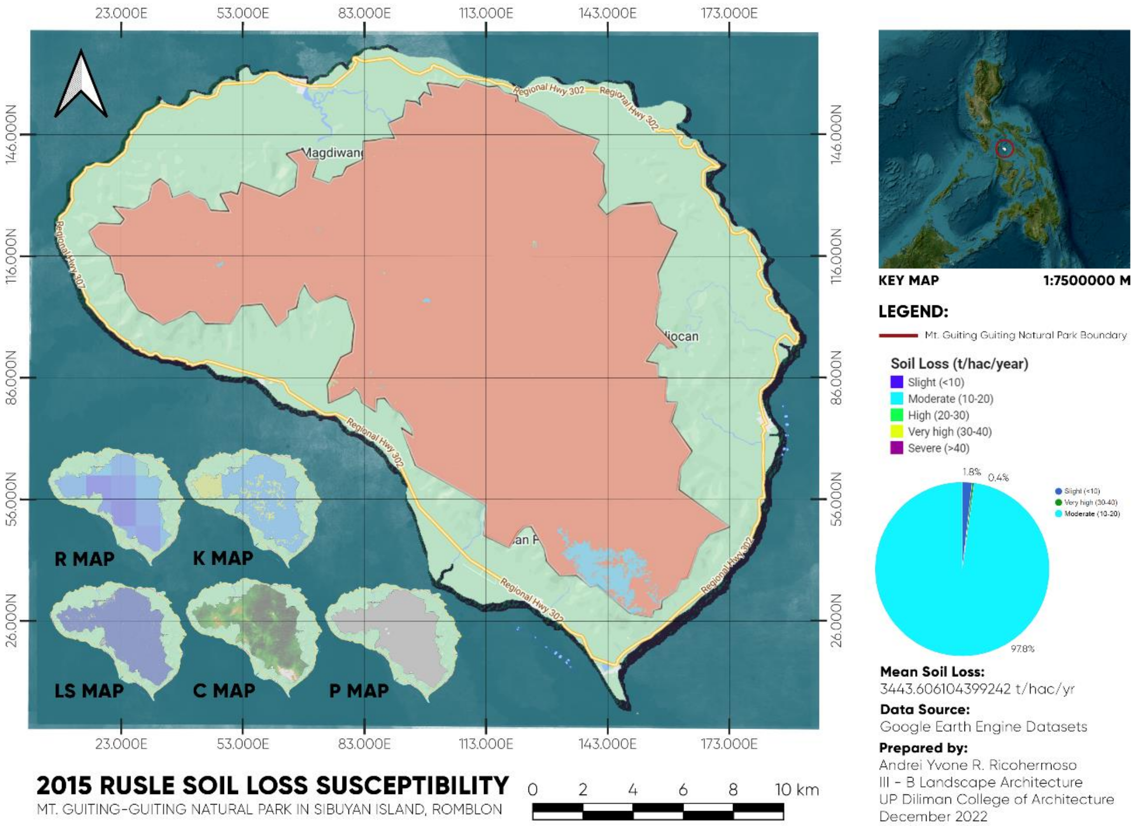


Figure 14. 2016 RUSLE Soil Loss Susceptibility Map of Mt. Guiting-Guiting Natural Park

The result of the 2015 assessment in Figure 13 shows that soil susceptibility is moderate along the lower boundaries of Brgy. San Fernando. This is highly likely because the area that the Department of Environment and Natural Resources (DENR) provided to Altai Philippines Mining Corporation (APMC) in 2010 is in San Fernando.

1.8% of vulnerable areas are slightly susceptible to soil loss, 97.8% are moderately susceptible, and 0.4% are very highly susceptible. The average soil loss in 2015 is 3,443.61 trees per hectare per year.

In the following year, there is a relatively significant increase in areas that are severely susceptible to soil loss (see Fig. 14). From Brgy. San Fernando, the scope included Barangay Cajidiocan as well.

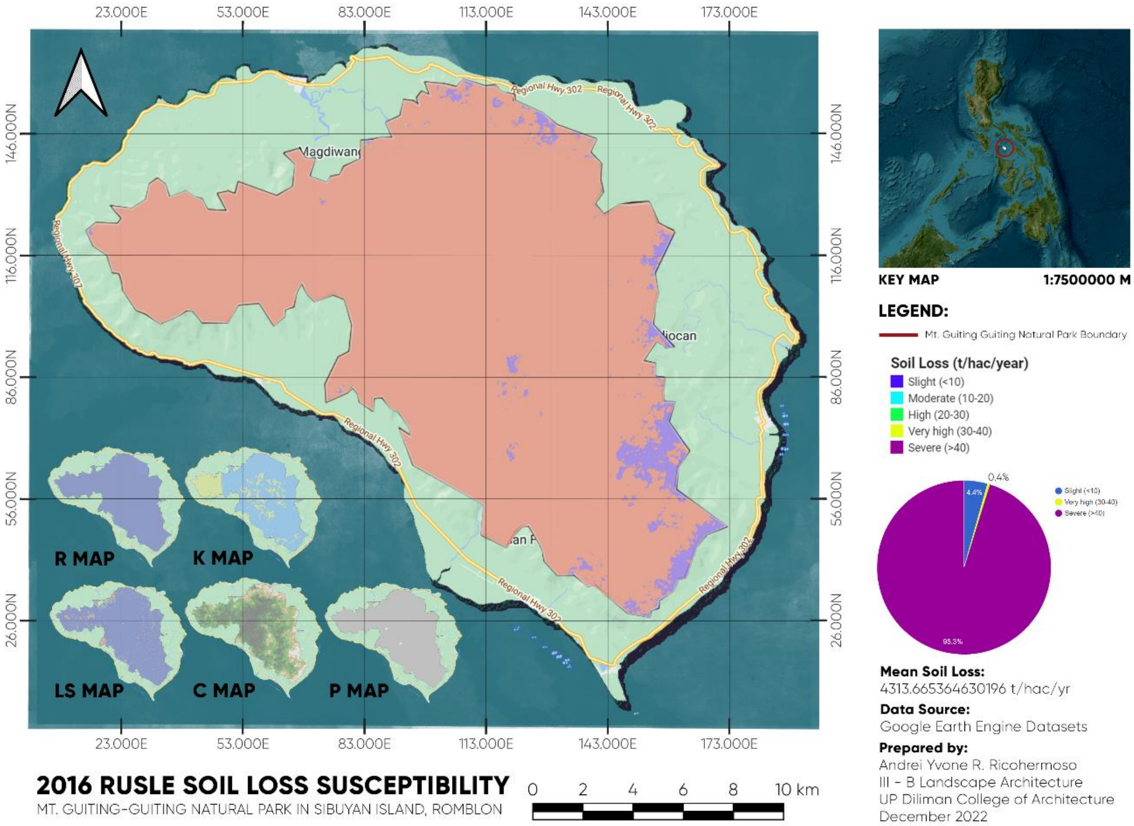


Figure 15. 2016 RUSLE Soil Loss Susceptibility Map of Mt. Guiting-Guiting Natural Park

There are spots within the montane forests of the protected area where soil loss became severely susceptible, most likely due to illegal logging within forests where the management board were not patrolling.

4.4% of vulnerable areas are slightly susceptible to soil loss, 0.4% are very highly susceptible, and 95.3% are very highly susceptible. The average soil loss in 2016 is 4,313.67 trees per hectare per year.

There has been a tremendous increase in the average soil mean loss for year 2017. However, the map shows very little data to support this (see Fig, 15). A small area of severe susceptibility is presented but it is significantly smaller than the scope in 2016. This inaccuracy may be a result of a map dataset that does not have available data for this year. The average soil loss in 2017 is 6,068.36 trees per hectare per year.

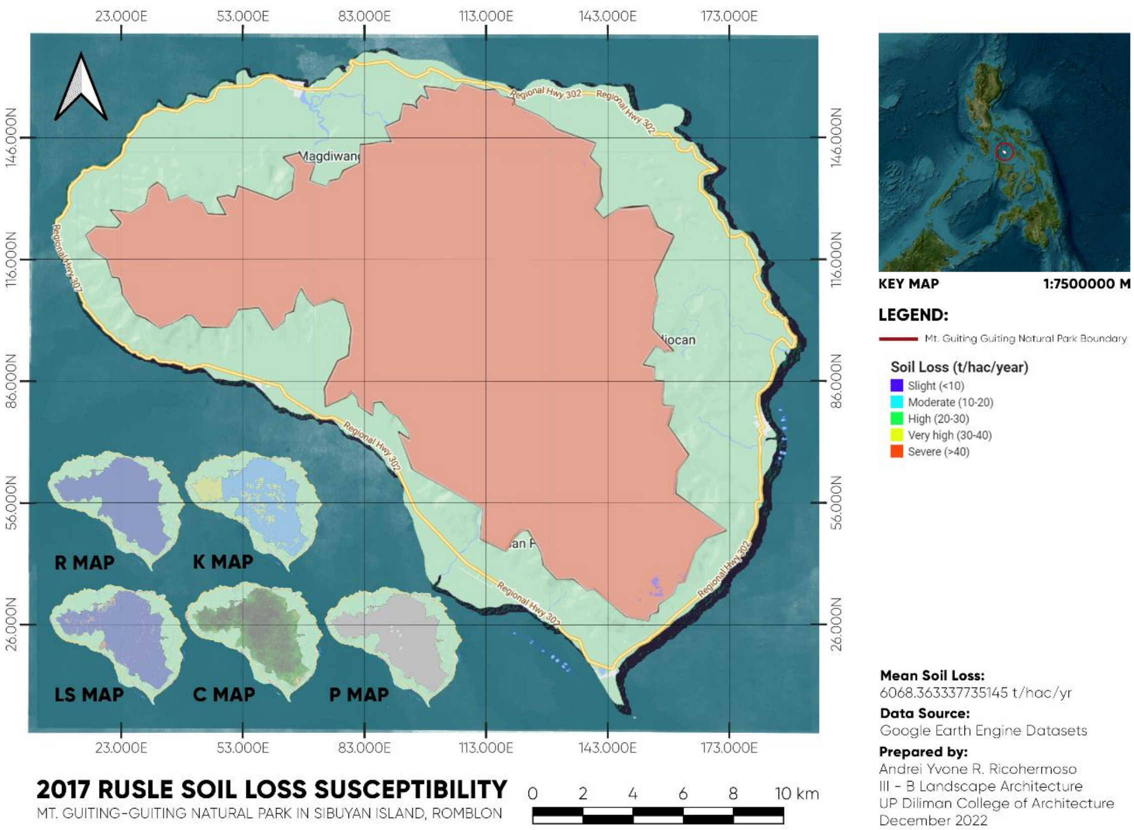
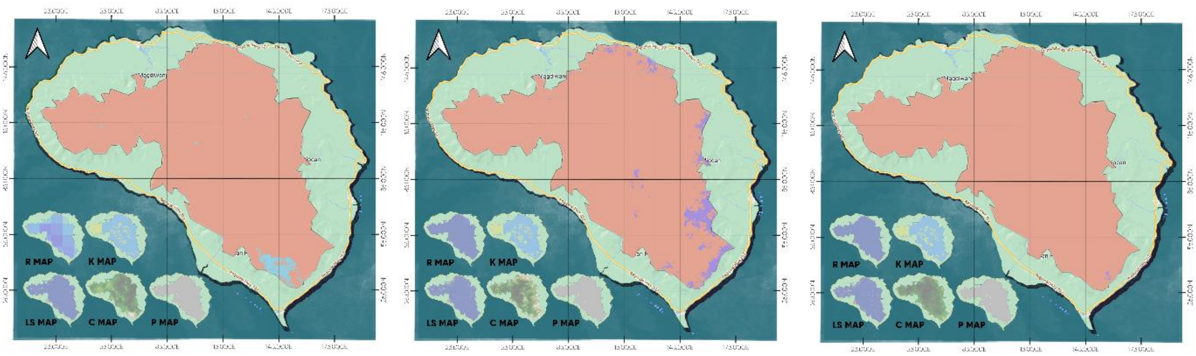


Figure 16. 2017 RUSLE Soil Loss Susceptibility Map of Mt. Guiting-Guiting Natural Park



2015 RUSLE Soil Loss Susceptibility | 2016 RUSLE Soil Loss Susceptibility | 2017 RUSLE Soil Loss Susceptibility

Figure 17. *Comparison of Generated Soil Loss Susceptibility Maps*

Overall, however, it is evident that there is a significant increase in the average mean soil loss in Mt. Guiting-Guiting Natural Park from 2015 to 2017. In total, there had been an increase of 2,624.75 trees per hectare per year in MGGNP's average soil loss in a span of three (3) years.

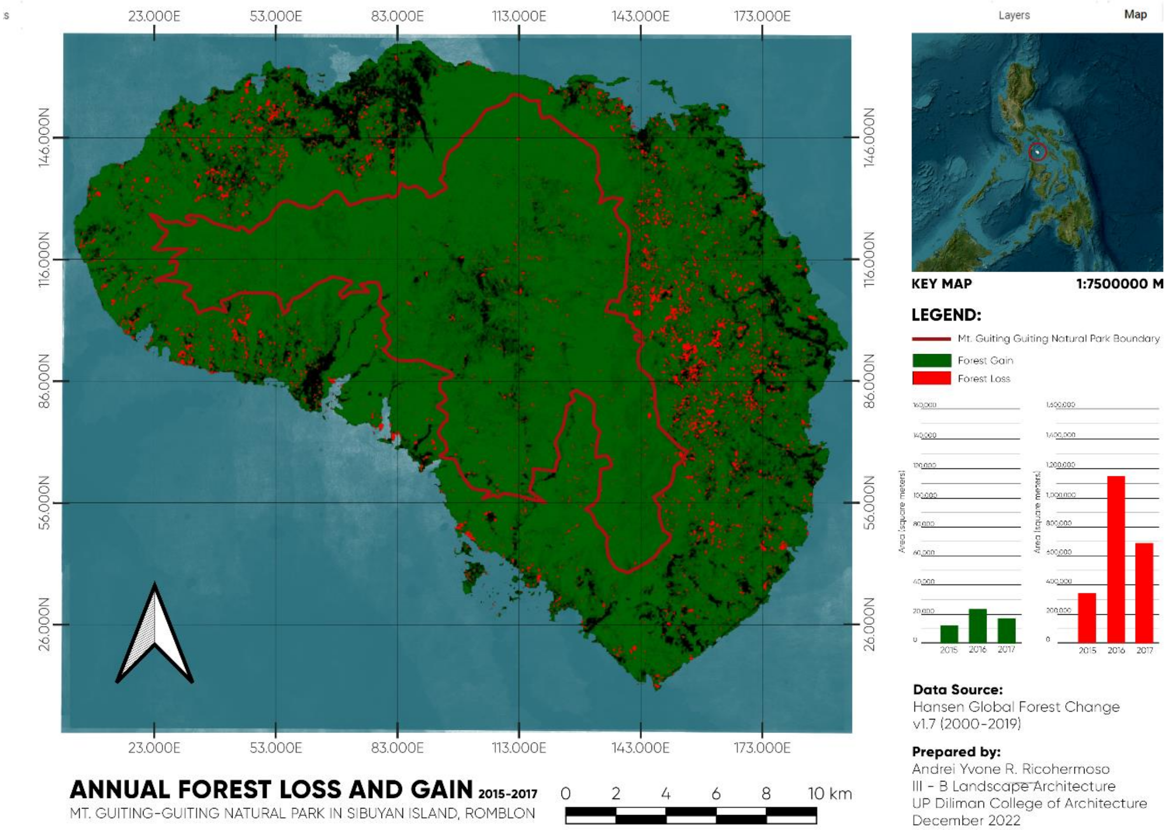


Figure 18. Annual Forest Loss and Gain of Mt. Guiting-Guiting Natural Park from 2015 to 2017

To cross reference, the annual forest soil gain and loss does show the highest forest loss in year 2016 rather than 2017. This data also presents a significant difference between forest gain and forest loss per year, where there is more forest ecosystems loss than gained. Areas where forest loss occurred from the map also can be found within the buffer zone and municipalities of the island, relative to the RUSTLE Model data.

Implications

General implications from the previously presented interpretation of results suggests that there had been an increase in average soil loss in Mt. Guiting-Guiting Natural Park, in terms of lost trees per hectare per year, in a period of three years (2015 to 2017). Possible factors, aside from soil erosion and degradation, include the occurrence of illegal logging within Sibuyan Island in 2010 based on the possible locations of patrolling management staff and location of high-quality timber. There is also a significant increase in annual forest loss, preceding annual forest gain, implying a large-scale forest cover change form forest to non-forest each year.

Soil erosion results to soil loss (Ritter, 2012). The soil loss susceptibility maps are indicators of MGGNP’s increasing vulnerability to soil erosion each year. Likewise, as a biophysical indicator of land degradation, this implies an annual increase in MGGNP’s land degradation vulnerability.

Conclusion

In summary, there is an annual increase in land degradation vulnerability in Mt. Guiting-Guiting Natural Park in Sibuyan Island, Romblon. Land degradation can negatively impact endemic species living within MGGNP’s ecosystems, disrupt the lifestyle of island residents, hinder the provision of ecosystem services, and threaten the protected area’s overall environmental significance. Every year, MGGNP is at constant risk of diminishing forest value and biodiversity authenticity.

Existing environmental threats within MGGNP such as illegal logging, illegal mining, and land conversion must be regulated and resolved immediately to accomplish the biodiversity conservation of the protected area. Thus, there is an intensified demand for an effective system of management both through local efforts and government policies and programs.

Lastly, GIS mapping is an effective technology for land vulnerability assessment and soil loss susceptibility. The accuracy of results, however, is dependent on the availability of data and the limitations of datasets and GIS software utilized in the study.

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