Maya subsistence farmer decision-making under climatic uncertainty in Belize, Central America

Project Background Information/Introduction:

The Maya population in Belize, like millions of Central Americans, decides when to cut, burn, and plant their crops based on experience as to when seasonal rains will begin, and misjudgements can be catastrophic (Rodríguez et al., 2015). Maize, the staple crop of Maya farmers, is already grown near its temperature and moisture threshold, making it highly vulnerable to warm and drought episodes (Richardson, 2009). Climate change means more frequent drought, floods, and destructive storms and less predictable precipitation seasonality. Although climate change is a threat to agricultural productivity around the world, little to no data exists on how smallholder farmers in the Central American region, confronted with abrupt climate change, make immediate and strategic decisions to mitigate potential food security stressors resulting from crop loss and economic depression (Richardson, 2009). Understanding and predicting how climate instability can and will affect rainfall dependent populations at the regional to local scale is critical for preparedness. This study provides the opportunity to record patterns of decision making in direct response to climate variability and extremes including moderate to strong phases of El Niño Southern Oscillation (ENSO) to inform models of resilience and response to climate events by small-scale farmers relying on rain-fed agriculture.

Subsistence or smallholder farmers are one of the most vulnerable groups to climate change due to a range of factors including but not limited to their low capacity to adapt to changes, their dependence on rain fed agriculture and the location of their farms in marginal landscapes that are exposed to a variety of climate hazards (Donatti et al., 2019). Due to a high dependence on rain fed agriculture, smallholder, mainly indigenous Maya, farmers' decisions regarding agricultural labour investment are particularly vulnerable to changes in the timing and distribution of seasonal precipitation.

Although poorly documented, crop failure and/or poor yields in the region occur regularly. The risk to indigenous subsistence farmers of a scarcity of some food stores is ever increasing. Little to no data exists on how the farmers in this region, confronted with abrupt climate change, make immediate and strategic decisions to mitigate potential food security stressors resulting from crop loss and economic depression. In addition, no study has yet documented the real-time effects of climate variability and extremes on agricultural yields of Maya subsistence farming communities in Central America.

It is also important to consider the productivity (yield) of subsistence farms not only related to climate variability but soil quality as well. Crop yield represents an easily quantifiable measurement of agro ecological productivity that is central to the needs of subsistence farming.

Attempting to look at the productivity of maize farms in relation to climate variability would be incomplete without also taking into consideration soil quality. This is an important variable that must be included in this study in order to properly understand the extent of how climate affects maize productivity.

Research Aim/Objectives/Questions/Hypotheses:

The main aim of this study is to document, for the first time, how climate variability and extremes impact the agricultural productivity and decision-making of Maya subsistence farmers in Belize (with implications for subsistence farming across Central America). This project will fill a crucial data gap by recording hourly-scale meteorological variables over a minimum of three years during the project to develop the highest resolution monitoring dataset of climatic variability for Belize, Central America. These data are crucial to develop a better understanding of how climate anomalies impact precipitation patterns in a region where agriculture is highly dependent on seasonal precipitation cycles.

The aim of this research will be achieved through the following objectives:

1.   To conduct high-resolution monitoring of climatic instability and extremes in southern Belize by installing 2 low-cost, high-performance HOBO® weather stations that will measure agriculturally important meteorological parameters at hourly intervals throughout the study as well as investigating climate data across the whole of Belize over the past 30 years using longer-term but lower resolution Belize Met Office data.

2.   To document the agricultural impacts of, and Maya farmer's response to, climate extremes and variability through the implementation of two cycles of ethnographic interviews per year with 5-7 farmers at each village in June (at the start of the wet season when crops are planted) and October (following the harvest when farmers will measure crop yields).

3.   To conduct soil quality monitoring and assessment at 5-7 select farms in each of the three Maya villages during the ethnographic interviewing cycles.

Data/Methods/Analysis:

Climate Monitoring

Low-cost, high-performance HOBO® weather stations installed at two locations in Southern Belize to measure agriculturally important meteorological parameters at hourly intervals through the study and supplemented by historical meteorological data obtained from the National Meteorological Service.

Ethnographic Interviews

Two cycles of ethnographic interviews conducted per year with 10-12 farmers in three Maya communities in June (at the start of the wet season when crops are planted) and October (following the harvest when farmers will measure crop yields). Background information on general farming practices (e.g., timing of burn, pesticides/fertilisers use, etc.) also gathered.

Crop Yields

In each village, farmers quantify their corn crop yields at the end of the rainy, growing season by using low-cost hanging scales.

Soil Quality Monitoring and Assessment

Soil sampling undertaken at 5-7 farms in each of the three Maya villages during the ethnographic interviewing cycles. This task involves collaborative development of a soil quality assessment card (a qualitative tool designed with famers at the start of the project to ensure soil quality criteria are locally relevant and readily assessed). This data will be augmented with agricultural soil test kit data (e.g., pH, Nitrogen, Phosphorous, etc.).

Contributions to the SDGs:

This research contributes to the SDG Goals in the following ways: i) No Poverty (1) by building the resilience of poor, vulnerable communities and strengthening disaster risk reduction, ii) Zero Hunger (2) by providing data to support the development of sustainable food production and climate change-resilient agricultural practices, and iii) Climate Action (13) by providing data to contribute to the development of national and local disaster risk reduction strategies, climate change adaptation projects and programmes, and environmental impact assessments.

Lessons learnt and key takes/reflections:

This research will demonstrate how climate variability impacts agricultural decision making of small Maya farmers in Belize with implications for millions of small holder farmers across Central America. Looking at trends in historical and present climatic variability in Belize can help farmers understand the impact of climate on agriculture and also contribute to producing future projections which can help build their resilience to future effects of climate change.

Project Information:

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- Project Duration: 3 Years
- Project Resources (funded by): Durham University
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References:

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