

Chapter 34

Soil, Water, and Agricultural Adaptations

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ABSTRACT

Threats to the Caribbean's diminishing soil and water resources will be heightened under predicted climate change scenarios for the Caribbean. Changes in climate change drivers, temperature, and precipitation present the greatest impact on soil and water resources. Predicted increases in air surface temperature would affect sea-level rise. Low total precipitation across both wet and dry seasons with increased incidence of drought and extreme storm events will pose challenges to agriculture. Erosion and land degradation are expected to increase, thereby reducing arable land acreage, and elevated temperatures will further reduce soil organic carbon contents. In this chapter, strategies to sustainably manage soil resources in the Caribbean are discussed and focus on (1) reducing the incidence of erosion and degradation and (2) increasing Soil Organic Carbon (SOC) contents. The authors also present some appropriate water conservation techniques including micro-irrigation and water harvesting, which are necessary to maintain consistency of food supply.

INTRODUCTION

Agriculture modifies natural ecological systems connecting humans to the environment. It relies on and influences natural resources including soil and water. Large variability in the nature and distribution of these resources in the Caribbean significantly affects their management. As these two resources remain a management challenge under present climatic conditions, the reality of a changing climate may further complicate management efforts. Climatic variability, as affected by atmospheric CO₂ levels, will affect and in return be influenced by soil and water resources. Climate change mitigation is aligned to agricultural soil and water resources with both pools being sources and sinks for CO₂. This dimension plays a crucial role in the region's response to climate variability, although little effort is directed toward

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reduction in agricultural CO₂ emissions. However, conservation systems that reduce atmospheric CO₂ levels may also increase the resilience of our soil and water resources to likely impacts and thus enhance their adaptability. Anticipated changes in global climatic systems will directly affect regional and local precipitation, and indirectly, soil and water resources. The resilience of these resources as supported by human management will determine the likely effect on productivity and food security.

Soil quality and fertility management remain suboptimal in regional agriculture. Appropriate use of organic and inorganic amendments along with diagnostic assisted plant nutrition is needed to increase productivity and maintain environmental sustainability. Mismanagement of soils especially on hillsides have led to significant soil loss through erosive processes, further degrading poor quality soils. Efforts directed at soil conservation and quality improvement has met with little success, partly due to unfavorable economies of scale and inappropriate technologies. Similar to soil resources, prudent use of water in agriculture is fundamental to increasing productivity thresholds. Water related constraints have limited regional agriculture more than any other production factor. Data indicate that < 15% of arable lands in the Caribbean is irrigated, with the result being a paradigm of seasonally, rain-fed food production, with productivity linked to the soil-water balance. Apart from crop improvement practices, agricultural water management remains the second most important avenue for increasing food supply and ensuring food security.

Changing weather patterns has resulted in production declines, especially when associated with extreme weather events. Many examples exist across the Caribbean, some with lasting physical and economical scars. The inability to deal appropriately with these scenarios highlights our vulnerability to climate change drivers. A void exists in our understanding of the local level impacts of climate change on agricultural resources. This is confounded by the high internal variability within soil and water resources, which complicates mitigative and adaptive management strategies. As the region attempts to grapple with global issues of climate change and predictive scenarios (global and regional climate scenarios) that grossly overcompensates SIDS, attention has to be focused on local and regional experimentation and analysis to ensure improved and sustainable productivity. Appropriate technologies including protected agricultural systems and ICTs become important tools in our adaptation arsenal.

The following topics focus on presenting and informing readers on the impacts of climate change on Caribbean soil and water resources for agriculture and the practical tools and techniques for adaptation to increase food security.

CARIBBEAN SOIL AND WATER RESOURCES FOR AGRICULTURE

Soil Resources of the Caribbean

The small landmass of the Caribbean region has tremendous variability in soil resources linked to differences in historical geological formation and parent material. Ahmad (2011) reported six pedological soil groups comprising hundreds of individual series. A summary of these soil groups are presented, highlighting major properties and qualities associated with management, vulnerability to climate change and climate variability and sustainable use. Soils are listed in chronological order starting with the geologically youngest soils.

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