

---

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

---

**DEON V CANYON**

THE AUSTRALASIAN COLLEGE OF TROPICAL MEDICINE

RED HILL QUEENSLAND AUSTRALIA

AN ACTM PUBLICATION



First Edition © 2008 The Authors

This book is copyright. Apart from fair dealing for the purposes of private study, research, criticism or review, as permitted under the Copyright Act, no part may be reproduced by any means without written permission from the publisher.

Author: Canyon, Deon.

Title: Environmental Change and Human Health Case Studies I [electronic resource] / Deon V Canyon.

Publisher: Red Hill, Qld: Australasian College of Tropical Medicine, 2008.

ACTM Secretariat  
PO Box 123  
Red Hill  
Brisbane, Qld., 4059  
Australia

Tel. +61-7-3872 2246  
Fax. +61-7-3856 4727  
Email. [ACTM@tropmed.org](mailto:ACTM@tropmed.org)  
Internet. [www.tropmed.org](http://www.tropmed.org)

ISBN: 978-0-9578717-9-3

Design by Deon V Canyon

Disclaimer: While every reasonable care has been taken to ensure that the information in this text is correct, neither the Editor, contributors, nor The Australasian College of Tropical Medicine can accept any responsibility for the inclusion or omission of any material or for any inaccuracies in the information supplied.

## 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.

*Peter A. Leggat, MD, PhD, DrPH, FAFPHM, FACTM, FFTM ACTM, FFTM RCPSG, FACRRM, FRGS\**

*Professor and Head, School of Public Health, Tropical Medicine and Rehabilitation Sciences, James Cook University, Townsville, Australia*

*Visiting Professor, School of Public Health, University of the Witwatersrand, South Africa*

*Conjoint Professor, Faculty of Health, University of Newcastle, Australia*

*President, The Australasian College of Tropical Medicine, 1996-98, 2002-04, 2006-08*

*Director-General, World Safety Organization, 1997-1999*

## 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.

\*Address for Correspondence: Professor Peter A. Leggat, Head, School of Public Health, Tropical Medicine and Rehabilitation Sciences, James Cook University, Townsville, QLD 4811 Australia

## 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.

*Deon V Canyon PhD MPH*

*Fellow of The Australasian College of Tropical Medicine*

## Table of Contents

Foreword.....	iii
Preface .....	v
Table of Contents.....	vi
Contributors .....	xiv
Biodiversity, environmental sustainability and human health .....	1
What does Development in the tropics mean? .....	3
Land clearing - ‘mining’ of renewable resources.....	3
Partial ‘mining’ .....	3
Foreign organisms.....	4
Fragmentation.....	4
Energy .....	5
Encouraging signs and current activities .....	5
What is the impact on human health? .....	5
The Deforestation example.....	5
Case in point – The Gogol Valley, Papua New Guinea <sup>8</sup> .....	6
References .....	7
Case 1: Cholera, Marine Ecosystems, and Environmental Change: An Outbreak Crisis?.....	9
Introduction .....	9
Investigation and Analysis.....	9
Cholera as a Human Disease.....	9
Cholera as an Environmental Pathogen.....	10
Environmental Change and Cholera .....	11
Management History and Effects .....	14
The Cost of Cholera and Environmental Management .....	15
Resolution .....	16
References .....	16
Case 2: Hogs, hurricanes and human health — the complex case of the Neuse River estuary .....	18
Introduction .....	18
The Neuse River Estuary .....	18
Investigation and Analysis.....	20
Recognizing the Problem .....	20
A Growing Concern .....	20
Causes .....	20

The Impact of Hog Farming.....	22
Nitrogen Loading.....	22
The Hurricanes Cometh .....	23
Management History and Effects .....	25
Non-Hog Related Efforts .....	25
Hog-Related Efforts.....	25
A Continuing Problem .....	26
Resolution .....	26
Recommendations for Intervention .....	26
General Policy Issues.....	28
Caveats on Water Quality .....	28
Case Study Exercise.....	29
The Scenario.....	29
The Issues.....	29
Outcomes Key .....	32
References .....	34
Case 3: Schistosomiasis control in China and the future impact of the Three Gorges dam.....	36
Introduction .....	36
Background .....	36
Global Disease Burden .....	36
Transmission .....	36
Clinical Features .....	37
Control Strategies .....	37
<i>S. japonicum</i> Infection in China.....	38
Historical Significance .....	38
The National Schistosomiasis Control Program.....	38
The World Bank Loan Project.....	39
Current Schistosome Transmission in China.....	39
Primary Host Activities.....	39
The Intermediate Host .....	40
Ecological Systems .....	41
Transmission Modes .....	41
The Three Gorges Super Dam .....	42
Environmental Changes .....	42

Population Changes .....	43
The Future of Schistosomiasis Control In China .....	43
Conclusion.....	44
References .....	44
Case 4: Neurocystercosis in Miao Ethnic Minority, Guangxi Autonomous Region, China .....	46
Introduction .....	46
Investigation and Analysis.....	47
A chronic problem.....	47
Other factors .....	48
A re-emerging disease?.....	48
Identifying the problem .....	49
Investigations in Guangxi .....	49
Management History and Effects .....	49
How effective were these efforts?.....	50
Social and psychological effects.....	51
Resolution .....	51
References .....	52
Case 5: Environmental Factors Influencing the Emergence of a New Zoonosis: The Nipah Virus Outbreak in Peninsular Malaysia and Singapore .....	53
Introduction: .....	53
Investigation and Analysis.....	54
How was the problem identified?.....	55
What were the findings of any investigations? .....	55
The hunt for a wildlife natural host: .....	56
What were the related circumstances or conditions?.....	57
Management History and Effects .....	60
Malaysia .....	60
Singapore .....	60
Effectiveness of the methods used.....	61
Probable outcomes .....	61
Resolution .....	62
Bioterrorism potential: .....	63
Conclusion:.....	63
References .....	63



Case 6: Hantavirus Pulmonary Syndrome in Argentina .....	65
Introduction .....	65
Location.....	65
Investigation and Analysis.....	66
Description of Hantaviruses.....	66
Causes and Concerns .....	68
Socio-economic Conditions.....	68
Changing Weather Patterns.....	69
Changing Human Populations: Demography and Geography .....	69
Management History and Effects: .....	70
Monitoring HPS .....	70
Effectiveness .....	70
Regional Guidelines for Public Health Awareness .....	71
Probable Outcomes and Future Considerations.....	71
Further Management Speculation and Resolution:.....	72
Conclusion:.....	73
References .....	73
Case 7: The Pneumonic Plague Outbreak in the Ituri Region of DRC 2006 .....	75
Introduction .....	75
Investigation and Analysis.....	76
The Disease .....	76
Clinical Presentation .....	77
Diagnosis .....	78
Treatment and Prognosis.....	78
Identification and Investigation of the Plague in Ituri .....	78
Causes .....	79
Impact .....	80
Management history and effects.....	81
Outcomes.....	81
Resolution .....	83
The Americas.....	83
North Africa.....	84
India .....	84
DRC.....	84

The Role of WHO.....	84
Conclusion.....	85
References .....	85
Figures.....	86
Case 8: Environmental change and skin cancer in Mackay .....	87
Introduction .....	87
Investigation and Analysis.....	87
What is the Environmental Cause of the Problem?.....	87
Disease of Concern.....	89
Management History and Effects .....	91
History of skin cancer prevention and control strategies.....	91
Ethical Considerations.....	96
References .....	96
Case 9: The Toowoomba Water Crisis .....	98
Introduction .....	98
Water Restrictions, Toowoomba shire, as of September 17 <sup>th</sup> , 2006.....	98
Toowoomba’s water supplies. ....	99
Toowoomba Dam Levels.....	99
Water Futures: .....	100
Parsons Brinckerhoff.....	101
Indirect Potable Re-use.....	102
Advanced Water Treatment. ....	103
Ultrafiltration .....	103
Reverse osmosis.....	104
Ultraviolet disinfection.....	104
Advanced oxidation: .....	105
Selling the Process .....	105
The Case For.....	105
The Case Against .....	107
There was the odd red herring .....	108
There was some nitpicking.....	108
There was some scare mongering and misinformation.....	108
And there was the “Yuk Factor”: .....	109
The Referendum took place on 29 <sup>th</sup> July 2006. ....	109

Where to from here? .....	111
References .....	112
Case 10: Ecological Change due to large-scale Dam Construction in Central Ghana and increased Prevalence of Schistosomiasis. ....	113
Introduction .....	113
Lake Volta.....	113
The Issue .....	113
Investigation and Analysis.....	114
Schistosomiasis .....	114
Prevalence Patterns in the Volta Region. ....	117
Socio-economic and Environmental impact of dam construction.....	118
Management History and Effects in the Volta Basin .....	119
History .....	119
Effects of Management Efforts .....	121
Resolution .....	123
Examples of Success.....	123
What is required for effective control and elimination .....	123
Conclusion.....	124
References .....	125
Appendix 1 .....	127
Appendix 2 .....	128
Case 11: Chikungunya Fever: Havoc in the West Indian Ocean Islands .....	130
Introduction .....	130
Investigation and analysis:.....	131
Cause and identification of the problem: .....	131
Findings of investigations:.....	132
Management history and effects.....	137
Clinical management of affected cases: .....	137
Public Health measures: .....	137
Vector control and surveillance (6, 19):.....	137
Public education (6, 19): .....	138
Community mobilisation (19): .....	138
Epidemiological surveillance in Reunion included (17, 18, 20): .....	138
Outcomes.....	139

Resolution .....	140
Vector control .....	140
Vector surveillance.....	140
Community involvement and education .....	141
Epidemiological surveillance.....	141
Effective response to outbreaks .....	141
Surveillance in other parts of the world .....	142
Research.....	142
Vaccine development .....	142
Conclusion.....	142
References .....	142
Case 12: Control of Chagas disease in Guatemala.....	146
Introduction .....	146
Investigation and Analysis.....	147
Cause of Chagas Disease and Modes of Transmission.....	147
Clinical Manifestations.....	148
Vector Surveys .....	150
Infection rate and seroprevalence.....	151
Blood Bank Seroprevalence .....	152
Management History and Effects .....	153
Central American Initiative (IPCA) .....	153
Insecticides.....	153
Housing Improvement .....	154
Education .....	154
Pharmaceutical Treatment .....	155
Transfusional Control.....	156
Outcomes.....	156
Economic Impact.....	157
Social Effects .....	158
Resolution .....	158
Sustaining vector control .....	158
Blood transfusion screening .....	159
Drug Treatment.....	159
Genetic Research .....	160

Conclusion.....	162
Appendix 1 - Chagas disease – An overview .....	163
Phases of disease .....	163
References .....	164

## Contributors

**W Brennan Arden** BA BA BS MA MPH&TM. Arden is currently a doctoral student in the Department of Geography and Anthropology, Louisiana State University. Research interests include the application of geographic information systems and spatial analysis in tropical medicine, public health, and disease surveillance with reference to communicable diseases in Brazil (leprosy, tuberculosis, and endo/ectoparasitic infections). Arden is also concurrently working on a Doctor of Dental Surgery degree at the University of Texas Health Science Center, San Antonio.

**Tani Brown** - BA BSc MBBS (Hons) MPH&TM. Tani completed degrees in Anthropology and Biomedical sciences at the University of Qld before completing her medical degree at the University of Sydney. She has been working as a junior doctor in metropolitan and regional NSW and is currently completing a Diploma of Medicine.

**Lawrence H. Brown** - EMT-P, MPH&TM. Lawrence is the Associate Director of Research for the Department of Emergency Medicine at the University of New Mexico School of Medicine in Albuquerque, NM, U.S.A. He is a paramedic with more than 21 years experience in emergency services who has spent the last 16 years working primarily in research and academic settings. Lawrence is the lead author of the textbook "An Introduction to EMS Research," serves on the board of advisors for the Prehospital Care Research Forum, and is a co-investigator for the U.S. National EMS Research Agenda project. Since 2007, Lawrence has been working to strengthen the ties between public health and EMS, particularly in resource-poor settings.

**Deon V Canyon** PhD MPH FACTM AFAIM. Senior lecturer in environmental health in the Anton Breinl Centre for Public Health and Tropical Medicine at James Cook University, Townsville Qld. Involved in teaching and researching environmental health-related fields since 1996.

**Jane Connell** RN RM MPH&TM. Jane is a local Townsville nurse/midwife currently co-coordinating Masters subjects on Reproductive Health in Developing Countries, Refugee Health and Infection Control in Health Care Settings. She has been working for the medical-humanitarian aid organization, Medecins Sans Frontieres, since 1999 and has worked in Afghanistan, Sierra Leone, China, Ethiopia, Liberia and Somalia, as well as urban and remote parts of Australia.

**Marije Dalebout** MBChB. Dr. Dalebout did an undergraduate degree in Biochemistry and Physiology before gaining her MBChB in 2003 from the University of Auckland, New Zealand. She has been working as a medical officer in various fields over the last 4 years including Paediatrics, Obstetrics and Gynaecology, and Public Health. She also holds a Diploma of Obstetrics and Gynaecology with the RANZCOG. She is currently completing a Masters of Public Health and Tropical Medicine part time through James Cook University and is expecting her first child.

**Brooke M. Ellis** BA MPH&TM. Recent graduate of the Anton Breinl Centre for Public Health and Tropical Medicine at James Cook University. Research areas include: health promotion, The Chlamydia Testing Trial, national and international policy and response to infectious diseases, specifically in regards to sexually transmitted infections.

**Marianne Gale** MB BS (Hons) MPH&TM. Worked as a junior doctor at The Townsville Hospital. Currently working with MSF France in a HIV/TB program for Burmese refugees and migrants in North West Thailand.

**Clare Heal** - MB ChB, DRANZCOG, FRACGP, DipGUMed, MPH&TM. Clare works half-time as senior lecturer in the Mackay rural clinical school of JCU school of medicine. She also works clinical sessions as a General Practitioner and as Visiting Medical Officer at Mackay Sexual Health Clinic. She is interested in research in the areas of skin cancer and Sexual health and is commencing a DrPH.

**Michael Allen Henderson** MB BS GDipOccHlth GDipEpiBiostats CertTravHlth. Dr Henderson has an extensive background in general practice. He worked for 2 years in Papua New Guinea prior to independence and for 18 months in the South African homelands during the early 80's apartheid era. He has worked as an occupational health practitioner for the last 7 years and as a travel health physician for the last 16 years.

**Tambri Housen** MPH&TM DipTropNurs BSc. Tambri is a Registered Nurse with varied overseas experience. She has worked with Medecins Sans Frontieres in Southern Sudan and has a particular interest in population displacement. Tambri has co-ordinated the Refugee Health subject at James Cook University for the past 3 years and is currently preparing to depart with her family to Turkmenistan where she will commence her PhD on the burden of disease and vulnerability of populations displaced as a result of natural or anthropogenic disasters in Central Asia.

**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.

**Ross McAlpine** MB BS FACEM. Consultant in Emergency Medicine, Shanghai United Family Hospital, Shanghai, China. Dr McAlpine received his medical degree at the University of Melbourne in 1992 and completed his Emergency Medicine training in 2000. After working as a staff specialist at St Vincent's and Epworth hospitals in Melbourne, he moved to China in 2002. He was appointed Director of Emergency Medicine at Beijing United Family Hospital, the first foreign invested, international standard hospital in China. He has lived in Shanghai since 2005.