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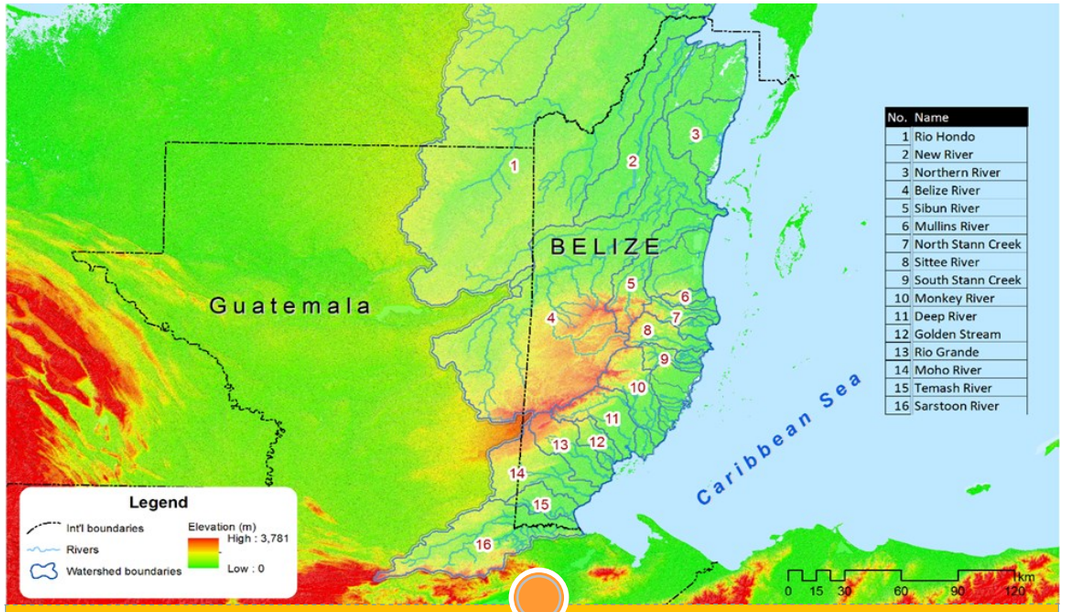
Assessing the Potential Impacts of Climate Change on Belize's Water Resources



Belize has sixteen major watersheds. Thirteen Global Climate Models (GCMs) were used in this study to asses the impacts of climate change and land-use change on these watersheds. Three land-use change scenarios, shown in Figure 1, were used in the study.

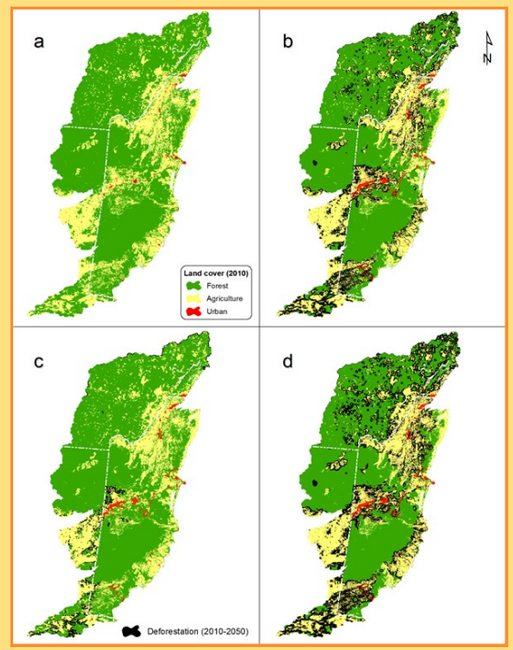


Figure 1: Maps illustrating areas where deforestation is projected to occur based on land-use data used in the hydrological modelling

a: 2010, baseline
b: 2050, business as usual scenario
c: 2050, deforestation rate halved
d: 2050, deforestation rate doubled.

The main results were examined in the context of the projections of the following :

(i) overall changes in **rainfall** patterns across Belize's major watersheds
(ii) overall changes in **runoff** as a result of the changes in rainfall, and
(iii) overall changes in **erosion**.

EXPECTED CHANGES IN RAINFALL, RUN-OFF AND EROSION

Eleven of the 13 GCMs indicate a drier climate over Belize's major watersheds by the 2050s.

Only two models (GFDL-CM3 and NorESM1-M) indicate slight increases in rainfall across Belize's watersheds by the 2050s. (See Figure 2)

Runoff volumes are overall higher in Belize's southern watersheds, which experience more rainfall than in the north. Nevertheless, in terms of erosion, most of Belize's major watersheds– even with climate change– will continue to experience high levels of erosion.

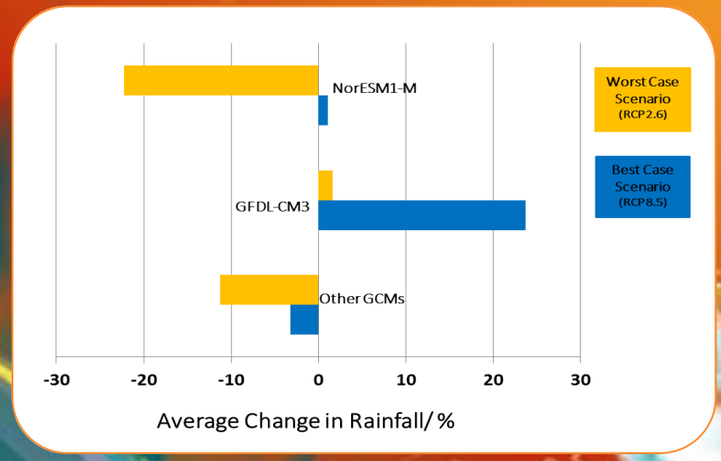


Figure 2– Average increases and decreases in rainfall patterns across Belize's watersheds as estimated by GCMs .

EXPECTED CHANGES IN RUN-OFF AND EROSION PATTERNS

CONDITIONS CONSIDERED	RUN-OFF PATTERNS	EROSION PATTERNS
CLIMATE CHANGE ONLY	- General tendency is toward a decrease in runoff. · South Stann Creek watershed is expected to experience the most pronounced decrease in runoff. · Localized increases in runoff, likely tied to rainfall increases in the 2050s, were estimated under the GCM- RCP 2.6, MRI- CGCM3 and NorESM1-M models. · Runoff as a percentage of rainfall would only increase slightly from 7.11% in 2010 to 7.44% in the 2050s.	· Generally, erosion patterns are similar to those for runoff. · Across most models, erosion is estimated to decrease across Belize's major watersheds. · While changes are not substantial, the Rio Grande watershed would experience the most pronounced decline in erosion.
LAND-USE CHANGE ONLY	· Modelling indicates an increase in runoff across all major watersheds especially in a scenario with a doubled deforestation rate. · Runoff as a percentage of rainfall increases from 7.11% in 2010 to 11. 3% in the 2050s.	· Modelling indicates an overall increase in erosion in the majority of Belize's watersheds if land-use conditions exist without climate change interference.
LAND USE CHANGE AND CLIMATE CHANGE	· Changes are generally dependent on the climate change scenarios · Overall, the Belize River watershed is estimated to experience an increase in runoff. · Under RCP 2.6, runoff would increase from 7.44% of rainfall in 2010 to 11.73% in 2050s in the Belize River watershed.	· Overall tendency is for increased erosion with few exceptions. · The Golden Stream watershed is estimated to experience the greatest increase in erosion. · The Rio Grande watershed is estimated to experience a small decrease in erosion.

RECOMMENDATIONS

- Based on this study, declining rainfall can be expected; therefore, the impacts of this warrant further analysis.
- Significant enhancement and expansion of Belize's hydrological monitoring and data management system for tracking both the supply and the demand for water resources is needed.
- Rainwater harvesting (i.e. the use of vats) for collection of water for human consumption or other uses need to be explored, given that sediment concentrations in rivers may increase, affecting the quality of drinking water.
- Reforestation of degraded lands with native species within key watersheds such as the Belize River watershed, and the agriculturally developed Rio Hondo and New River watersheds is needed.
- Adequate management of some of the major watersheds requires trans-national cooperation with national or municipal governments in Mexico and Guatemala.
- Further studies should be undertaken to examine the impact of climate change in other sectors and sub-sectors.