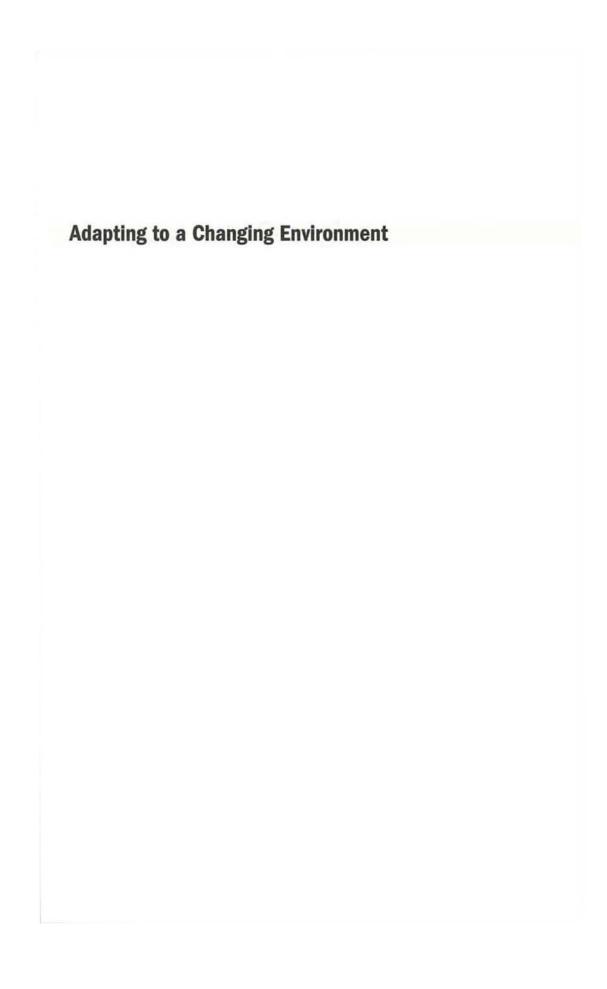


# ADAPTING TO A CHANGING ENVIRONMENT

CONFRONTING THE CONSEQUENCES
OF CLIMATE CHANGE

TIM R. McCLANAHAN and JOSHUA E. CINNER



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### **PREFACE**

The changing climate may fundamentally alter the land and sea as we know it. For those who depend on the beauty and bounty of the Earth's natural resources for their livelihoods—especially the world's poor—these changes could spell disaster. The problems climate change poses are complex, as are the ways in which societies cope with and adapt to change. Understanding and addressing these problems requires bridging diverse fields within the geophysical, ecological, and social sciences.

An ecologist and a social scientist, we have spent the last decade working together to integrate these fields. We approach the book from the perspective that social and ecological systems are intimately linked. Social processes, which can include cultural, political, and economic characteristics of society, influence the ways that people use and manage natural resources. Likewise, ecological conditions and processes can influence the societies' well-being.

Using this interdisciplinary approach, this book synthesizes, in simple terms, the rapidly emerging fields of climate change science and human adaptation and develops a practical framework for much-needed policy and adaptive responses. The framework addresses the differential responses of the environment, ecology, and people in affected areas, and identifies the policy action priorities based on this heterogeneity. We hope that this type of integrated analysis and problem solving will lead to policy actions that promote appropriate and lasting adaptations.

As a focal lens for these integrated climate change issues, we explore coral reefs and the coastal societies that depend on them throughout the eastern coastline of Africa and the islands of the western Indian Ocean. This is where many of the Earth's most impoverished people live. Here, both ecosystems and peoples' livelihoods are extremely sensitive to climate disturbances. Monsoonal rains, which are heavily influenced by climatic patterns, provide nearly all of the rainfall for the region's agriculture. Likewise, the islands and coasts are fringed by coral reefs, which provide livelihoods for millions of fishers and their dependants in the region, but are one of the most climate-sensitive ecosystems. Considerable climate impacts have already occurred to the regions coral reefs-and even more severe ones are expected. This region, like others in poor tropical countries, has neither contributed much to rising greenhouse gas emissions, nor is it likely to contribute greatly to the efforts to mitigate climate change. Countries in the region will have little choice but

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to adapt, but these efforts will face considerable challenges from persistent poverty, implementing decisions, corruption, and other prevalent socioeconomic conditions.

The challenges of undertaking climate science, making the findings accessible, and catalyzing action are considerable, but this region is where these efforts and responses are most needed. Harsh realities will need to be confronted with decisions that increase the chances for successful adaptation. Although our book focuses on a specific geographic region and ecosystem, the conceptual framework we develop is applicable to most regions and climate change problems. Those interested in how climate change may influence other regions or systems can adapt the framework and approach we develop beyond the specific case we present.

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### LIST OF ABBREVIATIONS

AHP Analytic Hierarchy Process
BMU beach management units

BP before the present
CV coefficient of variation
EEZ exclusive economic zone
ENSO El Niño southern oscillation

FAO Food and Agriculture Organization

GDP gross domestic product
GELOSE Gestion Locale Sécurisée
HDI human development index
IOD Indian Ocean dipole

IPCC Intergovernmental Panel on Climate Change

ITCZ inter-tropical convergence zone

LMMA Locally Managed Marine Areas network

MPA marine protected area

MMSY multi-species maximum sustainable yield

NGO nongovernmental organization

NOAA National Oceanographic and Atmospheric Administration
OECD Organization for Economic Co-operation and Development

PAR photosynthetically active radiation

PDO Pacific decadal oscillation PPP purchasing power parity

SIDA Swedish International Development Corporation Agency

SST sea-surface temperature

UNCLOS United Nations Convention on the Law of the Sea

UV ultraviolet

WIO western Indian Ocean

WIOMSA Western Indian Ocean Marine Science Association

WWF World Wildlife Fund