FACULTY OF BIOSCIENCE ENGINEERING

MAPPING AND MONITORING AGROFORESTRY AREAS IN ECUADOR

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Abstract

The high annual deforestation rate in Ecuador due to cropland expansion is an important incentive to start looking into developing agroforestry systems. However, there is a lack of research and baseline data about the biophysical constraints of agroforestry development in the country. The spectral, spatial, and temporal resolutions of the Sentinel-1 and Sentinel-2 satellites, constitute promising features to map and monitor agroforestry areas. This study evaluates 2 datasets from areas with different environmental conditions such as soil, climate and topography. We extract NDVI time series images to characterize the considerable temporal variations in the selected study sites and then to map the target classes of agroforestry development.

Introduction

Agroforestry models can be successful if sound detection and monitoring systems exist. But, biophysical characterization of the area influenced by trees in a mixed landscape of trees and crops is not evident. Remote sensing provides and effective way to do so. Unfortunately, the use of passive and active remote sensing for characterizing agroforestry systems in Ecuador is largely underexplored.

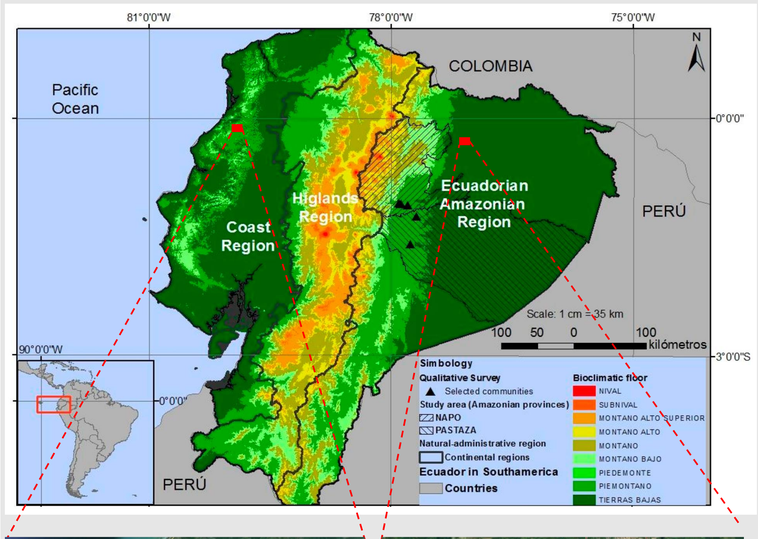
A highlight opportunity to access a free data such as imagery satellite provided by Sentinel through Copernicus platform support us valuable insight for this study. The datasets will be used to calculate some vegetation index (NDVI, EVI, SAVI), texture classification (GLCM) and quantification of above ground biomass.

It should be emphasized that this study is in the early stage and the data for this study will be based on Sentinel 1 and Sentinel 2 and the satellite images will be acquired in a period monthly from 2015 to 2018 which the differences and similitudes of the vegetation index will be analyzed for every agroforestry plot.

Objectives

- To develop a robust remote sensing based agroforestry mapping system for Ecuador (detection of composition and structure).
- To design operational monitoring procedures for Ecuadorian agroforestry systems (quantification of above ground biomass) .

For the study purposes, two areas have been selected and the firsts sentinel 2 images were acquired from June 2017 to June 2018. It is important to consider that the study areas are located in different regions of Ecuador with different soils, climate and topography.



Coast area | Amazon area

FIGURE 1: Study area

Methods

The diagram illustrate the consecutive steps will involve this study.

Collect Ground Sample

- To gather some information on the agroforestry field (Types of trees and crops, agroforestry management, field size, schedule of seed, production and harvest).
- Determine the AOI (Area of Interest) and get the georeferenced data.

Acquire Satellite imagery

- Select appropriate spatial and Spectral resolution
- Collect satellite image with low % cloud cover
- Select image from March/2016 to July 2018

Process Satellite Image

- Image processing (Atmospheric and Radiometric correction)
- Pre-processed to remove cloud, haze and sun effects.
- Calculate some vegetation index (NDVI, LAI, SAVI and average Biomass
- Feature extraction and classification
- Time series evaluation

Create the map

- Mapping big areas
- Accuracy assesment

Results

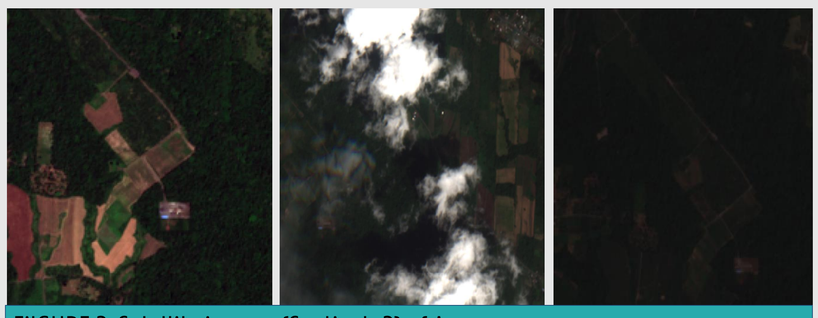
The final expected result is create a agroforestry mapping system which involves each region of Ecuador. But in this early stage this study only has some information for the first steps.

	Coast	Amazon
Climate	Tropical Monson	Tropical rainforest
Soil	Clayey silt to clay	Silty, andic
Topography	Elevation range 1,640-2,.290 feet	Elavation range 870 – 935 feet

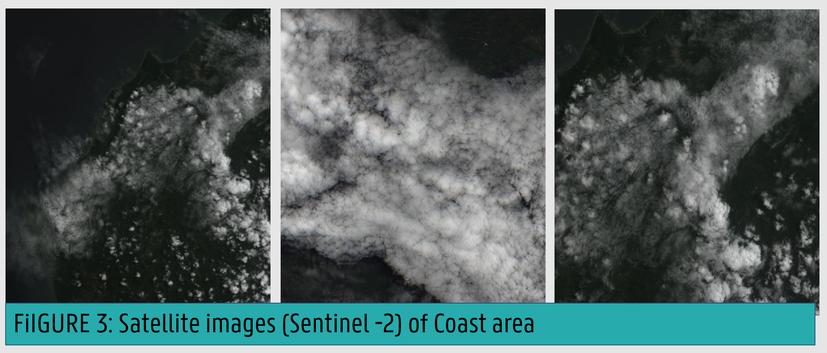
TABLE 1: Environmental conditions of the study area

	Coast	Amazon
Crops	Cacao Banana Coffee	Cacao Coffe
Forest	Fruit tree	Cedrelinga cateneaformis Erythrina sp
Ages	2 years	6 months

TABLE 2: Agroforestry systems from study areas



FIlGURE 2: Satellite images (Sentinel -2) of Amazon area



FIlGURE 3: Satellite images (Sentinel -2) of Coast area

Discussion and Conclusion

The two areas has different environmental condition however they have the necessaries requirements to plants Cacao. Although the two areas contained the same crop, they manage a different agroforestry system. That is important for the future study on comparation between then and get what is the best option.
There is a possibility to include the third study area located in the highland region. It will be interested due the environment condition are extremely different.
Some satellites images have been obtained from Sentinel 2. However the satellites images from Costa area show very cloudily so this images will be pre-processed to clean it (Figure 3).
In conclusion, the core of this study is the process of the satellite images, however, the previous steps are very important to get the aims of this research. For that reason is important to collect appropriated and quality data to assure the algorithms will use them can work well.

Acknowledgments

This research is supported by Secretariat for Higher Education, Science, Technology and Innovation of the Republic of Ecuador (SENESCYT). We are grateful with INIAP and third Millenium Alliance for providing agroforestry information on their farms

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