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Climate Change and Sea Level Rise: Assessing Their Impacts on Belize

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Climate Change and Sea Level Rise: Assessing Their Impacts on Belize

Abstract

First of all, as we all know, there are three aspects of climate change that we know occur. The first is the increase of global temperatures because of greenhouse gas emissions in the atmosphere. As a result of the warming of the oceans, sea levels rise; but even more importantly, additional fresh water is entering the oceans, which is now the predominant factor leading to increased sea-level rates. Finally, a change of the hydrological cycle—because of warmer temperatures, we are seeing more extreme weather events and shifts in precipitation patterns.

The impacts, however, are more important—for example, the impacts of climate change on health. In Belize, we are seeing much more dengue because more mosquitoes are being spawned. There are also impacts on agricultural productivity, forestry, water resources, the coastal zone, and ecosystems in general.

In the case of Belize, our best data from the international airport shows that in the past fifty years, temperatures have increased by one degree Celsius already, and we know the global average for the past one hundred and fifty years is about the same: 1.1 to 1.2 degrees Celsius. So in fact, in Belize, it is even rising at a greater rate than we see globally.

Keywords

International Law, International Environmental Law, Global Warming, Greenhouse Gas, Law of the Sea

CLIMATE CHANGE AND SEA-LEVEL RISE:
ASSESSING THEIR IMPACTS ON BELIZE

CARLOS FULLER*

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Thank you very much, Moderator, and let me thank all the other organizers for inviting us to participate in this event. I take it as my remit, I will discuss the impacts of climate change on Belize and not only the impacts from sea-level rise.

I. INTRODUCTION

First of all, as we all know, there are three aspects of climate change that we know occur. The first is the increase of global temperatures because of greenhouse gas emissions in the atmosphere. As a result of the warming of the oceans, sea levels rise; but even more importantly, additional fresh water is entering the oceans, which is now the predominant factor leading to increased sea-level rates.¹ Finally, a change of the hydrological cycle—because of warmer temperatures, we are seeing more extreme weather events and shifts in precipitation

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1. Sergey K. Gulev et al., *Changing State of the Climate System*, in CLIMATE CHANGE 2021: THE PHYSICAL SCIENCE BASIS, 287, 353 (2021); B. Meyssignar et al., *Evaluating Model Simulations of Twentieth Century Sea-Level Rise. Part II: Regional Sea-Level Changes*, 30 J. CLIMATE CHANGE 8565, 8572 (2017).

patterns.²

The impacts, however, are more important—for example, the impacts of climate change on health. In Belize, we are seeing much more dengue because more mosquitoes are being spawned.³ There are also impacts on agricultural productivity, forestry, water resources, the coastal zone, and ecosystems in general.⁴

In the case of Belize, our best data from the international airport shows that in the past fifty years, temperatures have increased by one degree Celsius already, and we know the global average for the past one hundred and fifty years is about the same: 1.1 to 1.2 degrees Celsius.⁵ So in fact, in Belize, it is even rising at a greater rate than we see globally.

II. THREATS TO AGRICULTURE

The impacts on agriculture have been studied. The main crops in Belize consist of beans, corn, and rice.⁶ With a two degree rise of

2. See Sonia I. Seneviratne et al., *Weather and Climate Extreme Events in a Changing Climate*, in CLIMATE CHANGE 2021: THE PHYSICAL SCIENCE BASIS, 1513, 1523 (2021) (naming geological proxies and glacial isostatic adjustment as contributing factors to increasing freshwater runoff into seas).

3. See Press Release, Belize Press Office, Ministry of Health & Wellness Advises on Vector and Waterborne Diseases Due to Flooding, PR#299-22 (Oct. 12, 2022) (warning the public of increased breeding sites for disease carrying mosquitoes due to an increase in rain and floods); *PAHO Warns of the Complex Situation of Dengue in Latin America and the Caribbean*, PAN AMERICAN HEALTH ORG. (Aug. 15, 2019), https://www3.paho.org/hq/index.php?option=com_content&view=article&id=15365:paho-warns-of-the-complex-situation-of-dengue-in-latin-america-and-the-caribbean&Itemid=0&lang=en#gsc.tab=0 (detailing a complex cycle of consequences stemming from climate change).

4. See *Climate Smart Agriculture*, WORLD BANK, <https://www.worldbank.org/en/topic/climate-smart-agriculture> (last visited Feb. 6, 2023); see also *Climate Change and Forest Health*, FOOD & AGRIC. ORG., fao.org/forestry/99569/en (last updated Dec. 10, 2021); Michael Oppenheimer et al., *Sea Level Rise and Implications for Low-Lying Islands, Coasts and Communities*, in IPCC SPECIAL REPORT ON THE OCEAN AND CRYOSPHERE IN A CHANGING CLIMATE, 321, 328 (2019); U.N. EDU., SCI. CULTURE ORG. [UNESCO], UNITED NATIONS WORLD WATER DEVELOPMENT REPORT: WATER AND CLIMATE CHANGE 1 (2020) (detailing insecurity to a multitude of resources as a result of climate change).

5. See Myles R. Allen et al., *Framing and Context*, in GLOBAL WARMING OF 1.5°C, 49, 53 (2018) (providing data on global temperature averages).

6. Spanish Lookout Cmty., *Crops and Animal Statistics: 2020 & 2021*, 45 BELIZE AG REP. 31, 31 (2022).

temperature and a change in precipitation of twenty percent, we will see a fourteen to nineteen percent decline in beans, a ten to fourteen percent decline in rice, and a seventeen to twenty-two percent decline in corn.⁷

Two of our major export crops have also been studied. With a one to two and a half degree rise in temperature and a twelve to twenty percent change in precipitation, we will see a twelve to seventeen percent decline in sugarcane and, much less, a three to five percent decline in citrus.⁸ However, to emphasize not only the fact that sugarcane production will decrease, but our two sugar factories in Belize are also cogeneration facilities, providing electricity to the grid.⁹ Therefore, in addition to a decline in sugarcane, we also see an impact on our energy generation.

III. THREATS TO FORESTRY

Forestry is also being threatened by climate change. We have a good example of what occurred in around 2000. We had a major pine bark beetle infestation that destroyed seventy five percent of the nation's pine forest.¹⁰ The infestation impacted our timber industry and biodiversity. We had much more emissions of greenhouse gasses as that decayed. When the rains finally did come, we had lost the forest cover and had much more erosion, resulting in a poor water quality in our rivers which eventually went out to the sea.¹¹

7. NAT'L CLIMATE CHANGE OFF. & MINISTRY OF AGRIC. FISHERIES, FORESTRY, ENV'T, & SUST. DEV., BELIZE TECHNOLOGY NEEDS ASSESSMENT: ADAPTATION 9 (2017) [hereinafter BELIZE TECHNOLOGY NEEDS ASSESSMENT: ADAPTION].

8. *Id.* at 10.

9. See Aldair Gongora & Dorian Villafranco, *Sugarcane Bagasse Cogeneration in Belize: A Review*, 96 RENEWABLE & SUST. ENERGY REV. 58, 58–61 (2018) (discussing how sugarcane cogeneration plants in Belize positively impact the state's energy grid).

10. MINISTRY OF AGRIC. FISHERIES, FORESTRY, ENV'T, & SUST. DEV., BELIZE FOREST REFERENCE LEVEL (FRL)/FOREST REFERENCE EMISSION LEVEL (FREL) 2001–2015 26 (2020); see Ronald F. Billings et al., *Bark Beetle Outbreaks and Fire: A Devastating Combination for Central America's Pine Forests*, FAO CORP. DOC. REPOSITORY 7, 8 (Mar. 18, 2007) (detailing the devastating results of bark beetle outbreaks).

11. See Vanese Martin-Arias et al., *Modeled Impacts of LULC and Climate Change Predictions on the Hydrologic Regime in Belize*, 10 FRONTIERS ENV'T SCI.

IV. THREATS TO THE WATER SUPPLY

Our water supply is not only being threatened by less rainfall, but also by the sea-level rise and saltwater intrusion. Our main tourism areas are being impacted. In San Pedro, the groundwater has been totally depleted due to saltwater intrusion and we have had to resort to reverse osmosis.¹² The same thing occurs in Caye Caulker, further south than San Pedro.¹³ Again, their groundwater supply is gone and they must use reverse osmosis for potable water.¹⁴ In Placencia, the fresh water has to be piped across a lagoon because the groundwater has been depleted.¹⁵ In Belize City, which is the biggest population center in Belize, the water supply is located seventeen miles upriver.¹⁶ However, during droughts, pumping from that river was limited to only during a high tide when it was able to raise the fresh water.¹⁷ As a result, wells have been dug on either side of the river and are used to extract water for Belize City. For example, at the Belize Brewing company, which is located ten miles off-stream, the filtration system has been overwhelmed by saltwater intrusion during the dry season, so they have resorted to going back to the public water supply seventeen miles inland.¹⁸ However, as that saltwater moves further and further inland, the water supply for Belize City may have to be moved further off-stream beyond the seventeen miles where it is now located.

1, 2 (2022) (explaining how erosion and runoff affect the density of nutrients in soil).

12. BELIZE TECHNOLOGY NEEDS ASSESSMENT: ADAPTION, *supra* note 7, at 99; U.N. FOOD & AGRIC. ORG., COUNTRY PROFILE—BELIZE 3 (2015), <https://www.fao.org/3/ca0417en/CA0417EN.pdf>.

13. BELIZE TECHNOLOGY NEEDS ASSESSMENT: ADAPTION, *supra* note 7 at 99.

14. *Id.* at 9; JAPAN INT'L COOP. AGENCY (JICA), DATA COLLECTION SURVEY FOR WATER SUPPLY PROJECTS IN THE CARIBBEAN AREA, 5R JR 19-005, 9-14 (2019).

15. HALCROW, FEASIBILITY STUDY FOR THE PLACENCIA PENINSULA PILOT WASTEWATER MANAGEMENT SYSTEM 46 (2012); BELIZE TECHNOLOGY NEEDS ASSESSMENT: ADAPTION, *supra* note 7, at 99.

16. BELIZE AUDUBON SOCIETY, AN ENVIRONMENTAL AGENDA FOR BELIZE 2008-2013, 27 (2008).

17. *Id.*

18. *Id.*

V. THREATS TO LIVELIHOODS IN BELIZE AND CARIBBEAN

We did some analysis on the impact of sea-level rise on the coastal zone in Belize, and we projected a sea-level rise of four, thirty, and fifty centimeters over time periods of twenty-five, fifty, and one hundred years. There was very little impact at twenty-five years. However, at the 100-year interval, in 2100, Belize will lose fifty to one hundred percent of its beaches. Beaches are the main tourist attraction in Belize.

Similar studies were done across the Caribbean community. With a one meter rise of sea level, three percent of the population of Belize will have to be displaced and moved inland.¹⁹ This will result in a three percent decline in the GDP of Belize.²⁰ Across the Caribbean Community (CARICOM), it will be 2.1 billion USD in total GDP losses.²¹ Sixteen multi-million-dollar resources will be lost, costing a replacement of 1.6 billion USD.²² Over one percent of the agricultural land will be lost by salinization.²³ Transportation networks will be disrupted. Ten percent of the airports will be lost at a cost of over 715 million USD.²⁴ Land and ports will be inundated at a cost of 320 million USD, and the reconstruction costs of roads will exceed 178 million USD.²⁵ The total economic impact, GDP lost, for the Caribbean, will be 1.2 billion USD per year, permanent land lost will be 70 billion USD, and the relocation and reconstruction costs will be 4.64 billion USD.²⁶

Coral reefs will also be affected across the Caribbean, including in Belize. If we can limit global warming to 1.5 degrees Celsius, coral reefs have about a fifty percent likelihood of survival.²⁷ However, if it

19. See M.C. SIMPSON ET AL., AN OVERVIEW OF MODELING CLIMATE CHANGE IMPACTS IN THE CARIBBEAN REGION WITH CONTRIBUTION FROM THE PACIFIC ISLANDS, 61, 62 (2009).

20. *Id.* at 61.

21. *Id.* at 90.

22. *Id.* at 85.

23. *Id.* at 62.

24. *Id.*

25. *Id.* at 86.

26. *Id.* at 89.

27. *Id.* at 129.

warms up closer to two degrees Celsius, virtually all coral reefs in Belize and across the Caribbean will be lost.²⁸ The economic value of the ecosystem services provided by the coral reefs is estimated to be between 1.5 and 3.5 billion dollars per annum.²⁹

Studies from French Guyana demonstrate the impact on fisheries, and in particular the Yellow tail, which can now be found across the Caribbean, including the coastline of Central America, Northern South America, and the Eastern and Northern Caribbean islands.³⁰ With a one degree rise in temperature, almost all fish have to migrate further north to cooler waters, resulting in a loss for fisheries.³¹ Fishing is going to be threatened by only a one degree rise of temperature.

VI. CONCLUSION

Climate change and sea-level rise are threatening Belize. The population of Belize right now is estimated to be 450,000 persons.³² With a growth rate of 2.8 percent, which is what is expected at the low rise of population, by 2100, the population of Belize will be closer to one million.³³ The population density will then increase to 41 persons per kilometer.³⁴ The area of the country is 23,000 kilometers or 8,867

28. *Id.* at 206.

29. *Id.* at 222.

30. See generally Helene Gomes et al., *The Major Roles of Climate Warming and Ecological Competition in the Small-Scale Coastal Fisheries of French Guiana*, 26 ENV'T MODELING & ASSESSMENT 655 (2021) (discussing the impact of climate change on fisheries in French Guyana).

31. See Kirstin Holsman et al., *Climate Change Impacts, Vulnerabilities and Adaptations: North Pacific and Pacific Article Marine Fisheries*, in IMPACTS OF CLIMATE CHANGE ON FISHERIES AND AQUACULTURE: SYNTHESIS OF CURRENT KNOWLEDGE, ADAPTATION AND MITIGATION OPTIONS, 113, 123 (Manuel Barange et al. eds., 2018); see also Hazel A. Oxenford & Iris Monnereau, *Climate Change Impacts, Vulnerabilities and Adaptations: Western Central Atlantic Marine Fisheries*, in IMPACTS OF CLIMATE CHANGE ON FISHERIES AND AQUACULTURE: SYNTHESIS OF CURRENT KNOWLEDGE, ADAPTATION AND MITIGATION OPTIONS, 185, 197 (Manuel Barange et al. eds., 2018) (explaining patterns of species migrating to deeper cooler waters as climates rise).

32. *Postcensal Estimates by Age Group and Sex, 2010–2022*, BELIZE STAT. INST., sib.org.bz/statistics/population (scroll to bottom of page; then type the document title in the search line; then download as XLSX) (last visited Feb. 8, 2023).

33. *Population Growth in Belize*, WORLD DATA, <https://www.worlddata.info/america/belize/populationgrowth.php> (last visited Feb. 7, 2023).

34. *Belize Population (Live)*, WORLDOMETER, <https://www.worldometers.info>

square miles.³⁵ However, because of sea-level rise and erosion, land mass in Belize will decline. The population will have to retreat from the coast because of sea-level rise, and that increased population will have to compete with the people already living inland and with agriculture. Food security will be threatened due to the impact of climate change on Belize's main crops and to the fishing industry. More marginal land will have to be used for agriculture to feed an increased population. Our water security is being compromised, as I have demonstrated. We also have competing uses for our water resources. Belize's main source of power right now is hydropower.³⁶ They will have to compete with agriculture, municipal water supplies, tourism, and navigation.

We are also seeing migration from other countries. We see what is occurring in El Salvador, Honduras, and Guatemala moving northward, and many of those people are also coming into Belize.³⁷ Belize is now proposing to regularize 40,000 migrants into the country who have migrated across our borders.³⁸ Health risks will increase because an increased population and migration tends to introduce new diseases into the country—for example, dengue.

These are the threats that Belize is now facing because of climate change and sea-level rise. With that, I conclude my presentation. Thank you very much.

/world-population/belize-population (last visited Feb. 7, 2023).

35. NATIONAL CLIMATE CHANGE OFFICE & MINISTRY OF AGRIC. FISHERIES, FORESTRY, ENV'T, AND SUST. DEV., *BELIZE TECHNOLOGY NEEDS ASSESSMENT: ADAPTATION* 25 (2017).

36. *Id.* at 42.

37. *Belize: UNHCR Acknowledges GOB for Efforts to Protect Asylum Seekers in Amnesty*, UNHCR (Mar. 4, 2022), <https://www.acnur.org/noticias/ul/2022/3/622cccc4/belize-unhcr-acknowledges-gob-for-efforts-to-protect-asylum-seekers-in.html>.

38. Gov't of Belize Press Office, *Announcement of Amnesty 2022* (2022), <https://www.pressoffice.gov.bz/announcement-of-amnesty-2022>.

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