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# **ENVIRONMENTAL CHANGE AND HUMAN HEALTH CASE STUDIES I**

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THE AUSTRALASIAN COLLEGE OF TROPICAL MEDICINE

RED HILL QUEENSLAND AUSTRALIA

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## Foreword

The World Health Organization (WHO) has become increasingly concerned about effect of global environmental change on human health.<sup>1</sup> In addition to climate change, biodiversity and natural disasters, there are a number of human interventions that are direct drivers of environmental change, such as land and agricultural practices, irrigation and dams and human behaviour.<sup>1</sup> Impacts can be modified or exacerbated by a local population's current vulnerability, such as population movement into an endemic area for a disease for which they have no immunity. Global changes, including an increase in trade and global warming, which act on the environment, are likely to impact on the evolution of pathogens and hence of diseases. For example, it is likely that climate change is likely to alter the geography of infectious diseases and pests, including the distribution of vector-borne diseases, such as Rift Valley fever, yellow fever, malaria, dengue and Chikungunya, which are highly sensitive to climatic conditions.<sup>1</sup> Other diseases may also be influenced by climate, such as meningitis and cholera.<sup>2</sup> Also, we have seen how changes to irrigation and dams have previously affected the distribution of diseases, such as schistosomiasis.

This present book, *Environmental Change and Human Health: Case Studies I*, is a significant contribution to addressing these challenges. The Editor, Deon Canyon, presents a unique publication that is sure to assist professionals and students working in public health and environmental health, as well as related areas such as tropical health or environmental engineering. The main components of the book are an introductory chapter on "Biodiversity, environmental change and the web of life" and a series of case studies, which illustrate and inform the reader about these issues. The cases relate to diverse interests including cholera outbreaks globally, water quality and nutrient loading in the USA, schistosomiasis in China, neurocystercosis in China, Nipah virus and Malaysia, Hantavirus and Argentina, pneumonic plague and the Congo, skin cancer and Mackay in Australia, the Toowoomba water crisis, schistosomiasis and Ghana, Chikungunya and the west Indian Ocean islands, Chagas' disease and Guatemala. The major advantage as always with electronically published monographs is the full colour illustrations. This is an important online publication to add to your list of website bookmarks.

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## References

1. World Health Organization. Global Environmental Change. URL. <http://www.who.int/globalchange/en/> (accessed 19 November 2008)

2. Greer A, Ng V, Fisman D. Climate change and infectious disease in North America: the road ahead. *Canadian Medical Association Journal*. 2008; 178: 715-722.

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## Preface

Case studies are an open-ended teaching strategy used to encourage higher-order thinking, teamwork and self-directed study. They are a way of teaching and learning by introducing dilemmas, which encourage exploration. A good case study offers carefully integrated clues about an issue that is embedded in a geographical, social, and ethical context. Questions are developed to explore the information on hand. In the process of answering these questions, students become involved in the dynamic and integrative thinking needed to solve problems scientifically. By going through this process, students gain a practical level of understanding for the science and social skills needed to solve public health problems.

The authors, who are mostly mid-career health professionals, were asked to develop case studies that were not about a person, but about a situation involving an ecosystem change and public health issue.

Each case study introduces its topic, sets the scene and explains the author's aim. From there, an investigation and analysis section uses the approach typically taken in a medical case study to dissect the presented environmental health problem. Causal factors feature strongly as do matters pertaining to transmission and variation from expectations or typical presentation. A management section follows which examines efforts to remediate, control or eradicate the problem. Outcomes are reviewed with a view to ascertaining physical damage to the environment and societal costs to exposed populations. Finally, each case study looks at alternate options that could have been or that were explored to resolve the issue.

Of course, in most areas, decisions that are taken or recommended are subject to local circumstances. The literature is not broad enough to cater for local conditions so many decisions are based on experience and knowledge at hand. It is hoped that these case studies present a little more information in a succinct format to support managers to take more evidence-based decisions.

In all the case studies, the focus remains unwaveringly on issues bearing directly on environmental health and little if any text is devoted to environmental issues that result in limited or no direct or indirect impact on human health. Certainly, such events may acquire importance as human-environment interactions continue into the future, but that is beyond the scope of the case studies. Nevertheless, these issues are fundamental to understanding the relationship between all organisms and the environment. So, the introduction addresses several of these general environmental issues.

Thus, a primary objective of these case studies is to provide readers and managers with information on how certain situations were handled, how they might have been handled differently and what the options were. This should increase the accessible evidence/knowledge-base required to intelligently evaluate scientific issues and information at hand so that more effective informed judgements can be made.

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**Colleen Lau** – MB BS FRACGP CertTravHealth. Dr Lau works as a GP half the week, runs a travel medicine clinic half the week, and is currently completing a MPH&TM at James Cook University. During the ten years that Dr Lau has been working in travel medicine, she has met a lot of interesting people going off to every corner of the world for fun, for work, and for all sorts of other reasons. Dr Lau was in the Seychelles in January 2006 during the Chikungunya Fever outbreak. On her return home, reports of the unprecedented outbreak in the Indian Ocean islands and India emerged and she thought it would make an interesting environmental health case study.

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