Theobroma cacao productivity is affected by tree intercropping and the subsequent shade canopy, Toledo District, Belize

Figure.1. A Theobroma cacao pod

Introduction

When I submitted my research proposal to both the school of Environmental Sciences and to the Katie Wilkinson Scholarship, the planned nature of my research was somewhat different to what I finally produced. I had originally planned to study the productivity of an agroforestry system in comparison to swidden (slash and burn) agricultural systems. However, there were a number of logistical issues that I only discovered once at the research base; the main one being that where I was staying was 2 miles up-river from the nearest village. This meant that to get to the village to conduct research I had to first wade across the river (I didn't have the technique to manoeuvre a dory, figure.2.) from there it was a 45 minute hike through jungle to the village where I could connect with a 7am bus to other villages!

Figure.2. Claire's bags plus some cement being taken up river to the farm by Jorge

There was also limited internet access due which made contacting my supervisor to change my project difficult too! I was in the country for over a month before I managed to re-plan my research. But, although hard to believe, this difficulty in conducting my original research is now

one of my best memories as it made me use my initiative in a foreign country and ultimately led me to have the best experience I could have wished for!

The Research

What was it all about?

My research took place in the Toledo District of Belize, where I stayed on the Maya Mountain Research Farm in the village San Pedro Columbia.

Understanding that deforestation and degradation is one of the largest drivers of climate change and losses in biodiversity, I began to question whether chocolate, a luxury product enjoyed across the Northern Hemisphere can be sustainably produced in comparative quantities to what is found on plantation style farms. This new research idea also linked well with recent debates regarding whether "land sharing", where food production and biodiversity conservation occur on the same plot of land or, "land sparing", where food production is intensified on a smaller parcel of land, leaving land available for biodiversity conservation, are best.

In addition, it was subsequently announced during my time in Belize by some of the world's leading chocolate companies, that there is likely to be a shortage in chocolate supply by 2020. This again lead to my thinking that there will be an ever pressing need to assess the production methods of cocoa (cacao) to determine how yields can be maximised while remaining within ecological limits.

With demand for cocoa increasing over the past decade, the Ministry of Agriculture and Fisheries in Belize stated in 2003 that there was a need to diversify its exports to focus on niche markets, under which culturally important cocoa was highlighted as a key crop to be developed. Under an agroforestry system, cocoa gives farmers the opportunity to pursue an alternative source of income while also having the potential to protect and improve the current state of the country's forests - *Theobroma cacao* (cocoa tree) is a shade tree, and so can be grown under a slightly thinned natural canopy.

How did I conduct the research?

Celini from the Maya Mountain Research Farm kindly put me in touch with the Toledo Cacao Growers Association where I met with the manager (Mr. Armando Choco) of the cooperative that is working to encourage sustainable

cocoa production in the district I was in. Mr Choco provided me with a list of farmers across near-by villages that I could contact.

I arranged to meet 10 farmers in my last 3 weeks on the farm; I then carried out a short semi-structured interview to break the ice, and gain information about farming methods, acreage and the annual yields etc. After the interview I carried out a specially designed belt transect that surveyed the diversity of neighbouring trees and shrubs (Figure.3.).

Figure.3. Myself holding the rope which marked out the belt transect on a cocoa farm in San Antonio

I also took multiple photographs of the shade canopy from which I could lay-over a 100 cell grid (Figure.4.) to calculate percentage shade cover over the *Theobroma cacao.*

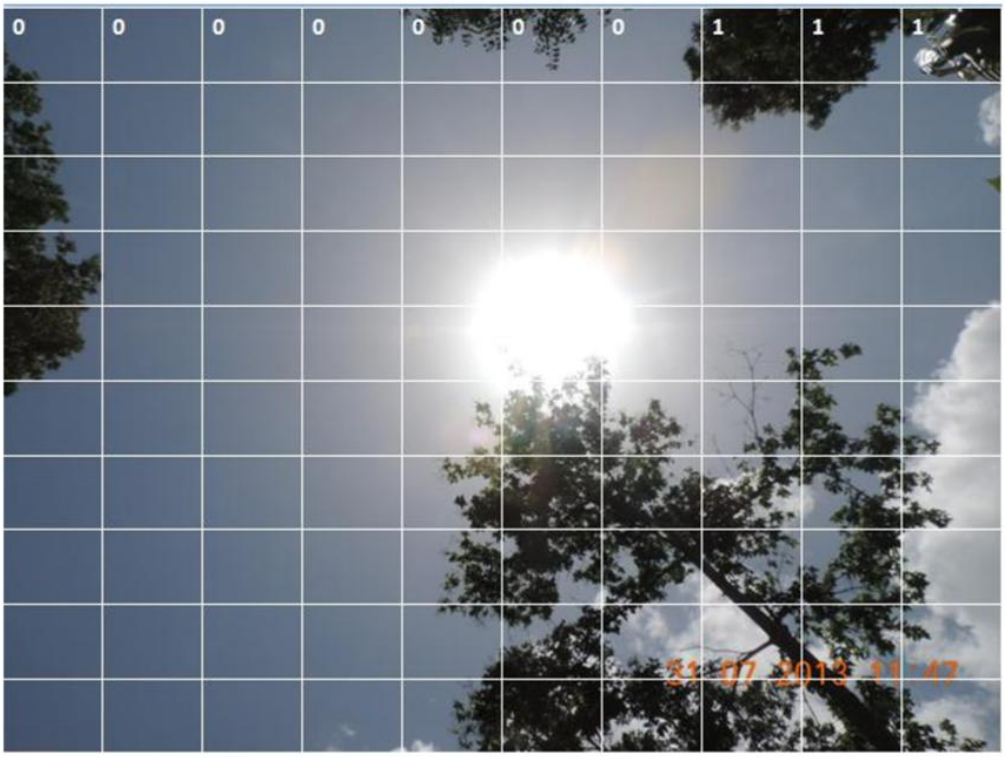

Figure.4. An example of how shade/ canopy cover levels were calculated across the farms

The percentage canopy cover within each individual square was then calculated, where if there was <50% canopy cover in a square it was labelled as 0, but if there was >50% canopy cover in a square it was labelled as 1. The number of "1's" were then summed, equalling the percentage canopy cover for that area of the farm. A mean canopy cover was calculated across the farm.

The Results

Due to the small sample size - only 10 farms, there was only one significant result in the data. It was found that as the diversity of neighbouring trees increased, the yield of cocoa significantly decreased. This result suggests that cocoa is best produced under a monoculture or selective-shade system, rather than promoting agroforestry and more natural forests. However a substantial literature review found that cocoa yields *can* match those seen in plantations/monocultures. However, the interviews also highlighted how because cocoa doesn't provide the farmer and their families with the entirety of the income or subsistence, the agroforestry system needs to be studied as per my original research proposal - as an entire system.

What the Katie Wilkinson Scholarship has given me

Despite my research somewhat falling apart when I arrived in the country, I feel that this was for the best. It forced me to experience a lot of things I doubt I would have done if everything went smoothly. Sitting in the jungle on a mobile phone, calling a local cocoa farmer in the next village to arrange a visit is certainly a very surreal experience!

One of the villages I visited was so remote that there was only one bus per day, so I had to arrange to stay with a local Mayan family in their home over night! See figure.5. for a photograph of the type of house I stayed in!

Figure.5. An example of a traditional Mayan house, much like the one I stayed in, in San Jose.

Some concluding photographs summarising the experiences I was given

The photographs below are accompanied by short snippets of some of the experiences I had while in Belize for 2 months. I honestly cannot put into words how grateful I am to the Katie Wilkinson Scholarship, and most importantly to Alan and Liz, for allowing me to have, what I would consider, this life changing experience. I 100% have the rainforest embedded in my heart now, and I cannot wait until I get to go back!

I got to visit a cocoa nursery run by Maya Mountain Cacao, and then hike to the nearest farm that is being planted with cocoa. The hike was longer than expected due to a road block and none of us had enough water - I had to taken out of the jungle on the back of a motorbike as I couldn't walk any further!

After interviewing in San Pedro Columbia village myself and some other researchers walked to the Mayan Ruins of Lubaantun in the village. I found the ruins breath-taking, and they certainly brought a tear to my eye.

This is myself on one of the paths back from a cocoa farm - living in Belize for 2 months, I began to feel like a local, and knew the jungle paths well!

Thank-you for the experience of a lifetime