

Effects of Climate Change on Agriculture in Guatemala and Honduras

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Abstract

This article looks at the impact of climate change in Guatemala and Honduras. Both countries rely on agriculture as a main source of income, hence they are highly vulnerable to climate change. Indeed, both countries have already been severely affected by past weather-related disasters that were induced by climate change. Guatemala and Honduras have started to adapt to climate change by farming more efficiently and conserving water. However, much more needs to be done to cope with long-term increase in temperatures and the increasingly volatile environment, which could strip away the agricultural livelihoods of the still many poor people in both countries.

I. Introduction

Though climate change may seem like a far off issue to some, it is already negatively affecting regions, like Central America. Since the 1990s, countries in Central America including Guatemala and Honduras have experienced an increasing number of natural disasters, increasing temperatures and a decreasing amount of rainfall. These countries have also been bombarded with an increasing amount of flooding and high winds because of their locations between the Atlantic and Pacific Oceans. These weather events, thought to be caused by climate change, are negatively affecting the agricultural production in Central America.

This is an especially big problem for countries like Guatemala and Honduras because a large portion of their gross domestic product (GDP) is from agriculture. Both countries produce large amounts of coffee, corn and beans. Like many countries in the Global Majority, the poor in the rural regions of these countries depend on the agricultural production of these products for their livelihoods. However, the increasing number of storms and changing temperatures/rainfall have forced many of the rural farmers to change techniques, move locations or abandon farming all together.

This article discusses the ways climate change has affected both Guatemala and Honduras. It compares the agricultural production in each country including what crops they produce, who produces it and how they produce it. The article then looks at the effects of climate change on the production and specifically, the ways it has decreased the production. Lastly, it discusses how both Guatemala and Honduras are adapting their production techniques to combat the effects of climate change.

II. Literature Review

There is a lot of literature about the effects of climate change on agriculture in Honduras and Guatemala. Much of the literature discusses how the location of the two countries and their topographies have exacerbated the effects of climate change. Scholars have studied how major weather events like Hurricane Mitch,¹ along with precipitation and temperature change, have affected agriculture and how or if these countries have adapted. Most of the literature also discuss ways each country is trying to combat the negative impacts of climate change.

- Díaz-Ambrona et al. (2012) describe how an increase in temperatures and a decrease in precipitation will lead to a decrease in the production of both corn and beans. Though both of these crops will be affected, the article suggests that the production of corn will be most affected. Crop yields will be most affected in low land areas, where yields could be reduced by as much as 22 percent. Yields may increase at higher elevations where the temperature will be cooler. However, available agricultural land in the mountain regions is scarce. Because of these factors, the article argues that there is high uncertainty about the future of maize and corn yields. The article provides suggestions to reduce the effect of climate change.
- McSweeney and Coomes (2011) discuss the ways Hurricane Mitch provided rural communities in Honduras with a window of opportunity. While climate-related disasters like Hurricane Mitch can leave developing countries vulnerable, McSweeney and Coomes argue that in this case, the hurricane allowed the Tawahka community to re-build and better prepare itself for future disasters. The article says that the hurricane forced the community to replant crops and rebuild housing away from low-land flood areas. Land was also reallocated in a way that benefited the rural poor. This region has is now less affected by similar future climate-related events.
- Lloyd (2015) summarized the main reasons for why Honduras is most vulnerable to the effects of climate change, focusing on the economic impact of climate change on Honduras. She points out that 60 percent of Honduras's GDP is agricultural, with coffee, corn and beans being the main crops. A decrease in agricultural production due to climate change would have a huge economic impact on the country, especially in rural regions where the poor depend on agriculture. To combat the effect of climate change, Lloyd suggests encouraging environmentally friendly farming, supporting diversification and educating local populations about climate change.
- In a news report for *The Guardian*, Felicity Lawrence (2017) summarizes how climate change imperils Guatemala's food security. Because Guatemala lies in between the Atlantic and Pacific Ocean, it is hardest hit by tropical storms. Further, increasing temperatures and changing rain patterns have decreased crop yields for smallholder farmers. Farmers are seeking other crops to produce and other ways to make a living but some of these tactics are exacerbating the effects of climate change. For example, people have begun cutting down forests to make room for new farmland. This is increasing the emission of carbon dioxide and making the problem worse.

¹ Hurricane Mitch, which hit Central America in late October and early November 1998, was the second-deadliest Atlantic hurricane on record, killing at least 19,325 people.

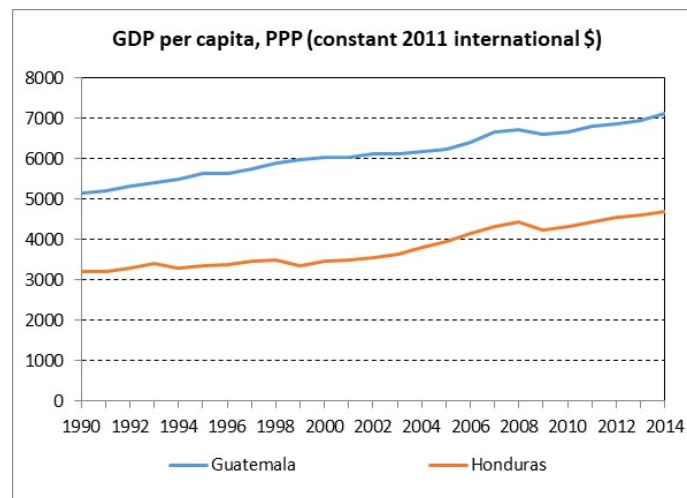
- A contribution to the Climate Change Adaptation Portal of the United Nations Development Program (UNDP) (2015) discusses ways Guatemala can incorporate climate change risk management strategies into their agricultural activities. It describes four main projects as part of the community based adaptation program. These projects include a soil recovery and conservation, reforestation and farming techniques. The goal of these projects is to decrease the vulnerability of Western Guatemala to future hurricanes, earthquakes and droughts.

III. Empirical Background²

Guatemala and Honduras are both lower-middle income countries in Central America. Within Central America, Guatemala is with about 16 million people the most populous country, while Honduras is with about 9 million people the second most populous country. Guatemala has the largest economy in Central America, with its top exports being edible fruits, nuts, coffee, tea and precious stones/metals. Despite being the second most populous country in Central America, the Honduran economy is the fourth largest as the less populous but richer Costa Rica and El Salvador have a larger GDP than Honduras.

Like many countries in Latin America, Guatemala and Honduras struggle with high income inequality, corruption and political instability. After a 36 year-long civil war ended in 1996, Guatemala adopted a representative government. Honduras had various military coups throughout its past, the latest in 2009. Since the 2010 inauguration of President Lobo, political stability has been partly restored, though the controversial re-election of President Juan Orlando Hernandez on November 26, 2017 has increased uncertainty and polarization in Honduran politics.

Figure 1: PPP-adjusted GDP per capita, 1990-2014



Source: Created by author based on World Bank (2016).

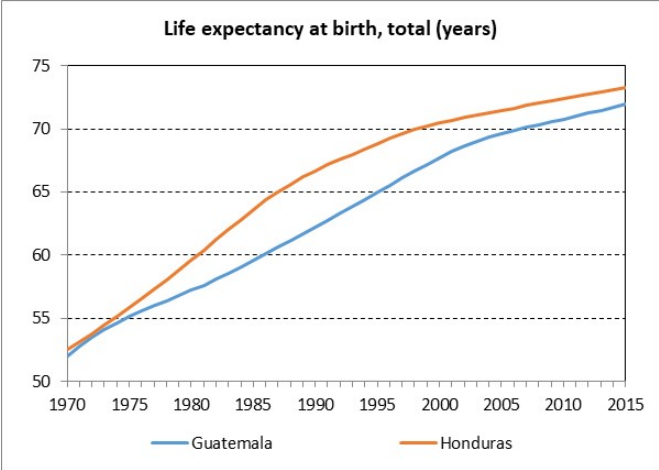
Figure 1 shows that Guatemala has a much higher GDP per capita (adjusted for purchasing power parity, PPP) than Honduras. Guatemala's GDP per capita increased from \$5,159 in 1990 to 7,112 in 2014 (which implies a cumulative increase of 37.8 percent over 24 years), while Honduras

² Most of the information provided in this section is based on World Bank (2016, 2017a, and 2017b).

increased its GDP per capita during the same period from \$3,205 to \$4,683 (which implies a cumulative increase of 46.1 percent).

Figure 2 compares the life expectancy at birth of Guatemala and Honduras. While the differences between the two countries were small in the early 1970s, Guatemala fell behind subsequently and was only able to catch up partly in the last decade. As of 2015, Guatemala’s life expectancy was 72.0 years, while that of Honduras was 73.3 years. It should be pointed out that even though Guatemala has a higher GDP per capita than Honduras, in terms of life expectancy, Honduras is doing better than Guatemala.

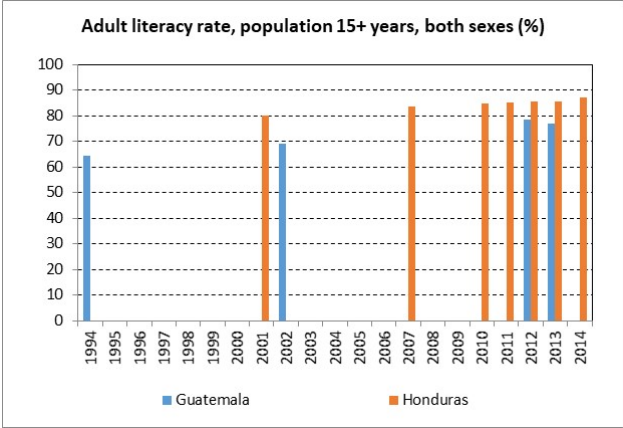
Figure 2: Life expectancy at birth, total (years), 1990-2015



Source: Created by author based on World Bank (2016).

Though data for literacy is available for only a few years, Figure 3 shows that Guatemala also has a lower literacy rate than Honduras. In 2001, Honduras had a literacy rate of 80.0 percent, while Guatemala’s was 69.1 percent in 2002. For 2013, which is last year such data was available for both countries, Guatemala had an adult literacy rate of 77.0 percent, while that of Honduras was 85.5 percent.

Figure 3: Adult literacy rate (percent), all available years



Source: Created by author based on World Bank (2016).

IV. Discussion

IV.1. Evidence of Climate Change

Both Honduras and Guatemala are listed among the top nations affected by climate change. Based on the long-term climate risk index (CRI), Honduras has been the most affected country from 1996 to 2015, while Guatemala has been the 9th most affected country.³

One of the main reasons for these countries' high vulnerability is their location. Both countries lie on a thin strip of land between the Atlantic and Pacific Oceans. Guatemala lies mainly on the Pacific Ocean where Honduras lies mainly on the Atlantic Ocean. Neither country has a buffer from the harsh weather events that the tropical oceans cause. These weather events include hurricanes, flooding as well as droughts. According to Baptiste (2014), a reporter for the Latin Correspondent, Honduras saw 60 extreme weather events and averaged 329 climate change-related deaths per year between 1996 and 2011. Both countries are also threatened by frequent volcanic eruptions and earthquakes.

Climate researchers have concluded that the increasing amount and strength of storms, floods and droughts are largely due to a changing and more volatile climate. In addition to many deaths, the recent storms have also caused a great deal of destruction to the economies of both countries. Jose Luis Rivera, the coordinator of Guatemala's Climate Change Unit, said that natural disasters have had serious consequences for the country: loss of infrastructure due to landslides and floods, loss of harvest causing food shortages and loss of natural space.⁴ When these storms flood the shores, they destroy the crops and farms that were once there. The people that worked on those farms are forced to move further inland.

Guatemala and Honduras are also extremely affected by climate change because it has changed the duration of their seasons. Normally, both countries have a rainy season that lasts from May to October and a dry season that lasts from November to April. However, in recent years the rainy season has not started until June. Because of the shift in seasons, a greater amount of rain falls in a shorter period of time. A document of the Adaptation Fund (2015) states that in Honduras this could be resulting in a greater frequency or intensity of both floods and droughts. These floods and droughts can ruin crops and destroy land. The changing seasons also affect the way the different crops grow. The next section will explore how the changing seasons and extreme weather events affect agriculture in each country.

IV.2. Climate Change Affecting Agriculture

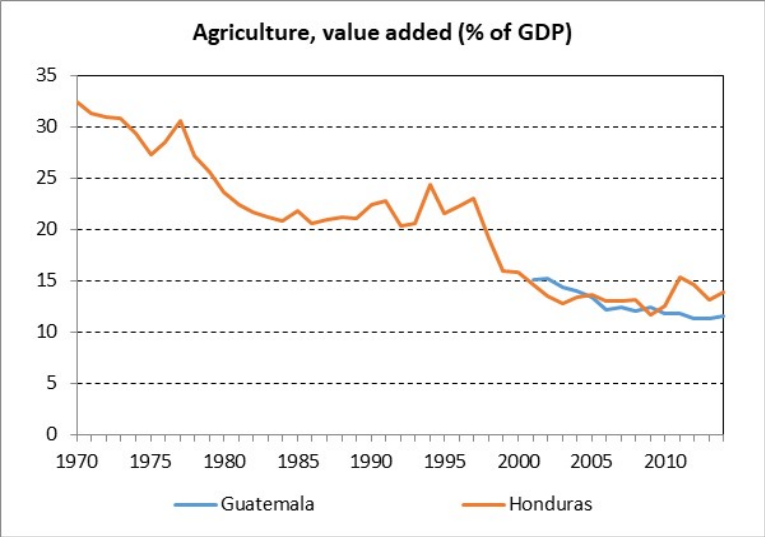
Though Guatemala and Honduras rely both on agriculture, climate change has affected their agricultural outputs differently. Guatemala's main agricultural exports are coffee, bananas, sugar and cardamom. Coffee and bananas are also the two biggest agricultural exports from Honduras. Eakin et al. (2006) examine the recent coffee crisis caused by climate change in Mexico, Guatemala and Honduras. Figure 4 shows the value added by agriculture as percent of GDP for all available years. While the data availability is too limited to say much about Guatemala, the high volatility for Honduras's agricultural output is an indication of some problems. The downward secular trend of the share of agriculture is not necessarily a problem, as growing country is

³ As stated by Kreft et al. (2017, p. 3): "The Climate Risk Index indicates a level of exposure and vulnerability to extreme events, which countries should understand as warnings in order to be prepared for more frequent and/or more severe events in the future."

⁴ As reported by Bevan (2013).

typically undergoing a structural transformation away from agriculture and towards industry and services, the very sharp declines of some years are likely reflecting shocks to the agricultural sector.

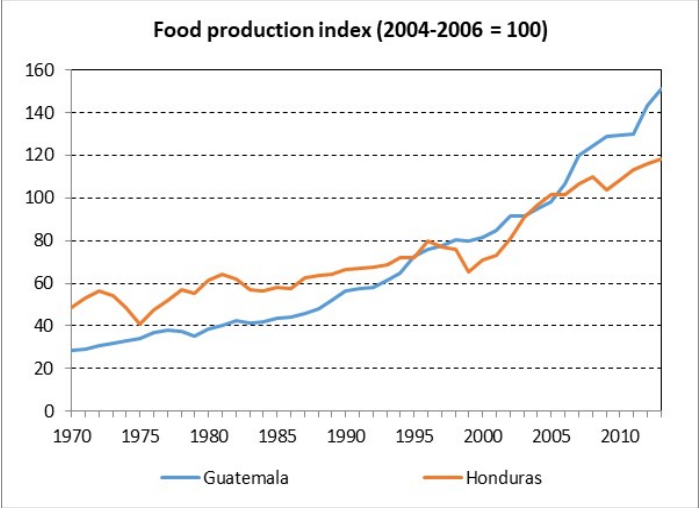
Figure 4: Agriculture, value added (percent of GDP)



Source: Created by author based on World Bank (2016).

To better assess such agricultural shocks, Figure 5 provides the data for the food production index, for which there is data for both countries from 1970 to 2015. The food production index includes food products that are edible. It excludes coffee and tea because these products are not edible in their natural form.

Figure 5: Food Production Index, 1970-2014



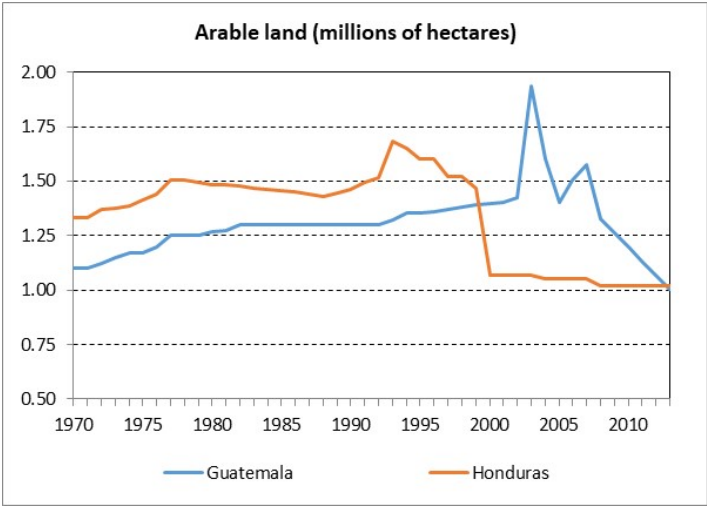
Source: Created by author based on World Bank (2016).

Excluding some minor volatility, Guatemala’s food production index has been steadily increasing since 1970. Though also trending upwards, Honduras’s food production index shows three clear declines: one in the early 1970s, one in the late 1990s, and one from 2008 to 2009. The very sharp decline from 1998 to 1999 has been due to Hurricane Mitch, which is actually also clearly visible in Figure 4 above. The overall increase in food production in Guatemala and Honduras can be linked to modernizations in the agricultural sector, especially the adoption of new technologies.

Climate change has decreased the amount of available agricultural land in both Honduras and Guatemala. Large storms like Hurricane Mitch flood neighborhoods by the shores, destroy homes, and ruin crops. An article written by Kendra McSweeney and Oliver Coomes (2011) discusses the devastating effects of Hurricane Mitch on one region of Honduras. They assert that some whole communities had to move further inland because of the destruction Hurricane Mitch caused. Focusing on the impact of Hurricane Mitch on the largest Tawahka community of Krausirpi (a village on Honduras’ Caribbean coast) McSweeney and Coomes (2011, p. 5203) write: “Ninety-five percent of the flood-plain’s 125 ha of cacao orchards were buried or washed away, and with them all income from cacao sales.”

Flooding of agricultural orchards and fields like this is common. Due to various climate-change induced impacts, salinization, and other land degradations, the total land available for agriculture in both Guatemala and Honduras has decreased over the years. Figure 6 shows the total amount of land available for agriculture in both Honduras and Guatemala.

Figure 6: Arable Land (millions of hectares), 1970-2014



Source: Created by author based on World Bank (2016).

In Guatemala, the amount of arable land grew at a slow pace from 1970 to 2002, but has since been on an overall declining trend, despite two sharp increases in 2003 and 2007. In Honduras, the availability of arable land increased slightly from 1970 to 1977, after which it decreased slightly until 1988. Following a few years of increase and subsequent decrease in the early and mid-1990s, there has been a very sharp decline in the amount of arable land from 1998 to 1999. Incidentally, this is when Hurricane Mitch devastated Honduras.

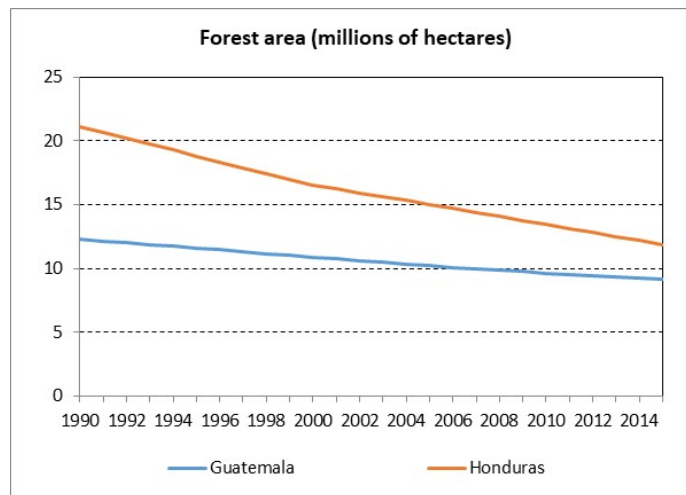
Increasing temperatures and the changing seasons have negative impacts on some crops. Crops like coffee and fruit (that are central to both Honduras and Guatemala) depend on a specific sequence of seasons. Because these seasons have been affected by climate change, the output of these products has been hurt. “Melons in the South of Honduras are now requiring more water to grow as temperatures are soaring and the vegetables in the mountains are struggling with the opposite, becoming sick with fungi due to the cold.”⁵

The vegetables in the mountains of Honduras are not the only crops infected with fungus. In Guatemala, a fungus called *La Roya*, has taken a hold of the coffee plants. NPR reporter Carrie Kahn (2014) writes that more than 70 percent of Guatemalan coffee crops are infected with *La Roya*, which has caused the loss of “100,000 jobs and a 15 percent drop in coffee output over the past two years”. Like the fungus affecting the vegetable crops in the mountains, *La Roya* has flourished because of the changing temperatures. Unlike the vegetable crops, *La Roya* thrives in warmer temperatures. Anyway, the changing temperatures across the region have allowed all types of fungus to grow. Climate change has reduced agricultural output because of fungi like *La Roya* and because of storm-induced flooding. People in both Honduras and in Guatemala have been forced to change the way they farm because of climate change.

IV.3. Deforestation: Exacerbating the Problem

The loss of arable land on the shores has led people in both countries to move inward. However, when they move inward, they typically have to cut down forests to make land available for farming. Figure 7 shows the amount of forest area in millions of square miles for each country from 1990 to 2015. It shows that the amount of forest area has been steadily decreasing in both, Guatemala and Honduras. The main reason for these decreases in forest area (especially in Honduras) is due to deforestation, which occurs mostly to create more farmland. Ironically, people are creating more farmland because climate change has negatively impacted the amount of crop they get on their previous land. Cutting down trees provides more farmland, but it also worsens the problem of climate change because cutting down trees releases carbon dioxide (CO₂) into the air.

Figure 7: Forest Area (millions of hectares), 1990-2015

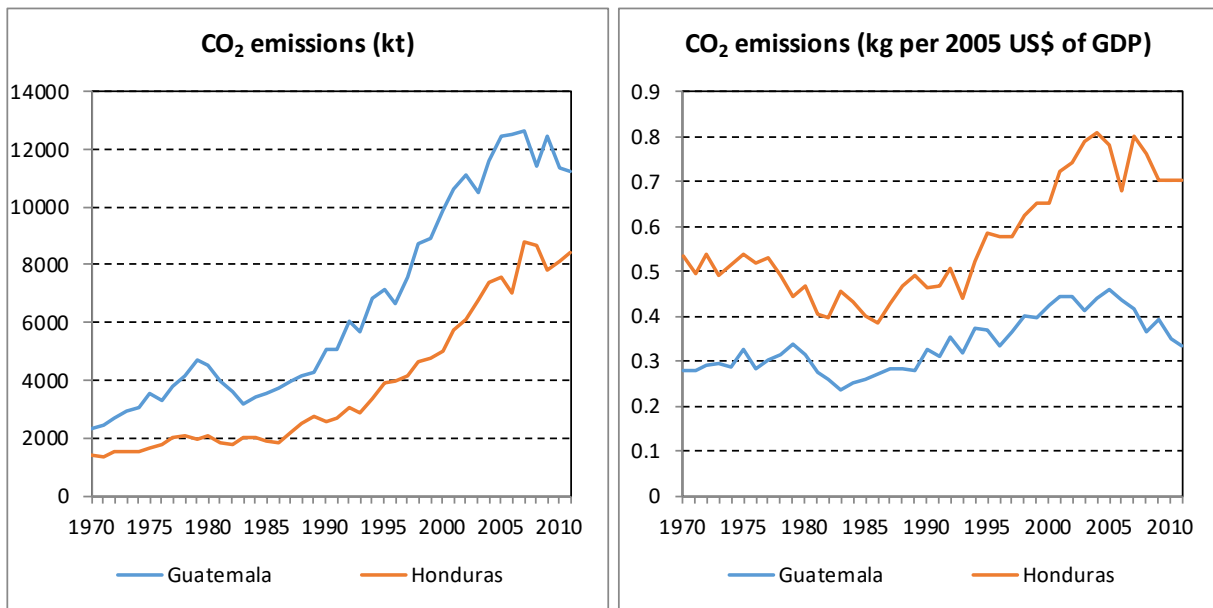


Source: Created by author based on World Bank (2016).

⁵ Llyod (2015).

There is of course no direct correlation between the impact of climate change on a country and that country's CO₂ emissions as the impact of climate change is determined by global emissions and those emissions have much longer-term implications. However, given the topic of this article, it is still interesting to see how CO₂ emissions have evolved over time in Guatemala and Honduras. Excluding the negative impact the world economic crisis of 2008/2009 had on output, the trends of total emissions, shown in Figure 8, are clearly upward. Controlling for GDP (in constant 2005 US\$), Figure 9 shows that CO₂ emissions have remained relatively stable in both countries from 1970 to around 1990, after which they increased until they turned highly volatile from 2005 to 2011, likely related to the recent world economic crisis.

Figures 8 and 9: Total CO₂ emissions and CO₂ emissions controlled for GDP



Source: Created by author based on World Bank (2016).

IV.4. How Are Honduras and Guatemala Adapting?

The effects of climate change in Honduras and Guatemala are exacerbated because both countries are highly vulnerable and have poor infrastructure. Nonetheless, both countries have put in place adaptation strategies to combat the effects of climate change. Honduras' main climate adaptation strategies involve water resource management. Increasing temperatures and decreasing rainfall mean that water levels in Honduras will decrease. Water is needed for everything, especially for agricultural production. Given the negative impact of climate change on water availability, Honduras is working on a) enhancing the quality of its irrigation system and b) improving water management more generally, which includes everything from water storage to water conservation.⁶

While Guatemala also has policies for water management, many of their climate change adaptation policies focus on soil recovery and forest conservation techniques. These strategies are aimed at

⁶ Adaptation Fund (2015).

protecting Guatemala against extreme weather events. As mentioned in the previous section, extreme weather events erode the soil on the shore where crops are planted. When crops are destroyed because of extreme weather events, people are forced to move inland. And, when people move inland they often have to cut down trees to clear the land. In order to prevent deforestation, Guatemala is working on protecting the soil and plants around existing forests. While replanting trees and adding soil, Guatemala is also attempting to add nutrients to the ground. They hope that these initiatives will also increase crop yields.⁷

While these adaptation plans are helpful, the implementation of the plans is more important. Because both countries are struggling with other problems, such as inequality and political corruptness, the necessary resources are not being allocated to implement climate change adaptation. In order for these countries to improve their situation, they must follow the steps set up and allocate the proper resources to deal with climate change.

V. Conclusion

This article examined the impacts of climate change on the agriculture of both Guatemala and Honduras. Generally, climate change has caused an increase in extreme weather events, an increase in temperatures, and a decrease in precipitation. Both Honduras and Guatemala are listed among the top ten countries most affected by climate change during 1996 to 2015.

Extreme weather events and changing temperatures are not good for any nation. However, they are especially harmful to nations that depend on agriculture, like Guatemala and Honduras do. The extreme weather events destroy crops and permanently destroy farmland. Changing temperatures and rainfall also negatively impact crop yields. Decreasing crop yields means less money for mostly already poor farmers, which greatly hinder their livelihoods. In countries where agriculture makes up a significant portion of GDP, these climate change related affects are a big problem.

Based on the data provided in this article, it is easy to see how much climate change has impacted Honduras and Guatemala within the last 20 years. However, we have also shown that within the last 10-15 years Guatemala and Honduras have begun to adapt to climate change. Both countries have begun to farm more efficiently and have begun to conserve water. They have also started planting different types of crops and have begun to diversify their economies.

While most of these initiatives have produced positive outcomes, they have not done enough to combat the eminent effects of climate change. As temperatures continue to rise and rainfall becomes less common, the agricultural industries in countries like Guatemala and Honduras will suffer. The amount of people living in poverty in both countries could increase as agricultural livelihoods are stripped away.

It is too late to reverse the effects of climate change. But there is still time to stop these effects from getting worse. International initiatives like the Paris Climate Agreement are good places to start. Agreements like this help hold nations accountable for their greenhouse gas emissions. Beyond mitigation, more adaptation initiatives that help countries already facing the effects of climate change, like Honduras and Guatemala, are needed. As the most vulnerable countries to climate change are overall also the least developed, these countries have to allocate many of their

⁷ United Nations Development Program (UNDP), Climate Change Adaptation Portal (2015).

resources towards poverty reduction and addressing inequality. Therefore, it is important for the international community to help these countries to adapt to their changing environments.

References

- Adaptation Fund (2015). *Addressing Climate Change Risks on Water Resources in Honduras: Increased Systemic Resilience and Reduced Vulnerability of the Urban Poor*; available at: www.adaptation-fund.org/project/addressing-climate-change-risks-on-water-resources-in-honduras-increased-systemic-resilience-and-reduced-vulnerability-of-the-urban-poor/.
- Baptiste, Nathalie (2014). Honduras' Biggest Threat: Climate Change. *Latin Correspondent*, News Report of September 12, 2014; available at: <http://latincorrespondent.com/2014/09/honduras-biggest-threat-climate-change/#qhPupWQtC6v4DpXV.97>.
- Bevan, Anna-Claire (2013). Guatemala: Adapting to Climate Change. News report for the Tico Times of August 13, 2013; available at: <http://www.ticotimes.net/2013/08/13/guatemala-adapting-to-climate-change>.
- Díaz-Ambrona, Carlos G. H.; Rubén Gigena; and Carlos O. Mendoza (2013). Climate Change Impacts on Maize and Dry Bean Yields of Smallholder Farmers in Honduras. *Iberoamerican Journal of Development Studies*, Vol. 2, No. 1, 2013, pp. 4–22; available at: <http://ried.unizar.es/index.php/revista/article/viewFile/43/26>.
- Eakin, Hallie; Catherine Tucker; and Edwin Castellanos (2006). Responding to the Coffee Crisis: A Pilot Study of Farmers' Adaptations in Mexico, Guatemala and Honduras. *The Geographical Journal*, Vol. 172, No. 2 (June) pp. 156–171.
- Fundación Vida (2012). Advancing Climate Compatible Development (CCD) for Food Security through the Implementation of National Climate Change Strategies, CDKN Honduras. *Case Study on the National Strategy on Climate Change and Agriculture/Food Security* (Tegucigalpa, Honduras: Fundación Vida, September); available at: https://cdkn.org/wp-content/uploads/2011/10/CCD-for-Agriculture_Case-Study_Honduras-final.pdf.
- Kahn, Carrie (2014). Rust Devastates Guatemala's Prime Coffee Crop and Its Farmers. National Public Radio (NPR), News Report of July 28, 2014; available at: <https://www.npr.org/sections/thesalt/2014/07/28/335293974/rust-devastates-guatemalas-prime-coffee-crop-and-its-farmers>.
- Kreft, Sönke; David Eckstein; and Inga Melchior (2017). Global Climate Risk Index 2017: Who Suffers Most From Extreme Weather Events? Weather-related Loss Events in 2015 and 1996 to 2015. Bonn and Berlin, Germany: Germanwatch; Briefing Paper; available at: <https://germanwatch.org/en/download/16411.pdf>.
- Lawrence, Felicity (2017). Global Food Crisis: Climate Change Imperils Guatemala's Food Security. *The Guardian*, News Report of February 2, 2017; available at: <https://www.theguardian.com/global-development/poverty-matters/2011/may/31/global-food-crisis-guatemala-climate-change>.
- Llyod, Ceri (2015). Honduras: Climate change and why we are here! Progressio 75, Blog of April 2, 2015; available at: <http://www.progressio.org.uk/blog/empowered-blog/honduras-climate-change-and-why-we-are-here>.

- McSweeney, Kendra and Oliver T. Coomes (2011). *Climate-Related Disaster Opens a Window of Opportunity for Rural Poor in Northeastern Honduras*. PNAS (Proceedings of the National Academy of Sciences of the United States of America), Vol. 108, No. 13 (March), pp. 5203–5208; available at: <http://www.pnas.org/content/108/13/5203.full>.
- United Nations Development Program (UNDP), Climate Change Adaptation Portal (2015). Community-Based Adaptation: Guatemala. Climate Change Adaptation Portal, internet resource; available at: <http://www.adaptation-undp.org/projects/spa-community-based-adaptation-guatemala>.
- World Bank (2016). *World Development Indicators / Global Development Finance Database* (Washington, DC: The World Bank); as posted on the World Bank website: <http://data.worldbank.org/data-catalog/> (downloaded on June 28, 2016).
- World Bank (2017a). Guatemala Overview. Washington, DC: The World Bank, Internet Resource, available at: www.worldbank.org/en/country/guatemala/overview.
- World Bank (2017b). Honduras Overview. Washington, DC: The World Bank, Internet Resource, available at: www.worldbank.org/en/country/honduras/overview#1.