Land-use and Land-cover change in Nicaragua

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Background

North of the Amazon - Most Biologically Diverse region
Nicaragua

Largest (in area) rainforests in Central America

Lost $\frac{1}{2}$ its rainforest since 1950
7 million - 4.3 million acres

Out of study radar
Few studies...
Deforestation-Agricultural Frontier

- Spanish colonialism
- British colonialism
Study Site: Jinotega, Nicaragua

Department where the frontier initiates and passes through

The Contra and Sandinista war was fought in this region

Observed deforestation in last two decades

Holds majority of arable lands in Nicaragua

Was known as the place of the clouds and pines

Coffee region
Bosawas Biosphere Reserve

International Bioreserve

Species rich

Home to the remaining Indigenous population

Being threatened by the Agricultural frontier
Research Questions

(1) Is LULCC occurring along the agricultural frontier; is the agricultural frontier moving eastward? If so, at what rate?

(2) If LULCC is occurring, what are the driving forces of LULCC in Jinotega?

(3) What is the future trajectory of the agricultural Frontier?
To explore LULCC

Social science field studies to understand changes in land-use and land cover change (in depth information)

Remote Sensing/GIS to calculate land cover and land use change (large scale views-examine patterns, time efficient and cost effective)

Modeling to combine natural science and social science data

Make predictions and management solutions
Hypotheses

1. LULCC is occurring along an agricultural frontier in Jinotega which is moving eastward.

2. The driving force of LULCC in Jinotega is the agro-export crop, coffee production (since colonialism)
Remote Sensing

Landsat images from 1976-present

30m resolution

Images that have few Clouds

Displayed in false color-easier to See vegetation
Continuation

Classify and analyze the images using ERDAS.

(supervised classification: assign a value to a spectral signature)

(unsupervised classification: computer separates all the distinct spectral signatures)

With help of an NDVI (maximum greenness) normalized difference vegetation index.

Remote Sensing and GIS
Continuation...

With Classification maps—Change detection maps are created to see vegetation gains and losses over time.

Reddish colors represent losses in forest cover.
Greenish colors represent gains in forest cover.
Many change detection and classification methods exist---I will be exploring some until I find the one that works best with my study site.

Challenges I faced:
- Supervised classification: Hard to distinguish between agriculture/clearing.
- Unsupervised classification: Too many distinct spectral classes.
- Very mountainous region—topography gets confused with shadows.
Limitations of Remote Sensing

- Doesn’t answer the “Why”
- Hard to obtain finer Resolution data—going to try to obtain SPOT images
- Need ground truth Control points for validation
- Collected 300 points this Summer across the Department of distinct Classes (secondary forest, Coffee, cattle, etc.)
- Initially I had pre-selected points of interest, but due to...
Inaccessible areas... I went to where I could
Social Science

Explore LULCC and its drivers of LUCC in Jinotega, through field studies (interviews, observation), historical and government records.

Government officials, NGO’s, communities members

Made Connections with MARENA, TNC, community mayors...
Continuation

Challenges:

Have to know the right people
(I got lucky)

Have to go with people whom the
Miskito Indians respect (esp. with
Their long history)

Election time!

Expensive since you can only travel by canoe
deeper in the reserve
Will be going this upcoming spring with an
NGO

Had to announce my study in advance
through the radio and went on TV so they
are aware that I am apolitical.
Future scenarios?

Develop a protocol for Agent Analyst, an agent based model which can incorporate both natural science and social science data and all the actors involved.

Or other conceptual models to create a management plan for Nicaragua in which they can preserve the remaining forests and the citizens can benefit.

Developed in Argonne National Laboratory.
What I know so far...

The agricultural frontier is moving eastward

It's moving faster than I had imagined

In the 70s, the agricultural frontier moved eastward due to coffee production, but with the worldwide drop in coffee prices, people switched to cattle grazing---one the driving forces of the movement in the agricultural frontier

The southern portion of the Bosawas Reserve has been deforested—I went 2 hours into the reserve...nothing there—was jungle in the late 80s.

Other driving forces:
Major one: CORRUPTION—selling of illegal wood from the Bosawas reserve—done by its own protectors.
Poor regulation

Lack of incentive to preserve.

Already observe changes in local climate and huge water crisis
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Fin! Any questions?