Sustainable Development: Asia-Pacific Perspectives

The Asia-Pacific region has been experiencing rapid development in the past 30 years, and issues relating to sustainable development will become increasingly important in the coming decades. This comprehensive overview presents sustainable development from the perspectives of Asia and the Pacific, with contributions from more than 70 leading international experts. The first part focuses on the theories and practices of sustainable development, including national and regional perspectives, as well as international policies and law concerning climate change. The second part highlights the challenges and opportunities of sustainable development and poverty reduction amid the changing ecological, social, cultural, economic, and political environment in this region. These include issues such as the importance of science for sustainable development and related areas, including sustainable energy, stratospheric ozone depletion, climate change, land-use change, biodiversity, and disaster risk reduction. The volume is an invaluable reference for all researchers and policy makers with an interest in sustainable development.

SUSTAINABLE DEVELOPMENT: ASIA-PACIFIC PERSPECTIVES

Edited by

PAK SUM LOW

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Dedicated to Dr Mostafa Kamal Tolba

Contents

Notes on contributors

EDITOR

Dr Pak Sum Low, is an adjunct professor at the China-ASEAN College of Marine Sciences of Xiamen University Malaysia. He has previously worked as the Regional Adviser on Environment and Sustainable Development (2001–2007) at the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP); Programme Officer/Senior Programme Officer (1991–1999) at the United Nations Environment Programme (UNEP); Senior Research Associate (1988–1991), Climatic Research Unit, University of East Anglia, UK; and visiting researcher at the Institute of Applied Physical Chemistry (1987–1988) and the Institute for Atmospheric Chemistry (1986–1987), Nuclear Research Centre, Jülich, Germany. From 2009 to 2018, he was visiting professor/adjunct professor at Bond University, Australia. Dr Low was the inaugural Yayasan Sime Darby Chair in Climate Change at Universiti Kebangsaan Malaysia (2011–2013); a senior visiting professor at the UNEP International Ecosystems Management Partnership (IEMP), hosted by the Institute of Geographic Sciences and Natural Resources, Chinese Academy of Sciences, Beijing (2011–2012); and a visiting professor at the Institute of Desertification Studies, Beijing (2013, 2015). In addition, he was an international adviser (2010) for the Climate Change Adaptation Initiative project of the Mekong River Commission (MRC) in Vientiane, Lao PDR, as well as an international expert (2008) in the United Nations Development Programme (UNDP) – Vietnam, based at the Natural Disaster Mitigation Partnership Secretariat, Ministry of Agriculture and Rural Development, Hanoi, Vietnam. He was a member of the Expert Group on Technology Transfer of the United Nations Framework Convention on Climate Change (UNFCCC) (2010). He has served as a consultant for the UNFCCC secretariat (1999, 2000), United Nations Convention to Combat Desertification (UNCCD) secretariat (2000, 2008, 2009, 2011, 2015), and UNDP – Timor Leste (2008, 2009). Dr Low is a Fellow of the Academy of Sciences Malaysia; and the editor of *Climate Change and Africa* (Cambridge University Press, 2005).

CONTRIBUTORS OF FOREWORDS

Dr Mostafa Kamal Tolba, who passed away in March 2016, was the President of the International Centre for Environment and Development (ICED) (Geneva and Cairo) that he established in 1994. He was formerly Executive Director of the United Nations Environment Programme (UNEP) (1975–1992), and Professor of Microbiology at Cairo University. As the head of Egypt's delegation to the Stockholm Conference on the Human Environment in 1972, Dr Tolba was among the first to promote the view that there are no irreconcilable conflicts between the environment and development. He soon became internationally renowned as a champion of the global environment and continued to promote his philosophy of development without destruction. Under his leadership, UNEP became the core organization within the United Nations family, acting as a catalyst for governments, businesses, academic bodies, intergovernmental organizations, and non-governmental organizations to take meaningful action to protect the environment. Dr Tolba was known for his formidable negotiating skills and his expertise on the science of the environment. He also had an uncanny vision of emerging environmental problems. These attributes led him, as early as the 1970s, to concentrate on the issue of ozone layer depletion as an area that merited careful scientific monitoring. Because of his success in negotiating the Vienna Convention on the Protection of the Ozone Layer (1985) and its Montreal Protocol on Substances that Deplete the Ozone Layer (1987), he was credited with formulating the prototype model for dealing with global environmental issues and the effective transfer of technology and funds to developing countries. Dr Tolba held a BSc degree in botany and a PhD in plant pathology. He was the author of almost 100 papers (1950–1973) on plant diseases, anti-fungal substances, and the physiology of micro-organisms, and of more than 600 statements, books, and articles on the environment and sustainable development. He received honorary doctorates from universities around the world, including Moscow State University, the University of Guadalajara, Williams College, and Imperial College, London. He also

received the following prizes in recognition of his work: the Sasakawa Environment Prize (1993), the Special Global Environment Leadership Award of the Global Environment Facility (2003), the Only One Earth Award of the René Dubos Centre, the Distinguished International Service Award of the Regents of the University of Minnesota, and the First Order Decoration of the Arab Republic of Egypt.

Sir Toke Tufukia Talagi passed away on 15 July 2020. He was the Premier of the Government of Niue from June 2008 to June 2020. He graduated with a Bachelor of Science (Agriculture Science) from Massey University, New Zealand, in 1975, after which he returned to Niue and started work as Livestock Officer. He was appointed Niue's Consul-General, in Auckland, when the office was first established in 1981, after which he returned to Niue and headed Niue's Economic Affairs Office as Director. Mr Talagi decided to practise what he preached in the early 1990s and resigned from government to set up a business in Niue. In 1999 he was elected as one of the Common Roll Members of the Niue Assembly. Re-elected in 2002, he was a member of Premier Young Vivian's Cabinet. In the latter capacity, he led the government's delegation to two international meetings: the World Summit on Sustainable Development, in September 2002 in Johannesburg, and the Mauritius 2005 (BPoA + 10) Meeting, in January 2005. As Minister for Education he attended many Pacific Islands Forum Education Ministers' meetings, as well as the University of the South Pacific Council meetings. Hon. Talagi was instrumental in spearheading the Taoga Niue, where at its first conference in October 2004, the Halavaka ke he Monuina Arrangement between the Government of Niue and the Government of NZ was signed. Hon. Talagi also contributed to non-government groups. He was former President of the Public Service Association, and an Alofi South Village council member. He was also founding patron of the Niue Weightlifting and Body Building Association, the past President of the Niue Rugby Union, and a senior member of the Alofi Ekalesia Church. In the 2017 New Year Honours, Hon. Talagi was appointed Knight Companion of the New Zealand Order of Merit (KNZM). In November 2019, Sir Talagi released an autobiography, *Niue Rising*.

Professor QIN Dahe Professor QIN Dahe, geographer, an Academician of the Chinese Academy of Sciences (CAS) and a member of The World Academy of Sciences (TWAS). He is currently the director of the Academic Committee of CAS, and the chairman of the Asian Geographical Society. Professor Qin has long been engaged in research on the cryosphere, climate change, and sustainable development. His studies of cryospheric changes and their effects and adaptation, as well as the functions and services of cryosphere, have contributed to building the theoretical framework of cryospheric science. Being the founder of the State Key Laboratory on Cryospheric Science and the Society on Cryospheric Science in China, he has led the compilation of textbooks on the cryosphere. All this has contributed to the development of the field of cryospheric science. He has participated in or led many scientific expeditions to the Antarctic, Arctic, Qinghai-Tibetan plateau and Western China. He was a lead author of the Working Group I of the Third Assessment Report (2001) of the Intergovernmental Panel on Climate Change (IPCC), and co-chair of the Working Group I of the IPCC Fourth Assessment Report (2007) and the Fifth Assessment Report (2013). He was also involved in the leadership for the preparation of the assessment of climate and environment in China, and of extreme weather and climate events and disaster risk management in China, making significant contributions to deepening the understanding of climate change science. Professor Qin served as the Administrator of the China Meteorological Administration in 2000-2007. He was awarded the 2008 International Meteorological Organization Prize, the 2013 Volvo Environment Prize, and the 2014 Second Prize of National Natural Science Award.

Dr Sálvano Briceño retired from the United Nations on 30 April 2011. Following his retirement from the UN, he was elected Chair of the Science Committee of the Integrated Research on Disaster Risk programme of the International Council for Science (ICSU), also sponsored by the International Social Science Council (ISSC) and the UNISDR. His career has focused on the management of environmental and sustainable development programmes at the United Nations, the World Conservation Union (IUCN), and the Government of Venezuela. He was appointed Director and first head of the Secretariat of the International Strategy for Disaster Reduction (UNISDR, now UNDRR) in June 2001. Prior to joining UNISDR, Dr Briceño was Coordinator of the BIOTRADE and GHG Emissions Trading Initiatives of UNCTAD (1999–2001). Before that, he was Deputy Executive Secretary of the UN Convention to Combat Desertification (UNCCD) secretariat (1996–1999), following several years as the Coordinator of Intergovernmental and Institutional Support of the UN Framework Convention on Climate Change (UNFCCC). Earlier in his career, Dr Briceño was the first Coordinator of UNEP's Caribbean Environment Programme (1987–1991). He was the Executive Officer of IUCN's Commission on Education, where he focused on environmental education programmes and coordinated a worldwide network of experts (1985–1987). He started his public policy career at the Ministry of Environment and Renewable Natural Resources with the Government of Venezuela (1978–1983). Dr Briceño earned a Doctorate in Administrative Law (University of Paris II, Panthéon-Sorbonne) in 1975 and a master's in Public Administration, Harvard University in 1984. A Venezuelan and French national, his languages include Spanish, French, and English.

Dr Philip Michael (Mick) Kelly is a climate consultant with Tanelorn Associates, based in Whakapara, New Zealand. He is

also a visiting fellow with the Climatic Research Unit at the University of East Anglia, from which he retired in 2007. On joining the newly formed Climatic Research Unit in 1972, Dr Kelly pursued an interdisciplinary research path, focusing on the causes of climatic change and the societal relevance of climate variability, particularly vulnerability to climate variability and trends. A member of the team that produced the definitive temperature record used in global warming detection studies, he has contributed to various international reviews of the global warming and nuclear winter issues. Concerned that all sectors of society have access to scientific information, Dr Kelly has appeared frequently on radio and television. He has acted as scientific consultant on a number of television documentaries, including *Can Polar Bears Tread Water?*, a winner of the prestigious Prix Italia award.

CONTRIBUTORS OF 'REMEMBERING DR MOSTAFA KAMAL TOLBA'

Ambassador Mikko Pyhälä graduated in Social Sciences from the University of Jyväskylä, writing theses on international development strategy, on transnational corporations, and on Guinea-Bissau. He was in the diplomatic service of Finland (1972–1990, 1995–2013). His posts included Venezuela (covering also Colombia), Peru, Pakistan, India, Italy, Mexico, and Czechoslovakia. Based at the Foreign Ministry in Helsinki, he also served as Environment Coordinator for FINNIDA (1988–1990), Ambassador for Asia and Oceania (2002–2006) with emphasis on Afghanistan and South Asia, and as Roving Ambassador to Venezuela and the Caribbean (2011–2013). He was with the United Nations Environment Programme (1991–1995) as Chief of Clearinghouse Unit, Chief of Global Environment Facility (GEF) Unit, and Secretary to the Scientific and Technical Advisory Panel (STAP) of the GEF. He played a significant role on behalf of Finland in the establishment of the Funding System for the Montreal Protocol on Substances that Deplete the Ozone Layer, and at UNEP in the establishment of the GEF. He has published books and reports on environment and development, and on political history. He has also written extensively on cinema, and ornithology, including the book *Birds of Islamabad* in 1998, and has uploaded more than 1,500 bird photographs from more than 40 countries on https://macaulaylibrary.org/catalog. He is a columnist to several newspapers in Finland. He received the Finlandia Award for best non-fiction book 1992 for *Amazonia* (co-authored with Dr Jukka Salo), and shared Peru's National Biodiversity Award 2002. In Peru, he helped to establish the Foundation Friends of the National History Museum, and he was conferred *Doctor honoris causa* by two universities, and Honorary Professor by three universities. His book *On Power and Resistance: Diplomacy with Empathy* (2016) (in Finnish) is about wars and political murders he has observed, mostly in Asia, with emphasis on Vietnam, India, Sri Lanka, and Afghanistan. Another book, *Venezuela from Riches to Rags – Struggle for the Rule of Law* (2019) (also in Finnish) is about Venezuela. He is currently Chairman of the Governing Council for Ecofoundation – Sustainability Elders, in Finland.

Dr Sálvano Briceño (see previous).

Naigzy Gebremedhin served as the Dean of the Building College, Haile-Selassie University in Addis Ababa, Ethiopia, after graduating from the School of Architecture of the Massachusetts Institute of Technology (MIT) in 1964. He then established a private practice in architecture and urban planning, practising architecture and urban planning throughout Africa. But following the demise of Emperor Haile-Selassie, he left Ethiopia and moved to Nairobi, Kenya, to join the United Nations Environment Programme (UNEP), serving under Dr Mostafa Tolba as Chief of the Technology and Environment Branch. After mandatory retirement in 1994, Naigzy moved to Asmara, Eritrea, to establish and head the Eritrean Agency for the Environment. Between 1997 and 2005, he directed the effort to document and preserve Asmara's modernist architecture. That effort culminated in the enrolment of Asmara as a UNESCO World Heritage Site.

CONTRIBUTORS OF CHAPTERS

Professor Dilip R. Ahuja is the former Head of the Energy and Environment Policy Programme of the National Institute of Advanced Studies (NIAS) in Bengaluru, India. He was the Indian Space Research Organization (ISRO) Chair Professor of Science and Technology Policy at NIAS, and his research includes estimating global warming potentials and national contributions of greenhouse gases, energy savings from adjusting Indian Standard Time (IST), and emission factors from small-scale biomass burning. He has contributed to the Special Report of the Intergovernmental Panel on Climate Change (IPCC) on Methodological and Technological Issues in Technology Transfer (2000), Working Group III, as a lead author; Third Assessment Report (2001) as a review editor; and Fourth Assessment Report (2007) as a lead author of the IPCC, in Working Group III. He took his PhD in Biomedical Engineering from the University of Virginia at Charlottesville in 1978 and a Bachelor of Technology (BTech) in Electrical Engineering from the Indian Institute of Technology (IIT) Bombay in 1972.

Dr Bryant Allen did fieldwork on development on Mangaia, Cook Islands, for a master's degree from Massey University, New Zealand, in 1966, and in villages around Dreikikir, East

Sepik Province, Papua New Guinea (PNG), in 1971–1972 for a PhD at the Australian National University (ANU). His PhD research was on the adoption of cash crops and millenarian movements. He then studied shifting cultivation systems at Dreikikir, which he continues to the present day. From 1974 to 1981 he lectured at the University of PNG. In 1982, Dr Allen joined the Department of Human Geography at ANU. With Harold Brookfield, he co-edited a special edition of *Mountain Research and Development* on the impacts of ENSO-associated frosts and droughts on food supply in PNG. From 1990 to 1996, with co-researchers Mike Bourke, Robin Hide, and the late Geoff Humphries, he did fieldwork and created a database and GIS of all agriculture systems in PNG. These data were used to investigate rural poverty in PNG for the World Bank and child malnutrition with the PNG Institute of Medical Research. In 1997, with Mike Bourke, Michael Lowe, and PNG associates, Dr Allen organized field assessments of food and water supplies in response to an ENSO-related drought and frosts in PNG, which was used to organize relief distribution. He is Honorary Associate Professor at the Department of Pacific Affairs, Coral Bell School of Asia and the Pacific, the Australian National University, Canberra.

Dr Gopala Areendran is the Director of the Indira Gandhi Conservation Monitoring Centre (IGCMC) at WWF-India. He has more than 25 years of experience as a professional and leader in geospatial technology and has been the driving force of location-based data monitoring and analytics since 2001 at WWF-India. His work at WWF ranges from addressing conservation issues occurring in various landscapes, with a high focus on the tiger, elephant, and rhinoceros to overseeing several institutional GIS-based projects. He has led the core technical team within WWF-India to utilize current generation technology and has always been a partisan for applying GIS solutions to overcome challenges within the field of conservation. Being an integral part of the WWF network, he has participated in and overseen various international projects from understanding the impact of global forest fires, deforestation, and degradation to capacity-building programmes on GIS, and remote sensing for staff at WWF-Bhutan. Recently he has spearheaded WWF-India's geospatial and analytical contribution to UNDP's SECURE Himalaya project and is the current coordinator for the Green Skill Development Programme of Ministry of Environment, Forest, and Climate Change (MoEFCC) (Government of India), wherein he has been regularly conducting GIS-based skill development trainings for youth. Dr Areendran has an MS degree in Ecology from Pondicherry University and a PhD from the Wildlife the Institute of India. He has also worked with leading research centres like Salim Ali Centre for Ornithology and Natural History (SACON), Wildlife Institute of India (WII) and Madras Environmental Society (MES), Chennai, and Institute of Remote Sensing, Anna University, Chennai. Dr Areendran has published several research papers and reports in peer-reviewed journals, and was involved in the publication of four books in the capacity of editor and co-author. As a pioneer of geospatial education, he has also supervised more than a hundred masters and research students.

Dr Bhishna Bajracharya has been Associate Professor of Urban Planning at the Faculty of Society and Design, Bond University, Australia, since 2008. He previously taught in the urban planning programme at the Queensland University of Technology (QUT) for more than 12 years. He also worked as a postdoctoral fellow at the Research School of Social Sciences, Australian National University. He practised as an architect while teaching at the architectural engineering programme in Tribhuvan University, Nepal, in the early 1980s. He completed his PhD in Geography and a master's degree in Urban Planning from the University of Hawaii, and a bachelor's degree in Architecture from the School of Planning and Architecture, Delhi University. Dr Bajracharya's research areas include master-planned communities, transit-oriented development, sustainable campuses, disaster management, and urban governance. He is an alumnus of the East-West Center, a Hawaii-based research organization with a strong focus on policy research in the Asia-Pacific region. He has served as the Chair of the University Sustainability Committee at Bond University. For his research profile, please see https://research.bond.edu.au/en/persons/bhishna-bajracharya

Dr Hans Juergen Boehmer is Full Professor of Biogeography at the University of the South Pacific (USP), with a broad background in applied ecology, including nature conservation, environmental planning, and policy advice. His research focuses on montane rainforests in the tropical Pacific islands, particularly on the complex interactions of natural vegetation dynamics, disturbance regimes, biological invasions, and climate change. He is editor of the international journal *Endangered Species Research* (ESR), co-coordinator of PABITRA (*Pacific-Asia Biodiversity Transect Network*), South Pacific coordinator of the IUFRO Taskforce *Monitoring Global Tree Mortality Patterns and Trends*, and Deputy Coordinator of the IUFRO Unit *Resource Data in the Tropics*. Professor Boehmer served as a member of the Pacific Island Development Forum *Agriculture and Forestry* committee in preparation for the 2015 Paris Climate Conference. He received several research grants for detailed studies on the regeneration of island rainforests after climate-induced decline, and the interactions of native tree population dynamics with invasive alien plant species. After joining USP in 2014, he designed a research project titled 'Structure and dynamics of Viti Levu's rainforests under impact of

invasive alien ivory cane palm (*Pinanga coronata*)', funded by the Research Office of the University of the South Pacific (2016–2019). This inter- and trans-disciplinary project is currently the most complex study of alien plant invasions in the South Pacific region, and includes institutions from Fiji, Australia, New Zealand, France, and Germany.

Professor Janet F. Bornman is Director of the Future Legumes Research, Education, and Training Hub, at Murdoch University, Perth, Western Australia. Prior to that, she was the Founding Director of the International Institute of Agri-Food Security at Curtin University, Perth, where she established a cross-Faculty network with national and international outreach. She has held positions as Director of the International Global Change Centre, in Hamilton, New Zealand, and Research Director at the Danish Institute of Agricultural Sciences, in Denmark. She currently co-chairs the United Nations Environment Programme's Environmental Effects Assessment Panel. Professor Bornman's research is focused on effects of environmental constraints, in particular climate-change factors and UV radiation, from an integrative disciplinary perspective. Food security, sustainability, and climate risk issues are of particular interest, with respect to multi-functional plant crops that are both climate-tolerant and have potential health benefits. Professor Bornman is the recipient of numerous awards, including the Edna Roe Lecturer for accomplishments in the photosciences, the European Society for Photobiology (ESP) medal, the Ozone Layer Protection Award for *'Scientific expertise and leadership in protecting the ozone layer*', and the Finsen Medal in memory of Niels Finsen, Nobel laureate and celebrated pioneer in photobiology.

Dr R. Michael (Mike) Bourke is an agricultural scientist and geographer and is a specialist in Papua New Guinea (PNG) and Pacific Island agriculture. He is Honorary Associate Professor at the Australian National University and a self-employed consultant. He has been continuously involved in research, training, consulting, and development in PNG and other Pacific Island countries since 1970 and lived in PNG for 13 years. He is a fellow of the Australian Institute of Agriculture and was appointed in 2015 as an Officer of the Order of Logohu by Papua New Guinea for services to PNG agriculture. Mike has published extensively on PNG and Pacific Island agriculture and related topics, including articles on speleology in PNG. He edited and wrote much of the definitive book *Food and Agriculture in Papua New Guinea*. A recent book (with three colleagues) is *Assessing Village Food Needs Following a Natural Disaster in Papua New Guinea*. In 2020, he was very engaged with issues of COVID-19 and food security in PNG. He has conducted fieldwork in all 85 rural districts of PNG, as well as in parts of Vanuatu, Solomon Islands, and other Pacific Island countries. He has expertise in many aspects of rural livelihoods, agricultural production, land use, and food security in PNG and other Pacific Island states.

Dr Sálvano Briceño (see previous)

Professor Peter Brimblecombe was born in Australia, but went to university in Auckland, New Zealand, where his PhD concerned the atmospheric chemistry of sulphur dioxide. His studies of long-term changes in urban air pollution and its effects on health and building damage are also an important activity; the historical aspects of subject resulted in a book, *The Big Smoke*. This encouraged an interest in the relationship between air pollution and architecture, literature, and even cinema. Peter has undertaken research on material damage by air pollutants in outdoor environments, but also within museum atmospheres, and has a continuing interest in the process of damage to cultural materials by air pollutants and climate. At present, his heritage research relates to climate change and insect damage to wooden buildings. He is currently a Distinguished Research Chair Professor at the Department of Marine Environment and Engineering, National Sun Yat-Sen University, Kaohsiung, Taiwan, though also an adjunct professor at the School of Energy and Environment at City University of Hong Kong (until 2020) and Emeritus Professor to the School of Environmental Sciences of the University of East Anglia in the UK.

Dr Gernot Brodnig has some 30 years of international experience in policy analysis, programme/project management and research in natural resources management, biodiversity conservation and climate change, with a focus on livelihood and governance issues. He currently works as a Senior Specialist for the World Bank in Washington, DC. Prior to this, he served as the Director for Social Sciences at IUCN, and as UNDP's Environment Adviser for Asia. Gernot holds a Doctorate in Law from the University of Vienna, as well as master's degrees in Geography (University of Cambridge) and Anthropology (University of Oxford). He spent five years as a research fellow at Harvard University, investigating environmental and social impacts of oil exploration, and has published on a number of natural resources management issues.

Dr Shoibal Chakravarty is a senior researcher at the Divecha Centre for Climate Change, Indian Institute of Science (IISc) in Bengaluru. He was formerly a fellow in the Climate Change Mitigation and Development Programme in the Centre for Environment and Development at the Ashoka Trust for Research in Ecology and the Environment (ATREE), Bengaluru, India. His research interests are in energy and climate policy, energy-economics modelling, and the study of equity in the context of energy and climate change. He was formerly a faculty member in the energy and environment policy programme at the National Institute of Advanced Studies (NIAS), Bengaluru, and

was a Research Associate at the Princeton Environmental Institute, Princeton University, from 2006 to 2013. He received his PhD in Physics from Princeton University in 2005, and a Bachelor of Technology (BTech) in Engineering Physics from the Indian Institute of Technology (IIT) Bombay in 1998.

Dr Yi Chen is a Senior Research Fellow at the Käte Hamburger Centre for Apocalyptic and Post-Apocalyptic Studies at Heidelberg University, Germany. She was an Assistant Professor of Confucian Philosophy at Bond University, Gold Coast, Australia (2017–2020). As an Alexander-von-Humboldt research fellow at the Max Planck Institute for Empirical Aesthetics in Frankfurt am Main, Germany (2016–2017), she worked on 'deceptive simplicity' as an aesthetic principle. She has a PhD in Comparative Literature from the University of Toronto, Canada (2015); an MA in Classics from the University of Arizona, USA (2008); and a PhD in Philosophy from Fudan University, Shanghai, China (2001). Recent publications include 'A faceless subject: Exploring impersonal subjectivity through poems by Wang Wei, Paul Celan, and Wang Yipei' (2020), in Fechner, Matthias and Stahl, Henrieke (eds.), *Schwellenzeit – Gattungstransitionen – Grenzerfahrungen*. Berlin, Germany, Peter Lang, pp. 247–265; 'Phenomenological comparison: Pursuing Husserl's "time consciousness" in poems by Wang Wei, Paul Celan and Santoka Taneda' (*Comparative and Continental Philosophy* **9**(3), 241–259, 2017), with Dr Boris Steipe. Her current research focuses on defining and leveraging the essence of Confucian philosophy to address the compelling issues of our time, including an aesthetically ethical approach to ecology and climate change, and a project to explore the relationship between Confucian philosophy, Japanese aesthetics, and organizational life.

Bernarditas de Castro-Muller, known simply by her first name to all her fellow negotiators, had negotiated the United Nations Framework Convention on Climate Change (UNFCCC) from its very inception. A career diplomat from the Philippines, she entered the negotiations as part of her responsibilities in the Philippine Mission to the United Nations in Geneva. She was then promptly involved in the negotiations leading to the United Nations Conference on Environment and Development (UNCED) in 1992, and followed all other negotiations leading to the three Rio Conventions: the UNFCCC, the Convention on Biological Diversity (CBD), and the United Nations Convention to Combat Desertification (UNCCD), as well as other Geneva-based multilateral environmental agreements (MEAs), and related agencies such as the Intergovernmental Panel on Climate Change (IPCC) and the Global Environment Facility (GEF). Bernarditas was a member of the Bureau of the Conferences of Parties (COP) of both the UNFCCC and the CBD, and served as one of the Vice-Presidents for Asia of the COP 7 Bureau of the UNCCD. Almost all throughout her involvement in these conventions, she was a lead negotiator for the Group of 77 (G77), the group of developing countries, in particular on financial and technology issues. Bernarditas also convened the group that became the Like-Minded Group (LMG) in the negotiations prior to the adoption of the Cartagena Biosafety Protocol of the CBD. She was named Environmental Affairs Adviser to the Department of Foreign Affairs, the Philippines, after her retirement from active service. Her last foreign posting was as Chargé d'Affaires, *de missi*, of the Embassy of the Philippines, and Acting Permanent Representative to the UN Environment Programme and the UN Human Settlements Programme (UN-Habitat) in Nairobi, Kenya. At the end of COP 12 in Kenya in 2006, where she led the Philippine delegation, she left to return to the Home Office and retired from active service in 2007. She served as lead coordinator for the G77 and China in the ad hoc working group on long-term cooperative action of the Bali Action Plan process until COP 16 in Cancún, Mexico. Bernarditas likewise conducted training seminars and lectures on climate change negotiations in developing countries, mainly in Asia and in Central and Latin America. She was also a Special Adviser on Climate Change, South Centre, Geneva, Switzerland, and a Consultant, National Climate Change Commission of the Philippines, until she passed away in December 2018.

Dr Rosita Dellios is Associate Professor of International Relations at Bond University, Australia. She lectures and writes on the themes of Chinese philosophy and strategic culture, Indo-Pacific geopolitics, and the application of complexity theory and futures studies to global politics. She co-authored *The Politics and Philosophy of Chinese Power: The Timeless and the Timely* (Lexington Books, 2017) and *China's Quest for Global Order* (Lexington Books, 2013). Her other works may be found at https://research.bond.edu.au/en/persons/rosita-dellios

Michael J. Dyer is a young Australian currently working at the United Nations Development Programme as a GIS and project specialist in Apia, Samoa. He graduated from his Honours Year at the University of South Australia, publishing his thesis on the invasion history of *Pinanga coronata* in Fiji via correspondence from the University of the South Pacific, Fiji. For his Honours Year, Mr Dyer was the recipient of the Federal Government's Department of Foreign Affairs and Trade, New Colombo Plan Scholarship, Australia's most prestigious scholarship in the Asia-Pacific region. He graduated with a perfect grade point average and was the recipient of the University of South Australia Honours Medal, University of South Australia's Division for Information Technology, Engineering, and Environment, in addition to becoming an Australian Council of Environmental Deans and Directors Scholar.

Dr Stefan Erasmi gained his PhD in Geography in 2001 from the University of Göttingen, Germany. He has many years of experience in remote sensing-based monitoring of land-use and

cover change. A focus of his work is on the spatio-temporal modelling of relations between land-use change, land degradation, and ecological indicators, such as biodiversity and climate. Since 2006, he has been employed as Assistant Professor at the Cartography, GIS, and Remote Sensing Department of the University of Göttingen, Germany.

FENG Qiya studied at Hebei Agricultural University from 2009 to 2013, majoring in agriculture economics and management, and obtained a bachelor's degree in management. During the years 2014–2017, she studied forestry and regional development at the Chinese Academy of Forestry, and obtained a master's degree in management. Since 2017, she has been studying for a PhD at the School of Agriculture and Rural Development, Renmin University of China, majoring in forestry economics and management under the supervision of Professor KE Shuifa. Her main research direction is the choice of farmers' behaviour and the development of China's green economy.

Dr R. James Ferguson is Director of the Centre for East-West Cultural and Economic Studies and Assistant Professor of International Relations in the Faculty of Society and Design, Bond University, Australia. He has been engaged in research, writing, teaching, and publication roles, and is a member of several international relations and strategic studies organizations. He is actively involved in research and teaching in International Relations, European and Eurasian Studies, the Indo-Pacific Region, and global governance processes. He has a background in history, cultural systems and Asian affairs. He has presented papers on these issues in Australia, Singapore, Malaysia, China, Japan, India, Austria, Serbia, Indonesia, and the UK. Recent books include *China's Eurasian Dilemmas: Roads and Risks for a Sustainable Global Power* (2018), and he co-authored *The Politics and Philosophy of Chinese Power: The Timeless and the Timely* (2017). He regularly visits Asia to assess new trends in regionalism and international relations. His current project is *Greening China's New Silk Roads: The Sustainable Governance of Belt and Road* (forthcoming).

Dr Stephen Galvin is Lecturer in Biogeography at the University of the South Pacific in Fiji. His research focuses on the use of dendrochronology as a means of understanding and contextualizing environmental change. In Fiji, he employs this methodology to investigate the ecological and economic impacts of invasive alien species on native forest stands, as well as the impact of climate change on productivity in tropical forests and coastal mangrove ecosystems. Dr Galvin has also examined the impacts of low-latitude and Icelandic volcanic eruptions on tree growth and weather patterns in Ireland, a study that was, globally, the first to successfully employ yew (*Taxus baccata*) as a source of high-resolution proxy data in this manner.

Dr Andrew N. Gillison is the Director of the Center for Biodiversity Management in Queensland, Australia. He has a long-term interest in improving methods of rapid natural resource appraisal that can be used to establish knowledge baselines for sustainable management. The aim is to build on science-based, low-cost, and user-friendly approaches that can be used by persons with relatively little training. Extensive experience as a botanist and plant ecologist in many of the world's tropical countries has facilitated the development of training modules in rapid survey and spatial modelling, one outcome of which is illustrated in Chapter 29. With more than 100 peer-reviewed publications, Dr Gillison has developed widely accepted methods of survey design by combining environmental, gradient-based (gradsect) sampling of plant vascular species with plant functional types, vegetation structure, and landscape-based physical variables (the VegClass method). Field data collected in the case study published in this book are contributing to a global database that is already being applied in bioregional planning worldwide.

Sunil Gopaul, a Guyanese scientist, completed his master's degree in Environmental Science at the University of the South Pacific. Prior to this, he was a forester with the Guyana Forestry Commission, specializing in forest monitoring and forest policy development. In 2016 Sunil, who also holds a BSc in Forestry from the University of Guyana, was awarded the Caribbean-Pacific Island Mobility Scheme scholarship by the European Union's Education, Audiovisual, and Culture Executive Agency to undertake postgraduate studies. His research interests focus on biological invasions in the South Pacific region, with specific emphasis on the fundamental changes to habitat conditions caused by invasive palms, particularly *Pinanga coronata*. At the University of the South Pacific, Sunil was awarded the 2017 Gold Medal and President's Prize for the Best Graduate in a Postgraduate Diploma. Sunil's work on the invasive *P. coronata* was presented to an audience of experts from academia and business at the Royal Society Te Apārangi in New Zealand and the Australian Academy of Science during the 2017 Falling Walls Lab. He currently serves as Environmental and Social Safeguards Coordinator for the Ministry of Housing and Water in Guyana, and Lecturer at the University of Guyana.

Dr Jamba Gyeltshen is a former faculty member of the Royal University of Bhutan at the College of Natural Resources, Lobesa, where he taught Agriculture. His knowledge of agriculture and its role in sustainable development comes from his farming background and involvement in agriculture education in Bhutan for more than 20 years. His insights on sustainable development challenges in the field of agriculture draw on his observations and experiences from his engagement in several research and consultancy services to determine the impact of

agricultural development projects and national research and extension services in Bhutan. His core competency is crop pest and disease management, a skill founded on professional training and education. He has a bachelor's degree in Agriculture from India, a master's degree in Crop Protection from the University of Reading (UK), a Doctor of Plant Medicine (DPM) from the University of Florida, a PhD in Biological Sciences (spore survival of *Phytophthora cinnamomi*, a highly aggressive plant pathogen) from Murdoch University, Australia, and a master's degree in Business Administration (MBA) from Edith Cowan University, Australia.

Geon Christopher Hanson received his BSc in Natural Resource Management from the University of Belize in 2012, and his MSc in Environmental Science from the University of the South Pacific in Fiji in 2017. He received the Vice-Chancellor and President Gold Medal award for his outstanding academic performance during his time at the University of the South Pacific. Geon's main areas of research interest are conservation biology, plant population dynamics, and invasive plant species management. His recent research work is part of the 'Structure and dynamics of Viti Levu's rainforests under impact of invasive alien ivory cane palm (*Pinanga coronata*)' project.

Shababa Haque is a doctoral researcher in the Deptartment of Geography at Durham University, UK. She is trained as an environmentalist. She completed her master's degree in Environmental Technology from Imperial College, London. Ms Haque has since then worked in the field of climate change, focusing on climate mitigation and renewable energy in the context of Bangladesh. She has also worked on building climate resilience for disabled persons in Bangladesh, and from there on developed her interest in strengthening adaptation for those who are disproportionately vulnerable to climate change.

Dr Mikiko Hayashi received her BS and MS degrees in life science, primarily architectural environment, from Ochanomizu University, Japan. She was funded through the EPISCON project (European PhD in Science for Conservation), which supported the interdisciplinary character of this field of science, as a Marie Curie research fellow, from 2006 to 2009. She represented Japan (actually Asia) with 15 other selected fellows from all over the world. She received a PhD in conservation science from Bologna University, Italy, in 2009, with the PhD research undertaken at Alexandru Ioan Cuza University in Iasi, Romania, and Trees and Timber Institute (IVALSA) and Institute for the Conservation and Valorization of Cultural Heritage (ICVBC) at Consiglio Nazionale delle Ricerche (CNR) in Florence, Italy. She worked as a research assistant at the Tokyo National Research Institute for Cultural Properties (TNRICP) from 2009 to 2014, and as visiting researcher at the School of Energy and Environment at City University of Hong Kong from 2015 to 2018. She is currently an associate fellow at TNRICP and engaged in research for disaster risk mitigation for cultural heritage.

Professor Karen Hulme, LLB, LLM (Nottingham), PhD (Essex), joined the School of Law at the University of Essex, UK, in 2001. Her research is centred on the effectiveness of environmental protection in times of armed conflict, and her book *War Torn Environment: Interpreting the Legal Threshold* (2004), published by Martinus Nijhoff, won the Lieber Society's American Society of International Law prize for 2004. Professor Hulme has worked with the Essex Business and Human Rights Project (EBHR) on several reports and consultancies on the extractives industry, including legislation amendments and human rights impact monitoring, and, in particular, on issues of environmental law and environmental human rights. She is also the Chair of the IUCN's Specialist Group on Peace, Security, and Conflict. In 2009, she contributed, alongside the International Committee for the Red Cross, to the report for UNEP, *Protecting the Environment during Armed Conflict: An Inventory and Analysis of International Law*.

Dr Saleemul Huq has been the Director of the International Centre for Climate Change and Development (ICCCAD) since 2009. He is also a senior fellow at the International Institute for Environment and Development (IIED), where he is involved in building negotiating capacity and supporting the engagement of the Least Developed Countries (LDCs) in UNFCCC, including negotiator training workshops for LDCs, policy briefings, and support for the Adaptation Fund Board, as well as research into vulnerability and adaptation to climate change in the least developed countries. Dr Huq has published numerous articles in scientific and popular journals, was a lead author of the chapter on Adaptation and Sustainable Development in the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), and was one of the coordinating lead authors of 'Inter-relationships between adaptation and mitigation' in the IPCC's Fourth Assessment Report (2007).

Dr Luong Quang Huy holds a PhD in environmental sciences from the University of East Anglia, United Kingdom. He has researched vulnerability and adaptation to climate change for years, with a focus on developing countries in Southeast Asia. His research and policy advisory work for the Government of Vietnam covers greenhouse gas emission reduction, international negotiations, carbon markets, and sustainable development.

Dr KE Shuifa is Professor in the School of Agricultural Economics and Rural Development, Renmin University of China. He received his PhD from Beijing Forestry University and worked in this university for about 10 years. He did

postdoctoral research at the Rural Development Institute of the Chinese Academy of Social Sciences. As a visiting scholar, he studied and undertook research work at the College of Environmental Science and Forestry, State University of New York. His research interests and expertise focus on the following areas: green economy and forestry development, and forestry policies and forest households' behaviour. He is a member of the Chinese Society for Sustainable Development. He has published more than 100 articles in academic journals.

Dr Philip Michael (Mick) Kelly (see previous)

Dr Gunnar Keppel is Associate Professor in Environmental Biology at the University of South Australia, Adelaide. He has a broad background in vegetation ecology, island biogeography, and conservation biology. Most of his recent work focuses on drivers of diversity patterns on islands and in climate change refugia. He has lived in Fiji for about 15 years, where he continues an active research programme.

Dr Safdar Ullah Khan is currently working as an economist (Investment Portfolio Officer) at the City of Gold Coast. He is also affiliated with Bond Business School, Bond University, Australia, where where he has been teaching Economics to undergraduate and postgraduate classes since 2009. He holds a PhD in Economics from Bond University, and an MPhil in Economics from Quaid-i-Azam University, Pakistan. Dr Khan served the State Bank of Pakistan (the central bank) from 2003 to 2009. He was selected from the International Monetary Fund, where he completed specialized courses, including 'Macroeconomic Modelling and Forecasting', 'Theory and Empirics of Growth', and 'Financial Programming'. He has also received prestigious awards in research, teaching, and organizational-level competences. Dr Khan specializes in applied and behavioural economics. His research interests include intersections of economics, law, finance, environment, demography, and sociology studies.

Dr Isara Khanjanasthiti is an Adjunct Teaching Fellow at the Faculty of Society and Design, Bond University, Australia. His research passions encompass a variety of areas in the built environment discipline, including smart cities, housing and placemaking. With a strong interest in urban planning for airports and their environs, Isara's PhD thesis investigated planning frameworks for economic development around Gold Coast Airport.

Professor Matthias Kowasch is a professor of geographical education at University College of Teacher Education Styria (Austria). He works on sustainability education, production/consumption patterns and the political ecology of mining resources. After a joint PhD at the University of Heidelberg (Germany) and the University of Montpellier III (France) on the participation of indigenous people in the nickel sector in New Caledonia, he was a postdoc at the French Institute of Research for Development and taught at the universities of New Caledonia, Bremen, Berlin (Humboldt), Cologne, and Graz. He focuses on research in the Pacific Islands (especially New Caledonia), Austria, France, and Germany. His actual main focus is sustainability education in school geography.

Professor Craig Langston is Professor of Construction and Facilities Management at Bond University, Australia. He has a combination of industry and academic experience spanning more than 40 years. His research interests include measurement of sustainable development, adaptive reuse, life cycle costing, and productivity. Professor Langston has held four Australian Research Council Linkage Project grants, amounting to nearly AUD 1 million in external competitive funding. He was also the recipient of the Vice Chancellor's Quality Award (Research Excellence) at Bond University in 2010. He is an international author and has won a number of awards for his research, including the Queensland Award, the Australian Award, and Asia-Pacific Research Award in the project management discipline in 2016.

Marie-Isabell Lenz is a master's student at the United Nations University and the Rheinische Friedrich-Wilhelms University in Bonn, Germany, where she is enrolled in the Geography of Environmental Risks and Human Security programme. Ms Lenz has a background and research interest in Geography, Cultural Anthropology, Political Ecology, and Marine Conservation. She has worked and studied in Germany, Israel, and Fiji, alongside Professor Hans Juergen Boehmer, where she examined an invasive alien palm and its impact on native island biodiversity in the Colo-i-Suva Forest Reserve, on the island of Viti Levu. Her current research interests lie in the spatial planning, assessing, and implementing coastal and marine ecosystem-based disaster risk reduction and adaptation methods. She aims to assess socio-ecological vulnerabilities and risks, as well as incorporating indigenous and traditional knowledge, to support decision-making of viable climate change adaptation and risk reduction policies.

Sherri Lodhar is a graduate of the University of the West Indies, St Augustine, where she obtained both her BSc (2011) and MSc (2014) degrees. She is currently enrolled as a PhD student at the University of the South Pacific Laucala Campus, where her research focuses on the structure and dynamics of Colo-i-Suva rainforest of Viti Levu, Fiji, which is being impacted upon by a *Pinanga coronata* invasion. Biodiversity conservation has always been the primary focus of her interest. For her master's thesis, Ms Lodhar investigated the genetic

structure and diversity of the endangered native orchid *Cyrtopodium parviflorum* Lindl., and for her undergraduate research, she assessed the impact of soil degradation on the vegetation of the Aripo Savannas in Trinidad and Tobago. Her present research will continue to feed her appetite for learning and her enthusiasm for conservation, while making valuable contributions to the field of science.

Zafar Manzoor has completed his MPhil in Applied Economics from Forman Christian College (A Chartered University), Lahore, Pakistan, with a *magna cum laude* certificate of higher distinction. Currently, he is a lecturer at Forman Christian College. In addition to teaching, he has also worked as a research fellow in the research grant project of PERI (Punjab Economic Research Institute) titled 'Study on crime, business activity, unemployment and economic growth in Punjab'. The results of the study revealed that crime adversely impacts economic growth, income per capita, and tourism in the province. Moreover, a rise in the rate of unemployment increases the incidents of crime in Punjab. He has worked on the Measurement of Pakistan's Informal Economy project. The outcome of the study suggested a positive significant effect of the tax burden on the demand for currency in Pakistan. Currently, he is working on the Higher Education Commission (HEC) thematic grant project titled 'Effectiveness of Criminal Justice System of Pakistan' as a Research Associate. He has wide-ranging research interests that include socio-economic issues related to institutions, governance, and climate change.

Naznin Nasir is a doctoral researcher in the Department of Geography at Durham University, UK. Her research focuses on the politics of climate change vulnerability and climate resilient development in Bangladesh. Ms Nasir previously worked as a Research Associate with the International Centre for Climate Change and Development (ICCCAD) at the Independent University and the Centre for Climate Change and Environmental Research at Brac University, Dhaka, Bangladesh. She received her master's in Environment and Sustainability from the University of Western Ontario, Canada. She did another master's in International Relations from the University of Dhaka, Bangladesh. She has also been working as a broadcast journalist for the past ten years.

Dr Nguyen Huu Ninh is Chairman of the Centre for Environment Research, Education and Development (CERED). He is Professor, Doctor Honoris Causa of the University of Pécs (Hungary), Doctor of Science Honoris Causa of the University of East Anglia (UK), and Honorary Member of Vietnam Business Council for Sustainable Development (VBCSD). He was a contributor to the Fourth Assessment Report (Working Group II) of the Intergovernmental Panel on Climate Change when it received the Nobel Peace Prize in 2007. He completed his studies in Hungary, at the University of Szeged and the Hungarian Academy of Sciences from 1971 to 1986. He has conducted a series of projects on environment and development in Vietnam and the wider Southeast Asia over the course of 30 years, as well as consulting for several companies on climate-smart technologies. He was a lead and co-author of *Policy for Environmentally Sustainable Development: Perspectives from Vietnam* (World Scientific, 2014), *Flooding in Mekong River Delta, Vietnam* (UNDP Human Development Report, 2007), and *Living with Environmental Change: Social Vulnerability, Adaptation and Resilience in Vietnam* (Routledge, 2001).

Dr Natarika Wayuparb Nitiphon has worked as an official at the Ministry of Natural Resources and Environment, Royal Thai Government, for 25 years. She graduated with a PhD from Macquarie University, Australia, in 2005. Since 2004, Dr Nitiphon has been working on climate change at the Office of Natural Resources and Environmental Policy and Planning, Thailand's National Focal Point to the UNFCCC. Her main work stream includes several areas: technical support for climate change and GHG mitigation policy; Measurement, Reporting, and Verification (MRV) system for GHG mitigation towards the country's pledges; climate change capacity-building and training programmes; and corporate strategies and low-carbon innovation. Also, since 2004 at COP10 in Buenos Aires, Argentina, she has been a Thai delegate to the UNFCCC negotiations. Her focus in the negotiation process is climate change and GHG mitigation issues.

Professor David M. Ong is Research Professor of International and Environmental Law, Nottingham Trent University, UK, where he is the Director of the Marine Ecological Resilience and Geological Resources (MERGeR) Centre and Founding Director of the LLM Degree in Oil, Gas, and Mining (OGM) Law. His main research interests are in the international law of the sea, international environmental law, as well as international investment and development finance law. He published in major international law, international environmental law, and international economic law journals and yearbooks, such as the *American Journal of International Law* (1999); *European Journal of International Law* (2001); *Yearbook of International Environmental Law, 2006* (2008); *Irish Yearbook of International Law, 2006* (2008); *Nordic Journal of International Law* (2010 and 2016); and *Journal of International Economic Law* (2017). He has also co-edited four volumes of essays in these fields, namely 1) *The International Maritime Law Institute (IMLI) Treatise on Global Ocean Governance*, Vol. I: UN and Global Ocean Governance, co-edited with Dino Kritsiotis and David Attard, Director of IMLI, Oxford University Press (OUP) (2018); 2) *Global Project Finance, Human Rights and Sustainable Development*, co-edited with Sheldon Leader, Cambridge University Press (2011); 3) *Research Handbook on*

International Environmental Law, co-edited with Malgosia Fitzmaurice and Panos Merkouris, Edward Elgar Publishing (2010); and 4) *Law of the Sea: Progress and Prospects*, co-edited with Richard Barnes and David Freestone, OUP (2005). During 2017–2019, David worked on his fifth co-edited volume, provisionally titled *Beyond the Joint Development Agreement*, being a collection of papers delivered at two international workshops in 2017 (Kuala Lumpur, Malaysia) and 2018 (Nottingham, UK) on this topic. In 2019, David was appointed to the International Law Association (ILA) Study Group on Asian State Practice in the Domestic Implementation of International Law, as the principal Rapporteur for the 'Environment' section of the Study Group's report. More information on David's profile can be found at: https://www.ntu.ac.uk/staff-profiles/law/david-ong

Keith Openshaw, now retired, has had a varied career working with donor and international agencies, governments, NGOs, and private firms, in the fields of natural resources, economics, renewable energy, and the environment. He has lived in Africa and Asia for 17 years and worked in more than 50 countries. For five years, he was head of the forest economics section at the University of Dar es Salaam (Morogoro Campus), now Sokoine University. He was a staff member at FAO and the World Bank and was a Senior Fellow at the Beijer Institute, now the Stockholm Environmental Institute. He was a member of the ALGAS (Asia Least-cost Greenhouse Gas Abatement Strategy) project team, which documented GHG emissions for 11 Asian countries and proposed strategies for GHG mitigation. This was sponsored by UNDP/GEF and executed by the ADB. He has more than 180 publications, two books, and several book chapters and is a leading proponent of biomass energy.

Dr John Peet was born in the United Kingdom and has been living in Christchurch, New Zealand, for the last 50 years. John has a BSc in Chemical Technology and a PhD in Chemical Engineering, and has worked in the petroleum industry. He is a retired Senior Lecturer in Chemical and Process Engineering at the University of Canterbury, New Zealand, where his main focus over the last two decades was sustainable development. Dr Peet is the author of *Energy and the Ecological Economics of Sustainability* and numerous papers on systems, sustainability, and the ethical requirements of stakeholder involvement. Since retiring from the University of Canterbury, he is working closely with a number of local, national, and international non-government organizations on issues of sustainable development.

Dr Phan Toan is an economist at the Research Department of the Federal Reserve Bank of Richmond, Virginia, USA. He was an assistant professor at the University of North Carolina in Chapel Hill until 2017. He graduated with a PhD in Economics at Northwestern University in 2012. He is a native of Vietnam. He has written research about the impacts of global warming on economic growth in the United States.

Dr Kanokwan Pibalsook was Environmentalist, Senior Professional Level, Office of International Cooperation on Natural Resources and Environment, Office of the Permanent Secretary, Ministry of Natural Resources and Environment, Thailand. She completed a master's degree in Environmental Social Sciences from Mahidol University, Thailand, in 1991, and a PhD in the Graduate School of the Environment (GSE), Macquarie University, Australia, in 2007, with the thesis titled 'An assessment of the application of Local Agenda 21 in Thailand for improving environmental policy and planning'. Sadly, Kanokwan passed away on 12 March 2016.

QIAO Dan is a postgraduate student at the School of Agriculture and Rural Development, Renmin University of China. She was a top student at Beijing Forestry University and holds a bachelor's degree in economics and management of forestry, a field of study that she continues under the supervision of Professor KE Shuifa.

Dr Mohammed Feisal Rahman is a Postdoctoral Research Associate in the Department of Geography at Durham University, UK. He was a former faculty member in the Department of Environmental Science at the Independent University, Bangladesh, based in Dhaka. An environmental engineer by training, he received his PhD from the University of Waterloo, Canada. He coordinated research activities at the International Centre for Climate Change and Development (ICCCAD). At ICCCAD, Dr Rahman was involved in several programmes, including Adaptation Technology, Urban Climate Change Resilience, and Capacity Development in Managing and Allocation of Natural Resources.

Dr Gulasekaran Rajaguru is Associate Professor of Economics in the Bond Business School, Bond University, Australia. He holds a PhD in Economics and MSocSci (Economics) from the National University of Singapore. He also has an MStat from the Indian Statistical Institute. He specializes in both theoretical and applied econometrics. His findings are published in both economics and econometrics journals, including *Journal of Forecasting*, *Econometrics*, *Economics Letters*, *Applied Economics*, *Economic Modelling*, *Empirical Economics*, *European Journal of Political Economy*, *Oxford Economic Papers*, *Economics Record*, *Japan and the World Economy*, *Journal of Asia Pacific Economy*, and *Journal of Economic Integration*. His research interests include irregular frequency modelling, high-frequency big data analytics, causal inferences with aggregated data, and panel data models.

Professor Dzulkifli (Dzul) Abdul Razak is the sixth Rector of the International Islamic University Malaysia. He is immediate

Past President of the International Association of Universities (IAU), based at UNESCO, Paris, after serving as the 14th President of IAU (2012–2016). He was also the Chairperson, Board of Directors, Universiti Sains Islam Malaysia, and has served as Honorary Professor at the University of Nottingham since 2014. As the fifth Vice-Chancellor/President of Universiti Sains Malaysia (USM) from 2000 to 2011, he convened and established the Penang Regional Centre of Expertise (RCE) on Education for Sustainable Development. Under his leadership, USM became Malaysia's first sustainability-led university based on the indigenous concept of *sejahtera*. In May 2017, he was awarded the prestigious 2017 Gilbert Medal in recognition of his long-term commitment to an integrated approach on sustainable (*sejahtera*) international development for Higher Education (HE) and his tireless work to support and develop the clearly public good dimensions of HE, according to the Universitas 21 (U21), a group of renowned research-intensive universities from 16 countries. Dzul is the first Asian and the seventh international academic to receive the Medal from U21. Of late, Dzul has been appointed Regional Coordinator of the Asia-Pacific Region in the International Research Project: Reorienting Education and Training Systems to Improve the Lives of Indigenous Youth, led by the UNESCO Chair at York University, Toronto, Canada. Dzul was awarded the 2017 Tokoh Akademik Negara (National Academic Laureate) and recipient of a number of Honorary Doctorate from various international universities. Dzul is a Fellow of the Academy of Sciences Malaysia, the World Academy of Art and Science (WAAS) and the World Academy of Islamic Management (WAIM). For almost 25 years he has written weekly Op-Ed columns for Malaysia's dailies, especially *The New Straits Times.*

Dr T. S. Gopi Rethinaraj is Professor and Programme Director of Energy Sciences at Atria University in Bengaluru. Before joining Atria University in January 2021, he was a visiting professor at the Divecha Centre for Climate Change, Indian Institute of Science (IISc) for two years. Earlier, he was an Associate Professor in the Energy and Environment Policy Programme of the National Institute of Advanced Studies (NIAS) in Bengaluru from June 2014 to September 2018, and a faculty member at the Lee Kuan Yew School of National University of Singapore from 2005 to 2014. He received his PhD in nuclear engineering from the University of Illinois at Urbana-Champaign in 2005, and was a research associate at the Program in Arms Control, Disarmament and International Security. He also worked as a science reporter for the *Indian Express* in Mumbai from 1995 to 1999, and received a master's degree in Physics from Bharathidasan University, India, in 1995. His research and teaching interests include energy policy, science and technology policy, and civilian and military uses of nuclear energy.

Professor Dietrich Schmidt-Vogt, Geographer and Fellow of the Alexander von Humboldt Foundation (AvH), is Honorary Professor at the Faculty of Environment and Natural Resources, Freiburg University, Germany, as well as Distinguished Adjunct Professor at the Asian Institute of Technology (AIT), Thailand, since 2015. From 2015 to 2017 he was also Director of the Mountain Societies Research Institute, University of Central Asia (UCA), in Bishkek, Kyrgyz Republic. Before joining UCA, he was stationed for six years in Kunming, China, as Head of the Research Programme at the World Agroforestry Centre (ICRAF) East and Central Asia Office and Professor at the Kunming Institute of Botany, Chinese Academy of Sciences. Prior affiliations were as Associate Professor with AIT from 2002 to 2009, and as Senior Lecturer with the South Asia Institute of Heidelberg University, Germany, from 1998 to 2002. Dietrich obtained his doctoral and postdoctoral degrees at Heidelberg University, Germany. He has more than 35 years of research experience in Asia, mainly in mountainous areas of the Eastern Himalayan and Mekong regions in South and Southeast Asia, but also in East Asia and Central Asia. His research interests include biodiversity conservation, land-use change, and sustainable mountain development. He is currently teaching courses and modules on Natural Resource Management, Land Use Change, and Integrated Land Use Systems at Freiburg University, Germany. He has experience also in capacity-building and curriculum development for academic institutions in Asia, such as the Royal University of Phnom Penh, Cambodia; Andalas University, Indonesia; National University of Laos; Hue University of Agriculture and Forestry, Vietnam; and Souphanouvong University, Laos.

Dr Rajeev L. Semwal holds a PhD in Botany and is an ecologist by training. As an ecologist, he has been making constant efforts to contribute towards developing science-based institutional support systems for conservation of forests and agro-ecosystems in the Himalayas. During his long research and professional career, he had an opportunity to work with WWF-India, LEAD-India, and subsequently also as the first coordinator of the Mountain Division at the Ministry of Environment, Forests, and Climate Change, Government of India. Till December 2020 he was working from School of Environmental Sciences, Jawaharlal Nehru University, India, for a Task Force under the National Mission for Sustaining the Himalayan Ecosystem. Dr Semwal has a large number of research papers to his credit and currently is an independent researcher.

Professor Amartya Sen is Thomas W. Lamont University Professor, and Professor of Economics and Philosophy at Harvard University, and was earlier the Master of Trinity College, Cambridge. He has served as President of the American

Economic Association, the Indian Economic Association, the International Economic Association, and the Econometric Society. He is an Honorary Fellow of All Souls College and of Nuffield College, Oxford, and also of Darwin College and St Edmund College in Cambridge. He was also Professor of Economics at Delhi University and at the London School of Economics. Dr Sen's numerous books have been translated into more than 40 languages, including *Collective Choice and Social Welfare* (1970, 2017), *On Economic Inequality* (1973, 1997), *Poverty and Famines* (1981), *On Ethics and Economics* (1987), *Inequality Reexamined* (1992), *Development as Freedom* (1999), *Rationality and Freedom* (2002), and *The Idea of Justice* (2009). His research has ranged over a vast number of fields in economics, philosophy, and decision theory. Among the awards he has received are the Bharat Ratna (the highest honour awarded by the President of India), Commandeur de la Legion d'Honneur (France), the National Humanities Medal (USA), Ordem do Merito Cientifico (Brazil), Honorary Companion of Honour (UK), Aztec Eagle (Mexico), Edinburgh Medal (UK), the George Marshall Award (USA), the Eisenhower Medal (USA), Peace Prize of the German Book Trade, and the Nobel Prize in Economics.

Dr Boris Steipe is Associate Professor in the Department of Biochemistry and the Department of Molecular Genetics, University of Toronto, Canada, and past Director of the University's Specialist Programme in Bioinformatics and Computational Biology. Previously research fellow at the Gene Center of the University of Munich, Germany (1995–2001), working on rational approaches to protein engineering; Habilitation in Biochemistry and appointment as Lecturer, Faculty of Chemistry and Pharmacy, Ludwig-Maximilians University of Munich (2000); Postdoctoral Fellow of the Department for Structural Biology at the Max Planck Institute for Biochemistry, Martinsried, Germany, with Professor Robert Huber (1990–1994); PhD (1990) and MD (1985) from the Faculty of Medicine, University of Munich. Recent publications include 'Phenomenological comparison: Pursuing Husserl's "time consciousness" in poems by Wang Wei, Paul Celan and Santoka Taneda' (*Comparative and Continental Philosophy*, **9**(3), 241-259, 2017), with Dr Yi Chen. Current research focuses on linguistic models for molecular self-organization and the philosophy of emergence in complex systems.

Professor Shabib Haider Syed holds a PhD in Economics from the Quaid-i-Azam University in Islamabad, Pakistan, and a postdoc from Bond University, Australia. He earned his MA (Economics) from Government College University (GCU) in Lahore, Pakistan. His PhD dissertation is in Applied Microeconomics. He has more than 26 years of teaching and research experience in various national and international institutions. Currently, he is serving as a Professor and Dean in the Faculty of Economics and Management Sciences at Minhaj University, Lahore. He is a member of the Sustainable Development Policy Institute (SDPI), Islamabad, and WWF-Pakistan, and South Asian Network for Development and Environmental Economics (SANDEE). He has visited Australia, Thailand, Nepal, Bangladesh, and Sri Lanka for various training courses and presentations. He has supervised research in the areas of economic growth, finance, black economy, trade, energy, crime, terrorism, suicide, climate change, formal and informal institutions, and the environment. His work has been extensively published in credible international and national peer-reviewed journals. He has worked on various projects as an adviser or a consultant on subjects of national interest, such as crime, growth, and the environment. He was editor-in-chief of *Forman Journal of Economic Studies* from 2005 to 2019, and he serves as a peer reviewer and a member of the editorial board of various national and international peer-reviewed journals.

Dr Ros Taplin is Director of the MSc Environmental Management Programme, Centre for Development, Environment and Policy, SOAS, University of London. Her research interests include climate policy, low-carbon energy policy, sustainability indicators, environmental impacts of resource extraction, education for sustainability, and climate change art. Dr Taplin's former academic roles include Professor and Research Director, Australian Centre for Sustainable Mining Practices, University of New South Wales, Sydney; Professor and Head of the Department of Sustainability Science, Bond University; and Director of the Environmental Management Programme, Graduate School of the Environment, Macquarie University, Australia. Her qualifications include a PhD on environmental policy-making and a Doctor of Visual Arts on climate change art.

Dr Mostafa Kamal Tolba (see previous)

Karma Tshering is the Chief of Policy and Planning Division of the Ministry of Agriculture and Forests, Royal Government of Bhutan. He was previously the Head of Policy and Programming Services, National Environment Commission Secretariat. In January 2019, he was again nominated as the Alternate Board Member of the Green Climate Fund representing Least Developed Countries (LDC). Mr Tshering is the core negotiation team of LDC Finance and Technology in the UNFCCC. His main expertise is in the areas of mainstreaming environment, climate change, poverty, gender, and poverty concerns into policy and plans of both central and local

governments. Other areas of his expertise are the field of negotiation, fund mobilization, planning, team building and coordination, project developments, monitoring, and evaluation, including networking. He also served as a member of the Technology Executive Committee under the UNFCCC from January 2015 to June 2017.

Dr TUN LWIN was a consultant and the founder of Myanmar Climate Change Watch (MCCW), a non-profit organization that provides information and education to the public about weather, climate, and natural disasters through social media, talks, radio, television, and more in Myanmar since 2009, until he passed away on 4 November 2019. Prior to this, Dr Tun Lwin served as a civil servant in the Department of Hydrology and Meteorology for more than 40 years, where he was awarded five medals during his service, until his retirement as the Director-General-cum-Adviser of the department. He completed his PhD in Physics from Yangon University, and his master's and bachelor's in meteorology from Florida State University, as well as a bachelor's in physics with Distinction from the Arts and Science University, Mandalay. His main fields of study were climate change vulnerability and adaptation assessment in Myanmar, natural disaster management, and monsoon climatology. Dr Tun Lwin was a member of the ASEAN Outstanding Scientists Group, a Chief Executive Council Member in National Committees on Climate Change Adaptation and Environmental Conservation and Disaster Management, and the lifetime World Wildlife Fund (WWF)-Myanmar Ambassador for Climate Change since 2017. He was also the Chairman and Technical Adviser for the Steering Committee of the Regional Integrated Multi-hazard Early Warning System (RIMES), the World Meteorological Organization (WMO) Focal Point for Public Information of Myanmar prior to his retirement. Dr Tun Lwin wrote six books, two of which were awarded the Best Science Literary Prize, the Thuta Swe Zone, and Tun Foundation Award. He was also the recipient of the *HERO Award* from 7Day Media Group in 2016, and the *Popular Public Figure Award: The People's Weatherman* by the Irrawaddy Media Group in 2017.

Swan Yee TUN LWIN is the lead Landscape Designer on the Alley Garden Projects, an urban revitalization project that transforms the many kilometres of back alleys in Yangon from wasteland to healthy recreational spaces together with the local community and governance, at Doh Eain, an urban heritage-led placemaking and capacity-building social enterprise based in Yangon, Myanmar. She is experienced in community engagement, asset-based research, and user design, in addition to creating designs for public spaces in the city. She graduated summa cum laude from Berkeley City College, concentrating on Natural Sciences, before completing her BA in Landscape Architecture with a focus on City and Regional Planning at the University of California, Berkeley. At UC Berkeley, she completed two Undergraduate Research Apprentice Programmes in 'Integrative Biology on Identification of Tropical Trees Using Drone Images and QGIS', and in 'Public Policy on Case Study of Natural Disaster Preparedness Policy in Myanmar with Field Work'. Her areas of interest are disaster risk management policies, urban transportation planning, monsoon climatology and climate change adaptation in urban design and planning, and incorporation of natural systems and elements within the city through public spaces for a more liveable and sustainable urban landscape.

Dr Sk Noim Uddin is a Senior Environmental Consultant with GHD Australia and is an Honorary Associate, with the Department of Geography and Planning of Macquarie University, Australia. He graduated with a PhD from Macquarie University in 2009. His research focuses on sustainable/low-carbon energy strategies, climate change policy, and greenhouse gas risk management. He serves as a lead author in WGIII of the IPCC Fifth Assessment Report.

Professor Jan C. van der Leun had his basic training in physics, with specializations in meteorology and biophysics. His research was directed primarily on influences of solar radiation on the human skin. He spent a year on similar research at Cornell University Medical College, New York, and became a professor of dermatology at Utrecht University, Netherlands. This background brought him into early contact, in 1971, with the problem of the depletion of the stratospheric ozone layer, and the effects of that danger. Later, that reality became the focus of investigations in his research group at Utrecht. After his retirement from the university in 1993, he continued these activities with an additional interest in interactions between stratospheric ozone depletion and climate change and the effects of these changes on living organisms. He did this work as a guest co-worker in a dynamic international company, Ecofys BV, that works for 'a sustainable energy supply for everyone', before he passed away in July 2016.

Dr Helena Varkkey is a Senior Lecturer at the Department of International and Strategic Studies, University of Malaya in Kuala Lumpur, Malaysia. She completed her doctorate at the Department of Government and International Relations, University of Sydney, Australia, in 2012. Dr Varkkey has been interested in sustainable development throughout her academic career. Her interest in the field has evolved to focus on transboundary pollution in Southeast Asia, particularly pertaining to the role of patronage in agribusiness, especially the oil palm industry, and its link to forest fires and haze in the region. Her findings were published as a book in 2016 as part of the

Routledge Malaysian Studies Series. Her writings have also appeared in many international academic journals, including *International Environmental Agreements*, *Wetlands*, and *Asia Pacific Viewpoint*. Her work was also featured in the 2014 *Routledge Handbook on Contemporary Malaysia*. She recently served as Chief Editor on a Local and Transboundary Haze Report sanctioned by the Academy of Sciences Malaysia. Dr Varkkey has been interviewed by various media for her views on haze, agribusiness, and ASEAN, including *The Wall Street Journal*, *The Economist*, *Financial Times*, Channel News Asia, *The Straits Times* (Singapore), and *The Star* (Malaysia). She continues to undertake research in sustainable development and haze issues. She maintains an academic blog at helenavarkkey.wordpress.com

WANG Baojin has been studying in Beijing for six years. She earned a bachelor's degree at the Economics and Management College of Beijing Forestry University and now is a master's student in Forestry Economics at Renmin University of China. At present, her main focus is forestry green economy and sustainable development. She worked as an intern in the State Forestry Administration and was responsible for collecting and analysing research data of the national collective forest areas. She participated in the surveys of farmers in Liaoning Province, Yunnan Province, Fujian Province, Guizhou Province, and others. She has a comprehensive understanding of the forestry management behaviour and development of farmers and rural areas in China.

Dr Dick Watling is Principal and Founder of Environmental Consultants Fiji, Ltd., Fiji's leading specialist environmental consultancy practice. In this capacity, his 35 years of consultancy experience encompasses a very broad range of environmental and conservation planning and management in Pacific Island Countries and South East Asia. Dr Watling read Zoology at Bristol University for his BSc and received his doctorate from the Department of Applied Ecology, University of Cambridge, UK. A resident of Fiji since childhood, Dr Watling is an internationally acknowledged authority on Fiji's environment, its birds, and terrestrial wildlife. In 2006, Dr Watling established the Fiji Nature Conservation Trust, which, through its working arm, NatureFiji-MareqetiViti, is Fiji's only membership-based biodiversity organization. He served as Managing Director until January 2013 and remains as the Executive Trustee. Currently, Dr Watling is retired and farms in the Sigatoka valley.

Professor Anoja Wickramasinghe is Emeritus Professor of Geography, University of Peradeniya, Sri Lanka. She has made significant contributions to the fields of energy, forestry, resource management, rural development, and poverty, and is also known as a policy and institutional analyst, gender activist, community mobilizer, and trainer. She has served as a consultant to several international and national agencies, including the United Nations Development Programme, FAO, International Fund for Agricultural Development (IFAD), World Bank, Millennium Challenge Cooperation and many others on gender and social inclusion, energy access and livelihood development, community forestry and biomass energy development, social and environmental safeguards, and land resource management. She has published several books, including an annotated bibliography on gender and energy in South Asia, funded by ENERGIA, and more than 100 research articles. She possesses extensive experience in undertaking collaborative projects and research in many countries in Asia and the West. She coordinated the Collaborative Regional Research Network in South Asia (CORRENSA), funded by the British Council, and, as the focal point for ENERGIA International Network, she leads the National Network on Gender, Energy, and Environment. Professor Wickramasinghe started her career as a geographer, with a BA Honours from the University of Peradeniya, Sri Lanka, and holds an MSc in Natural Resource Management and a PhD in Forest Ecology from the University of Sheffield, UK.

Dr Amirtharaj Christy Williams is the Country Director for WWF-Myanmar. He has more than 19 years of conservation leadership expertise with WWF in Asia. Since 2016, he has been leading the WWF-Myanmar Country Office to influence the conservation agenda of Myanmar as the country opens up. The work in Myanmar ranges from boots on the ground to protect wildlife from poaching to protecting the forests and freshwater by influencing investments in Myanmar via a green economy approach. Under his leadership, WWF-Myanmar has been able to build a programme of work on the ground despite the conflict by building relationships with key stakeholders including the CSOs, the government, and the Karen National Union (KNU), a political front of the armed ethnic group controlling significant parts of the forested landscape. Before this, he was the Programme Leader for Asian Rhino and Elephant Action Strategy (AREAS), a WWF conservation programme on elephants and rhinos that is being implemented in eight countries across Asia. He worked with WWF offices and its partners in implementing strategies to combat the illegal trade in wildlife, mitigating human-elephant conflict, and engaging in policy and advocacy work to address the impact of developmental infrastructure (e.g., roads, dams, oil drilling, human habitations, etc.) on elephant and rhino habitats. Christy is a large mammal biologist who did his PhD from the Wildlife Institute of India on 'Elephants and their habitats in Rajaji National Park'.

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Editor's note

This book was first conceived during the Eminent Scientists Symposium on *Global Change and Sustainable Development* held on 24–25 March 2005 in Seoul, Republic of Korea. The symposium was a separate side event for the Fifth Ministerial Conference of Environment and Development (MCED-5) of the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) that was held on 28–29 March 2005. I organized the symposium as the Regional Adviser on Environment and Sustainable Development of UNESCAP. Dr Mostafa Kamal Tolba, then at the age of 82, kindly travelled all the way from Geneva to chair the two-day symposium, which was attended by some 70 scientists from about 30 different countries, the majority from the Asia-Pacific region. It was a highly successful and memorable event.

The original idea was to publish the papers presented at the symposium. However, it took quite a few years for the draft book to be organized owing to a number of reasons, including my earlier than expected departure from UNESCAP at the end of 2007, which was followed by my work in Vietnam during the second half of 2008, and then Australia, Malaysia, and China. My frequent travels made the coordination of the draft book difficult, and it has taken much longer than anticipated.

Meanwhile, the issues related to global change and the progress in promoting sustainable development were rapidly advancing, including the adoption of the Sustainable Development Goals by the United Nations General Assembly in September 2015, to replace the Millennium Development Goals. Therefore, I decided to restructure the original draft of the book to include research on the most recent progress. Unfortunately, many former chapters in the draft book could not be updated. Only 17 chapters that have been updated remain in this volume, while 15 new chapters have been added. I wholeheartedly apologize to those authors whose chapters could not be included, as well as the authors who chose to spend time and effort to update their chapters, for the lengthy delay in getting this book published. It has been a long journey to reach this point.

This book presents 32 chapters contributed by more than 70 leading international experts on various aspects of sustainable development, from the perspectives of Asia and the Pacific. It contains two parts, each with 16 chapters.

Part I focuses on the theories and practices of sustainable development. It opens with the chapter by Amartya Sen, the Nobel Prize winner in Economics in 1998, titled *Asian identities*, which discusses the lasting impacts of diverse Asian traditions, beliefs, cultures, and civilizatons on the world. This is followed by the chapter by Mostafa Kamal Tolba, *On sustainable development* (Chapter 2), which traces the evolution of the concept of sustainable development from the publication of George Perkins Marsh's 1864 classic *Man and Nature*, and the chapter by John Peet on the scientific dilemma of sustainability (Chapter 3), in which he traverses some of the ground occupied by both the utility-based and metabolic models of economic activity, and shows that neither is of itself sufficient to address the entire spectrum of issues related to sustainable development. A chapter by Yi Chen and Boris Steipe (Chapter 4) discusses the respect and reward derived from the ecological aspects of the philosophy originating from the *Analects* of Confucius, who was an influential philosopher and teacher of ancient China more than 2,500 years ago. Rosita Dellios (Chapter 5) further discusses how the concept and practice of sustainable development can benefit humanity 'through an integration of traditions of thought culture' that 'entails cultivating the holistic approach found in Eastern philosophy and culture, while still valuing the analytical Western contribution', and this 'integrative or holistic model can work well for incorporating diverse approaches'. Two chapters, *Sustainable urbanism: Measuring long-term architectural merit* by Craig Langston (Chapter 6) and *Sustaining wooden architectural heritage* by Peter Brimblecombe and Mikiko Hayashi (Chapter 7), illustrate the practice of sustainability in architectural design, in modern urbanism, and in wooden architectural heritage, respectively.

Three national perspectives on the good practices of sustainable development are then presented. These are *Green development in China* (Chapter 8, by KE Shuifa, FENG Qiya, WANG Baojin, and QIAO Dan), *Bhutan's sustainable development initiatives in pursuit of Gross National Happiness* (Chapter 9, by

Jamba Gyeltshen), and *A different form of sustainable development in Thailand and Bhutan: Implementation of a sufficiency approach* (Chapter 10, by Ros Taplin, Sk Noim Uddin, Kanokwan Pibalsook, Karma Tshering, and Natarika Wayuparb Nitiphon). These examples illustrate the alternative approaches to sustainable development that value green development within the context of ecological civilization (China), Gross National Happiness (Bhutan), and Sufficiency Economy (Thailand) more than the ever-increasing economic growth in terms of Gross Domestic Product (GDP).

Bryant J. Allen and R. Michael Bourke highlight that the most important threats to the sustainability of food production and supply in Papua New Guinea (PNG) are high rates of population change, which threatens to bring about land degradation in shifting cultivation systems, an HIV/AIDS epidemic, and global climate change (Chapter 11). 'If global climate change increases rainfall, reduces diurnal temperature ranges or increases the frequency of El Niño-Southern Oscillation (ENSO) events, then food production will be adversely affected'. Dzulkifli Abdul Razak's chapter *Education for sustainable development: An overview of Asia-Pacific perspectives* (Chapter 12) emphasizes the importance of 'balancing' the spiritual and materialistic aspects of development, as observed within the diverse indigenous communities of the Asia-Pacific, such as in Japan, Indonesia, Malaysia, Thailand, and New Zealand, so as to further enhance, expand, and enrich the concept of sustainable development 'through real-life examples', and make it 'even more relevant and viable as a way of life'. I would even posit that it is more important to *integrate* rather than merely *balance* the delicate demands of various aspects (ecological, social, and economic) of sustainable development. The interests of each aspect should be thoroughly considered and then well integrated into the planning in the design and on the drawing board, rather than as an afterthought.

Bhishna Bajracharya and Isara Khanjanasthiti have developed a placemaking framework for social sustainability of master-planned communities (MPCs) and applied it to a case study from Australia (Chapter 13). It shows the importance of both physical design as well as the process of placemaking to build sustainable communities. The key concepts in placemaking include provision of places for social interaction, walkability, community governance, stakeholder engagement, legibility, safety, and sense of place. These ideas and the proposed framework are relevant for the sustainable development of MPCs in the Asia-Pacific region.

Anoja Wickramasinghe (Chapter 14) examines the interconnections between the large population, poverty, social inequity (including gender-based inequalities), and environmental degradation issues that threaten sustainable development in Asia. A new development paradigm, aided by supportive and guiding national policy instruments and commitments, is needed to address these issues, so as to enhance the benefits to vulnerable segments of the society and to geographically marginalized or deprived areas.

Two chapters present the international policies and international law related to climate change that have significant implications for sustainable development. Chapter 15, by Karen Hulme and David M. Ong, provides an overview in *The challenge of global climate change for international law*. The authors analyse the challenges that global climate change presented to certain basic concepts and principles of international law, such as the fundamental notion of statehood, and state responsibility and liability, as well as issues of sovereignty, human rights, and humanitarian intervention. Chapter 16, by Bernarditas de Castro-Muller, presents the perspectives of developing countries on *Sustainable development and climate change negotiations* that led to the adoption of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 and its Kyoto Protocol in 1997, and eventually the Paris Agreement in 2015. Bernarditas de Castro-Muller, a seasoned diplomat and a well-known negotiator, who unfortunately passed away in December 2018, had been a strong voice for defending developing countries' positions during negotiations on multilateral environmental agreements.

Part II highlights the challenges faced and the opportunities created by the implementation of sustainable development for poverty alleviation amid the changing ecological, social, cultural, economic, and political environment in the Asia-Pacific region. The topics discussed range from science, energy, gender equality and energy access, stratospheric ozone depletion, climate change, vulnerability, Sustainable Development Goals, land use, and biodiversity, to disaster risk reduction, all of which are relevant to achieving sustainable development.

Chapter 17, by Mostafa Kamal Tolba, discusses the important role of science, and emphasizes that policymaking should be based on the best available science, in addition to the consideration of many other social and economic factors. It is essential to maintain the ethics of scientific research, and the application of the precautionary principle should not be opposed to science-based regulation, but the two should be complementary. Chapter 18, by Helena Varkkey, discusses the transboundary haze issue in Southeast Asia originating largely from forest fires in Indonesia. The auhor observes that, in order to protect their tourism sectors during the haze events, national governments tend to under-represent the health risks of haze, both to citizens and tourists. In addition, ASEAN member states have yet to agree on a common regional air quality measurement system, with many continuing to use a system that under-represents health risks.

Three chapters assess energy and related issues. Chapter 19, by Keith Openshaw, examines energy consumption in general

and biomass consumption in particular for all 69 countries in Asia and the Pacific (A-P). The author found that in 2015, the 20 low-income countries of South, Northeast, and Southeast Asia, containing 85% of the A-P population, consumed 57% of total primary energy and 97.5% of biomass energy. He argues that biomass is a promising fuel for sustainable development in Asia and the Pacific, and that the use of biomass for energy and other purposes could be increased substantially. Chapter 20, by Shoibal Chakravarty, T. S. Gopi Rethinaraj, and Dilip R. Ahuja, reviews the state of the coal-dominated electricity sector in India, examines the pathways to a more sustainable electricity sector, and analyses the challenges and benefits of increasing the share of renewables and nuclear power in India's electricity system. Chapter 21, by Anoja Wickramasinghe, assesses gender inequality and women's limited access to energy, which are barriers to maximizing development effectiveness in the South Asia Association for Regional Cooperation (SAARC) region, and suggests ways to overcome these barriers.

Chapter 22, by Jan C. van der Leun and Janet F. Bornman, discusses the interactions of the stratospheric ozone layer with the rapid climate change, especially from the viewpoint of the consequences for living organisms, and the involvement of living organisms in the interactions. Chapter 23, by R. James Ferguson, discusses the risks and prospects of the political challenge of linking the implementation of the Sustainable Development Goals (SDGs) (2015-2030) and the Paris Agreement (2015). The author points out that uneven implementation of these two agendas could slow down their progress 'if collective action on emission targets and related funding wavers'. A pluralist, multi-actor approach is needed to reassure developing countries of the benefits of sustaining emissions reduction alongside balanced implementation of the SDGs and continued use of resilient, 'low-emission' adaptation strategies. Chapter 24, by Nguyen Huu Ninh, Luong Quang Huy, Philip Michael Kelly, and Phan Toan, focuses on the social vulnerability to climate change in the nations of the Lower Mekong (Cambodia, Lao PDR, and Vietnam). Social vulnerability 'is a function of the social conditions and historical circumstances that put people at risk'. The authors highlight that 'poverty is the largest barrier to developing the capacity to cope and adapt effectively with change'. Chapter 25, by Shababa Haque, Naznin Nasir, M. Feisal Rahman, and Saleemul Huq, discusses the effects of climate change and the lack of funding mechanisms for implementing necessary actions as the main barriers for achieving the various targets of Sustainable Development Goals 2030 in Bangladesh, a low-lying country that is most vulnerable to sea-level rise and extreme climatic events. Consequently, it is important to implement national plans and policies that incorporate SDG targets as well as climate action with adequate national and international financial resources. Chapter 26, by Safdar Ullah Khan, Zafar Manzoor, Gulasekaran Rajaguru, and Shabib Haider Syed, discusses sustainable development in Pakistan. The authors highlight Pakistan's vulnerabilities to a number of current environmental, social, economic, governance, and institutional issues, which are used as indicators directly and indirectly related to the achievement of the Sustainable Development Goals 2030. The findings reveal important insights into the interconnectedness of various indicators, which may be useful in guiding appropriate policy actions to successfully achieve the objectives of sustainable development in Pakistan.

Four chapters focus on land-use change and biodiversity. Chapter 27, by Gernot Brodnig, examines the challenges emerging from two distinct but related global threats: climate change and invasive alien species. It assesses the respective impacts of these drivers on ecosystems and biodiversity, and highlights the importance of adopting perspectives over a longer time and at larger spatial scales, as well as the need to look beyond the boundaries of conservation areas to address these challenges. Chapter 28, by Dietrich Schmidt-Vogt, provides an overview on the causes of land-use change and biodiversity losses in Monsoon Asia, and highlights that deforestation and forest degradation are considered to be the most detrimental processes of land-use and land-cover change that lead to biodiversity losses. Thus, it is important to create in the countries of Monsoon Asia, through education, awareness of the value of biodiversity, and to help generate the political will to promote and support land use that is compatible with the aims of biodiversity conservation. Chapter 29, by Andrew N. Gillison, Amirtharaj C. Williams, Gopala Areendran, and Rajeev L. Semwal, reports a low-cost, high-return, and readily transferable methodology that utilizes both ground-based and remotely sensed data to assess the linkages between land use and biodiversity that has been successfully used in a case study from the Eastern Himalayas. The low-cost methodology has wider implications for assessing the impact of global change on biodiversity. Chapter 30, by Marie-Isabell Lenz, Stephen Galvin, Gunnar Keppel, Sunil Gopaul, Matthias Kowasch, Michael J. Dyer, Dick Watling, Sherri Lodhar, Geon C. Hanson, Stefan Erasmi, and Hans Juergen Boehmer, highlights the problem of biological invasive alien species that threaten sustainability in a small island developing state in the tropical South Pacific. The authors illustrate this problem with two relatively recent biological invaders in Fiji – the ivory cane palm (*Pinanga coronata*) and the green iguana (*Iguana iguana*), and use these examples to examine the potential consequences of continuing inaction, despite awareness in relevant government departments, for native forest biodiversity and human livelihoods. They highlight the desperate need for on-the-ground action to control, eradicate, and prevent invasive alien species.

The final two chapters deal with disaster risk reduction and disaster risk management. Chapter 31, by Sálvano Briceño,

reviews the approach to the response to the Indian Ocean tsunami that occurred on 26 December 2004, which, according to the UN Office for the Coordination of Humanitarian Affairs (OCHA), killed 230,000 people across a number of countries, with Indonesia, Thailand, Sri Lanka, India, and the Maldives sustaining massive damage. The author highlights the urgent need to improve preparedness and reduce risks from future disasters, including early warning and attempts to integrate disaster risk reduction into reconstruction. Chapter 32, by Tun Lwin and Swan Yee Tun Lwin, describes the tragic event of Cyclone Nargis that struck Myanmar on 2 May 2008 and left approximately 84,500 people dead and almost 54,000 people missing. Certainly, lessons can be learned from both tragic events in terms of developing more systematic disaster risk reduction strategies and capabilities for disaster-prone countries.

All the above chapters and the issues discussed in them have profound implications for the implementation of sustainable development in the region. I hope that the book will serve as a useful reference for all researchers and policy makers who have an interest in pursuing sustainable development under the continuing influence of global change within the context of Asia and the Pacific.

I would like to express my special appreciation and gratitude to the authors of this book. Without their persistent effort, patience, dedication, and great understanding, the completion of this book would have been impossible. I would also like to acknowledge the kind assistance provided by the peer reviewers, who voluntarily spent their time and effort to ensure the quality of each chapter that has been accepted for publication in this volume. Many authors also kindly served as peer reviewers.

I am most grateful for the forewords by Dr Mostafa Kamal Tolba, Sir Toke Tufukia Talagi, Dr Qin Dahe, Dr Sálvano Briceño, and Dr Mick Kelly.

This book is dedicated to my mentor, the late Dr Mostafa Kamal Tolba, former Executive Director of the United Nations Environment Programme (UNEP) (1975–1992), one of the great pioneers in promoting sustainable development throughout his career. Dr Tolba passed away on 28 March 2016 at the age of 93. I am most grateful to have contributions from three of Dr Tolba's former colleagues, Ambassador Mikko Pyhälä, Dr Sálvano Briceño, and Naigzy Gebremedhin, in the section *Remembering Dr Mostafa Kamal Tolba*. They have added their memories and perspectives to join the numerous international tributes that had already been written about Dr Tolba after his passing in 2016.

During the preparation and publication of this book, Dr Mostafa Kamal Tolba, Professor Jan van der Leun, Dr Kanokwan Pibalsook, Ms Bernarditas de Castro-Muller, Dr Tun Lwin, and Sir Toke Tufukia Talagi unfortunately passed away. I deeply regret that they could not see the publication of this book, to which they made valuable contributions. I was most honoured to have had opportunities to work with Dr Tolba, Professor van der Leun, Ms de Castro-Muller, and Dr Tun Lwin. Dr Tolba was Executive Director of UNEP when I joined the Ozone Secretariat of UNEP as a scientist in 1991. Professor van der Leun co-chaired UNEP's Environmental Effects Assessment Panel (EEAP), established in 1988 under the Montreal Protocol on Substances that Deplete the Ozone Layer, when I assisted the Ozone Secretariat in serving the EEAP in 1991–1992. As a strong voice for developing countries, Ms de Castro-Muller's contribution in the negotiations of the United Nations Framework Convention on Climate Change (UNFCCC) were most significant. She and I were resource persons for a number of training courses in climate change negotiations, including those for Vietnam, Lao PDR, Timor-Leste, and Indonesia. I first met and worked with Dr Tun Lwin in 2005 when he was Director-General of the Department of Meteorology and Hydrology of Myanmar. I vividly recall how he desperately tried to provide early warning for the incoming Cyclone Nargis that struck the coastal areas of Myanmar on 2 May 2008. I met with Hon. Talagi on a few occasions, including my visits to Niue in 1997 and 2005. Hon. Talagi also participated in the Eminent Scientists Symposium that I organized in Seoul in 2005,

I wish to thank the book's sponsors: the Asia-Pacific Network (APN) for Global Change Research; China Meteorological Administration (CMA); United Nations Development Programme (UNDP) Regional Office for Asia and the Pacific; United Nations Disaster Risk Reduction (UNDRR) (formerly United Nations International Strategy for Disaster Reduction, UNISDR); and Tiempo.

After serving more than six years as the Regional Adviser on Environment and Sustainable Development at UNESCAP, I left in December 2007. In the later part of 2008, I spent five months in Hanoi, Vietnam, as an International Expert in the Natural Disaster Mitigation Partnership project located in the Ministry of Agriculture and Rural Development, a post funded by the UNDP-Vietnam. I returned to academia in January 2009, and became a visiting and adjunct professor at Bond University in Australia (2009–2018). I was appointed as the first Yayasan Sime Darby Chair in Climate Change, Universiti Kebangsaan Malaysia (National University of Malaysia) (2011–2013); Senior Visiting Scientist at the Institute of Geographic Sciences and Natural Resources, Chinese Academy of Sciences, Beijing (2011); and Visiting Scientist at the Institute of Desertification Studies, Beijing (2013, 2015). I was an International Adviser for the *Climate Change Adaptation Initiative* project, Mekong

River Commission Secretariat, Vientiane, Lao PDR (2010). I have also been a freelance consultant.

In August 2017, I was invited to participate in a project titled *Sustainable and Climate-Resilient Land Management in the Western Region, China*, funded by the Asian Development Bank and Global Environment Facility. Through this project, I had the honour of meeting many technical experts in various fields and visiting many demonstration sites in China (i.e., Inner Mongolia, Shaanxi, Gansu, Qinghai, and Sichuan), and I met many new colleagues and friends who warmly welcomed my participation in the project, which was completed in December 2018.

I would like to take this opportunity to express my sincere thanks to all the colleagues and friends whom I have met and worked with in the past 15 years. They have greatly enriched my professional and academic life. Special thanks and appreciation go to the following people: Dr John Todd, former Associate Professor of the University of Tasmania, Australia; Dr Mick Kelly, Tanelorn Associates, New Zealand; Dr Mohd Nor Salleh, Academy of Sciences Malaysia; Dr Rezaul Karim, former Coordinator, Asia Unit, United Nations Convention to Combat Desertification (UNCCD) secretariat, Bonn, Germany; Rae Kwon Chung and Siva Thampi, both former directors, Division of Environment and Sustainable Development, UNESCAP; the late Chow Kok Kee, former Director-General of the Malaysian Meteorological Department; Tan Meng Leng, former Director-General of the Department of Environment, Malaysia; Nguyen Ngoc Ly, Director, Centre for Environment and Community Research (CECR), Hanoi, Vietnam; Nguyen Mong Cuong, Director, Research Centre for Climate Change and Sustainable Development, Hanoi, Vietnam; Nguyen Khac Hieu, former Deputy Director-General, Department of Climate Change, Ministry of Natural Resources and Environment, Vietnam; Professor Ros Taplin, former Director, Environmental Management Programme, School of Sustainable Development, Bond University, Australia; the late Dr Allen Clark of the East-West Center, Hawaii, USA; Dr Qin Dahe, former Adminstrator, China Meteorological Administration; Dr Jian Liu, former Director of the International Ecosystem Management Partnership (IEMP), Chinese Academy of Sciences; Professor Lu Qi, Director of the Institute of Desertification Studies, Beijing; Professor Fredolin Tangang and Professor Mohd Talib Latif, Faculty of Science and Technology, Universiti Kebangsaan Malaysia; Yang Youlin, former Regional Coordinator of the UNCCD secretariat for Asia, Bangkok, Thailand; Dr Ye Bing and Dr Meng Yongqing, Research Institute of Forestry Policy and Information, Chinese Academy of Forestry; Professor Li Junqing of Beijing Forestry University; Dr Victor R. Squires, International Dryland Management Consultant, Australia; Dr Michael H. Glantz, Director, The Consortium for Capacity Building, University of Colorado, USA; Dr Natchanun Leepipatpiboon, former Assistant Professor, Department of Chemistry, Chulalongkorn University, Thailand; Dr Tan Geok Chin, National Institute of Education, Singapore; Professor Peter Brimblecombe, Department of Marine Environment and Engineering, National Sun Yat-Sen University, Kaohsiung, Taiwan; my forner colleagues at Bond University, especially Dr Lynne Armitage, Dr Bhishna Bajracharya, Professor Shelley Burgin, Dr Rosita Dellios, Dr R. James Ferguson, Professor Craig Langston, Dr Daryl McPhee, and Dr Daniel O'Hare; and Kai Yin Low of University of Essex, UK, as well as Karma Thinley of Bhutan, for their persistent support and encouragement.

I must also express my gratitude to a number of people: Rick Whisenand and Ling Si Low for assisting in proofreading; Wang Chuyue for assisting in compiling the list of peer reviewers and acronyms and abbreviations of some chapters. Last but not least, I am grateful to Matt Lloyd, Senior Executive Editor of Cambridge University Press (CUP), for his great patience and understanding in overseeing the completion of this book over the past 10 years; to Sarah Lambert, Editorial Assistant; Esther Miguéliz Obanos, Senior Content Manager; Elle Ferns, Content Manager; and to Shalini Bisi, Administrative Assistant of CUP, for providing their efficient and effective assistance in getting this book published.

Foreword by Mostafa Kamal Tolba

Editor's note: This Foreword was written by Dr Mostafa Kamal Tolba when I was preparing an earlier version of the book that was not completed. It remains valid even though new chapters have been added in this version.

Our understanding of the concept of sustainable development is still evolving, even to this day. The concept itself was adopted universally at the Earth Summit in 1992 at Rio de Janeiro. However, the changing global conditions, be they economic, social, or environmental, are complicating the premises of sustainable development. This book gives insight into the impacts of various aspects of global change – such as stratospheric ozone depletion, climate change, biodiversity, and land-use change – on sustainable development. The book further includes another group of outstanding chapters on the relationships between environment and development, environment and economic development planning, and risk management. All these chapters are written by a host of very distinguished authorities, essentially from the Asia-Pacific region, which is endowed with a very rich group of talented scientists.

This is not the first time that Pak Sum Low has stuck his neck out to edit such a varied group of topics, knitting all of them into a fabric that brings forward the myriad complex issues of global change impact on sustainable development. The examples stressed in the book are from the Asia-Pacific region. However, the material in all of the chapters applies equally to the world at large.

The book is a solid piece of work that should constitute a basic reference source in the library of any person concerned with the issues of sustainable development: not only scientists, economists, and other social scientists but, more importantly, the decision makers.

Mostafa Kamal Tolba
International Centre for Environment and Development
Cairo, Egypt

Foreword by Toke Tufukia Talagi

Editor's note: Everyone who knew Sir Toke Tufukia Talagi was saddened to hear that he had passed away on 15 July 2020. He was the Premier of Niue, a small island state in the Pacific, from June 2008 to June 2020. As a strong voice advocating that developed countries ought to have a greater ambition for undertaking emissions reduction, as well as providing the necessary finance to help small island developing states with adaptation to climate change, he contributed this Foreword with great enthusiasm.

It has become an established fact that globalization in its many forms impacts the small Pacific states much more than the countries that created these globalized phenomena.

It is no different in terms of the global impacts of changes to our climate and the worldwide environmental changes that have taken place over the past few decades. The small island states in the Pacific have been the first to note and experience the rising sea levels, the erosion of their fragile islets, and the major impacts that the climate has had on their dwellings, ecosystems, agriculture, water and sanitation, and fragile economies. These adverse impacts have significant implications for sustainable development of the small island states.

The threat to their sovereignty is very real and poses international legal questions that are not as easily answered as some may think, by the supposed option of relocation to somewhere else. Aside from the legal status of the islands they would be vacating, it also raises questions as to the status the people would be granted in the places they may be relocated to. It is no wonder that they are resisting any pressure to relocate, seeking answers instead that will result in a global reduction in the factors that have caused the problem, as an initial response, and secondly compelling the world to look at practical solutions and adaptations.

It is the view of the small island states that even though there is now widespread acceptance of the fact of climate change and its causes, there is still not the same urgency of response, in comparison with the current economic, financial, and social crises in the world. The fact that the changes in climatic conditions will one day supersede all else seems ironic, and world leaders are urged to ensure that the changes needed to reduce the factors worsening climate changes are dealt with quickly and with alacrity.

Much of the work so far has been involved with measuring the levels of change and the impacts at local, regional, and international levels. The adaptation scientific studies conducted in the areas of production and changes required in the commercial and non-commercial fields are just starting to show some positive results. Many agree that this will offer opportunities for a new sector of the economic and commercial business fields. It would be a timely and appropriate measure to offer these changes in the economic and financial stimulus packages that are currently being mooted, thereby creating a win-win situation for everyone.

The adaptation measures needed to assist the small island states have been very slow and cumbersome. Funds have been allocated and pledged, but the process for approvals leaves a lot to be desired. The solutions have also not been as clearly defined as desired.

That action is urgent and widely needed must be realized and implementation targeted quickly to help the small island states now, not at some distant time in the future when all is too late.

After many years of international negotiations, the Paris Agreement was finally adopted in 2015. This Agreement aims to limit the increase in the global average temperature to 'well below 2°C' and even to 1.5°C above pre-industrial levels. However, even with the current 1.0°C increase, the Pacific small island states are already feeling the heat. Scientists have projected that the achievement of 2°C and 1.5°C targets will remain a great challenge. Therefore, more political will and decisive actions to ambitiously reduce the emissions of greenhouse gases are urgently needed.

However, we will never be able to make any real changes unless or until humanity's greed at all levels is managed so that we all realize, as our ancestors realized when they lived on these islands, that everything must be allowed to sustain itself and that our harvests must be managed to ensure long-term use and survival.

This is what humans must now learn if we are to survive the most important challenge in our time. This publication has helped with some of the answers and demonstrates that more needs to be done if we are all to make a significant difference.

To survive, we must mitigate and adapt. But to do so, we must also transcend our complacency and arrogance and put an end to our international political failure to make decisions in our time for the good of everyone.

Hon. Sir Toke Tufukia Talagi KNZM
Premier of Niue (June 2008–June 2020), and Chair of Pacific Island Forum 2009

Foreword by Qin Dahe

Over the past century, there have been major climate and environmental changes that can be attributed to global warming. The magnitude of these changes has gone beyond the range of natural variability and they are posing a major threat to sustainable development and the survival of humankind. Climate change is not only an environmental concern, but also a major development issue. It has become an imminent challenge encountered by all human beings in the world.

According to the latest findings of the IPCC Working Group I contribution to the Fifth Assessment Report (AR5), there has been a remarkable increase in global average surface temperature, continuous sea-level rise, and steady shrinkage of snow cover in most areas of the Northern Hemisphere, all indicating a trend of global warming. Over the past century (1880–2012), the mean global combined land and ocean surface temperature has increased by an average of 0.85 [0.65–1.06]°C. The average temperatures in the Northern Hemisphere during the second half of the 20th century were very likely higher than during any 50-year period in the last 500 years, and likely the highest in at least the past 1,300 years.

Climate change has had severe impacts on the climate and environment in the Asia-Pacific region, and it has brought challenges to the region's development. As indicated by the IPCC Working Group II contribution to the Fifth Assessment Report, major rivers and some large delta areas in Asia would most likely be under the threat of more severe consequences of climate change, for example, decrease of fresh water resources, increased risks of floods, reduction of agricultural productivity, increased hindrances due to higher dependency of economic development on natural resources and the environment, and increased exposure to diseases related to climate warming. A large number of developing countries are located along the circum-Pacific earthquake belt and within the Asian monsoon areas, yet they have relatively low capabilities for predicting and preventing disasters, such as earthquakes, typhoons, dust storms, floods, and droughts. For these reasons, proper responses to climate and environmental change are essential for achieving harmony between human beings and physical nature, and for sustainable development of humankind in this region.

In this book, more than 70 scientists and experts address the challenging issues related to sustainable development facing the Asia-Pacific region, including scientific and policy aspects, as well as challenges and good practices. I believe it will definitely improve our understanding and facilitate broader and deeper research studies in the future.

Qin Dahe
Academician, Chinese Academy of Sciences,
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Foreword by Sálvano Briceño

At a time when the frequency and severity of climate-related disasters herald the consequences of an increasingly warmer and urbanized planet, the need to see disaster risk reduction as a core development concern has never been so important for preventing needless death and destruction. There is an urgent need to bring disaster risk reduction and adaptation to climate change into mainstream policy and planning, and to strongly develop a culture of prevention. This is important for all countries but particularly for the developing countries in the Asia-Pacific region, as the developing world is predicted to bear the brunt of climate change-related catastrophe in the coming years, as well as the human cost of other disasters.

We are experiencing the effects of a building global crisis or tipping point. But with crisis comes opportunity for political and cultural change. The unprecedented devastation of the Indian Ocean tsunami that took place on Boxing Day 2004, and the Tohoku-Japan earthquake, tsunami, and nuclear radiation catastrophe of March 2011 shone a global political spotlight on the need for more sustainable and better-coordinated risk reduction (prevention, mitigation, and preparedness) strategies in the wake of disasters triggered by natural hazards that would carry on long after media attention faded.

Seizing on the political will to act, the second United Nations World Conference on Disaster Reduction (WCDR) held in Kobe, Hyogo, Japan in January 2005 adopted the *Hyogo Framework for Action 2005–2015: Building the Resilience of Nations and Communities to Disasters*, laying out a 10-year plan to make disaster risk reduction an essential component of development policies, plans, and programmes. In 2015, the third World Conference on Disaster Risk Reduction adopted the Sendai Framework for Disaster Risk Reduction 2015–2030, providing a 15-year plan to follow up on the Hyogo Framework, making disaster risk reduction an even higher priority in the international policy agenda and guiding work at regional, national, and local levels.

While the Indian Ocean and Japanese tsunamis were touched off by massive undersea earthquakes, climate-related catastrophes have held the world's attention over the following years. Intensifying hurricane and typhoon seasons, floods, wildland fires, and drought meant that disaster risk reduction issues maintained their urgency. Stakeholders across the board in areas prone to natural hazards began to realize that they had to become more proactive in identifying, assessing, and reducing disaster risks.

The emerging focus on reducing risk rather than just getting prepared to respond to hazards offers a valuable opportunity for further positive change and substantive contributions to building various aspects of sustainable development. Disasters have the potential to be politically neutral, and to unify parties with conflicting priorities – even parties at war. This can create space for positive action in the most fraught of circumstances.

To fully take advantage of those openings and alliances, we must continue to strengthen linkages across the development agendas. The Hyogo Framework affirms that '[s]ustainable development, poverty reduction, good governance and disaster risk reduction are mutually supportive objectives'. For the rest of the development communities, disaster risk reduction's potential as a unifier can help create space for other closely related development issues.

Disasters resulting from vulnerability to natural hazards exert an enormous toll on development. In doing so, they pose a significant threat to prospects for achieving the Sustainable Development Goals and the goals outlined in the Sendai Framework for Disaster Risk Reduction, as well as those of the Paris Agreement on Climate Change and the New Urban Agenda.

The desired resilience of nations to disasters can be possible only when communities develop their capacities to reduce risk and vulnerability to natural hazards and the multiple risks that can derive from them.

The United Nations Office for Disaster Risk Reduction (UNDRR) (formerly United Nations International Strategy for Disaster Reduction (UNISDR)), which has the global mandate for coordinating disaster risk reduction in line with the Sendai Framework, attaches great importance to national, local, and

community-based risk reduction initiatives. UNDRR has increased its efforts in strengthening the exchange of information, experience, and knowledge on risk reduction, now available on the PreventionWeb website.

I am pleased to welcome this publication, *Sustainable Development: Asia-Pacific Perspectives*, which should greatly contribute to increasing understanding and knowledge of individuals and organizations on the challenges of sustainable development requiring a risk reduction approach, with a long-term perspective and team-oriented efforts at all levels.

Sálvano Briceño
Former Director, UNISDR (2001–2011) and former Chair, Science Committee, IRDR programme of ICSU/ISSC/UNISDR
<www.irdrinternational.org>

Foreword by Mick Kelly

Just as globalization has presented humanity with fresh challenges and opportunities, so global environmental change raises major questions about the sustainability of the development process. Indeed, given the tortuous progress of the climate negotiations, the global warming issue is also raising questions about the capacity of our politicians and political systems to guide us through these testing times. If we are to find sustainable ways forward, we must set aside the worn paradigms of the past and seek diverse perspectives, learning from as wide a range of experience as possible.

I am delighted, therefore, that the Tiempo Programme, with its commitment to global dialogue, has been able to support publication of this book. *Sustainable Development: Asia-Pacific Perspectives* provides a timely view from the Asia-Pacific region, thought-provoking and inspiring in its wealth of facts, ideas, and recommendations. While political progress may be frustratingly slow, it is clear from the examples given in the following pages that there are, regardless, people who are moving forward towards a more sustainable future.

Mick Kelly
Founding Editor, Tiempo

Environmental keystones: Remembering Dr Mostafa Kamal Tolba

MIKKO PYHÄLÄ

The decade from 1985 to 1995 was crucial in the formation of the most important institutions and conventions for the environmental governance of the globe. Also, for the first time, nations and governments became fully aware of the mortal danger of potential environmental collapse with the discovery of the 'ozone hole'. One could say that there was partial awareness of impending climate change and looming loss of biodiversity. Initially, short-term political expediency gave much importance to establishing national ministries of environment and funding them, as well as the United Nations Environment Programme (UNEP), but soon their high profile was diluted, and funding decreased, as did the authority of these ministries and of UNEP itself.

ENVIRONMENTAL GROUNDWORK

UNEP had been established in 1974 after the United Nations Conference on Human Environment, which was held in Stockholm in 1972. That conference had been inspired by Indira Gandhi, Prime Minister of India, and Pierre Trudeau, Prime Minister of Canada, and was chaired by Maurice Strong of Canada. There was much debate about whether UNEP should graduate into an environment agency, but arguments of 'environment as a cross-cutting issue' prevailed over counterarguments that an independent agency would have much more teeth. In the early years of the 21st century, after the approval of the Millennium Development Goals by the United Nations General Assembly in 2000, sustainable development was seen as the responsibility of all, and all tried to explain that what they were already doing was sustainable.

UNEP's role was somewhat overshadowed by the UN Commission for Sustainable Development, which was established in 1992, and national ministries of environment were scaled down by governments struggling with the economic straightjacket of unmanaged globalization. It was only in 2015, when environmental imperatives emerged upfront in an integrated manner, that the General Assembly adopted the Sustainable Development Goals, later enmeshed with Agenda 2030.

The adoption of the Vienna Convention for the Protection of the Ozone Layer in 1985 was the first time countries adopted a universally shared environmental obligation. That convention started to be implemented through the Montreal Protocol on Substances that Deplete the Ozone Layer (1987) and the London Agreement on the Financing of that Protocol (1990).

The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 upon an initiative by UNEP and the World Meteorological Organization (WMO). It was only in its second assessment report in 1995 when developing countries' scientists came fully on board, thanks to financing from the Global Environment Facility (GEF), which had been created by UNEP, the World Bank, and UNDP in 1991, and which received its proper legal format only in 1994.

Environmental sustainability was brought on a par with social development, already suggested by Indira Gandhi in Stockholm, but largely based on the outstanding report *Our Common Future* of 1987 by the World Commission on Environment and Development chaired by Gro Harlem Brundtland, former Prime Minister of Norway. The most important vehicles of this were Agenda 21 and the Rio Declaration on Environment and Development, both of which emanated from the Rio de Janeiro Earth Summit of 1992, chaired by Maurice Strong with Dr Tolba at his side. Important global environmental conventions were signed – the United Nations Framework Convention on Climate Change and the Convention on Biological Diversity – and the Statement of Forest Principles was approved. Subsequently, the United Nations Convention to Combat Desertification was adopted in 1994.

DR TOLBA AS *PRIMUS MOTOR*

I limit myself in this note to my personal experience of working with Dr Tolba, whose life achievements are well covered in other contributions.

Dr Tolba in a way was the *primus motor* for the entire set of key global environmental conventions and for putting the

environment on a par with economic and social development. He was skilful in bringing consensus behind closed doors with only the heads of delegations inside with him, for the final compromises. His great acumen was in recognizing scientific talent, and he excelled in formulating UNEP's messages on environmental priorities.

Perhaps the finest monument to Dr Tolba is the creation of the Vienna Convention and the Montreal Protocol system for the protection of the ozone layer, which has brought about the most tangible results of any environmental convention. Dr Tolba also had a decisive influence on the creation of the IPCC in 1988, which started working under the auspices of WMO, and which received the Nobel Peace Prize in 2007, jointly with Al Gore. Among Dr Tolba's significant achievements was the creation or facilitation of secretariats for the global environmental conventions, creation of a set of Regional Seas Conventions, launching the *Global 500*, the UN environmental prize, which received huge publicity, and the creation of a number of solid science-based global report series, as well as UNEP's environmental photography archives, open to all.

Dr Tolba had the stature and scientific knowledge to converse, particularly in Rio, with world leaders on a level footing, which some of his successors may not have managed to do as eloquently. However, being located in a developing country was a challenge that handicapped UNEP in the eyes of many key players in international environmental policies, and certainly played against UNEP's top expertise being easily recruited, or provided at key fora.

One fine example of Dr Tolba's wisdom in international environmental policies was that, when he no longer was the first actor, workable decisions among governments continued being made along lines which he had originally envisaged in climate, biodiversity, and desertification. In spite of trying very hard, Dr Tolba was not able to get sufficient obligations baked into these three conventions. Many of the ideas included in Agenda 2030, however, originated in Dr Tolba's speeches and writings.

Dr Tolba retired from his post in 1992. But he did not retire from the environment; on the contrary, he became quite active in giving direction to the UN Sustainable Development Commission as head of the Egyptian Delegation at its meetings.

DR TOLBA AND FINLAND

Finland established a Ministry of Environment in 1983, and it was clear that Finland wanted to work closely with UNEP. Finland and other Nordic countries were the largest providers of voluntary contributions to UNEP, and a lively dialogue flew in the axis of Helsinki-Nairobi as long as Dr Tolba was the head of UNEP.

In the creation of the Vienna Convention and the Montreal Protocol, Finland played a major role, as Dr Tolba had requested. When the First Meeting of the Parties to the Montreal Protocol was held in Helsinki in April 1989, it was decided to establish a Preparatory Committee for the Financial System for Phasing Out Ozone Depleting Substances. Finland's Ambassador Ilkka Ristimäki was elected as chair of that committee, and the committee finalized its work in one year, culminating in the London Conference in 1990, which adopted unanimously the final document, with an encouraging speech by Prime Minister Margaret Thatcher.

How was it possible to reach unanimity in only one year when harmonizing conflicting views and interests often had taken many years of negotiations? To begin with, at the Helsinki Meeting of the Montreal Protocol in April 1989, the Ministers of Environment of China (Wang Yuqing, Deputy Administrator of NEPA), Finland (Kaj Bärlund), India (Z. R. Ansari), and the Netherlands (Ed Nijpels) had decided to make an effort for a joint platform in preparing the financing system for the Montreal Protocol. That kind of a procedure in international negotiations has been a rare occurrence, at best.

Soon after the Helsinki Conference of the Parties, Finland convened a meeting in Geneva for representatives of the four countries, and a short text was agreed upon. Ambassador Ristimäki then started conversations in Nairobi with the clear-headed Ambassador of Mexico, Juan Antonio López Mateos, that country holding the presidency of the Group of 77, consisting of developing countries. With some nudging from China and India, 'G-77 and China' adopted the Geneva platform. After that, with the main guidelines already widely accepted, negotiations concentrated on the nuts and bolts of technical aspects and proceeded very well.

The last fence to cross was in London, when the World Bank was lobbying hard for the Global Environment Facility (which had not been formally established) to become the financial mechanism. With Ristimäki's careful navigation, the London Conference agreed on an intergovernmental Secretariat for the Financing Mechanism to be based in Montreal, the establishment of which was carried out by Finland. The Group of 77 would not have agreed to the GEF here because it did not exist yet. Being based in Nairobi, Ristimäki worked closely with Dr Tolba and got his enthusiastic support for this process. In London, India's representative was Minister Maneka Gandhi, and the Netherlands was represented by Minister Hans Alders.

Ristimäki was supported in this process by Ms Aira Kalela, a high-ranking official at the Ministry of the Environment, Professor Antti Kulmala from the Finnish Meteorological Institute (both of them were key negotiators), and myself from the Ministry for Foreign Affairs as spokesman for Finland in the Plenary. Our excellent, memorable counterparts included above

all Madhava Sharma, Additional Secretary at the Ministry of Environment of India, who later became head of the Ozone Secretariat at UNEP, and the young lawyer-diplomat Ms Song Li at the Foreign Ministry of China, who later joined the United Nations and ended up in a high position at the World Bank. Naturally, we also became close personal friends.

WORKING WITH DR TOLBA

My personal relationship with Dr Tolba was truly enriching, and it was he who pushed for my recruitment as Chief, Clearinghouse Unit, after he got to know me at the meeting of the Montreal Protocol in Helsinki. During a few consultancy weeks in 1990 in Nairobi, I learned that he wanted me to play a key role as UNEP's spearhead in the creation of the Global Environment Facility (GEF).

I started as a staff member on 1 January 1991, and already on the first working day, on 2 January, I was representing UNEP in New York in a working meeting between UNDP, the World Bank, and UNEP, to start planning the GEF operations. I was flanked by Dr Robert Watson, NASA's leading expert on stratospheric ozone depletion, already then envisaged by Dr Tolba as the person who should lead the scientific advisory process to the GEF. I accompanied Dr Tolba to a meeting in early 1991 at the World Bank headquarters in Washington, DC, when he signed the founding declaration of the GEF with Barber Conable, President of IBRD, and Theodore Draper, Administrator of UNDP. While the GEF idea was precooked at the World Bank, Dr Tolba certainly defended environmentally sound parameters in preparation for that meeting, and at the meeting itself.

Dr Tolba was strong in giving detailed feedback on staff reports and initiatives, at least my own ones, but he may have overestimated the capacity of UNEP regular staff to contribute to the GEF. He himself was up to date with the most modern technological means and policies of communication, but had difficulty making UNEP as an organization do the same. Dr Tolba established a completely new GEF Unit, and I was to be its Chief, in addition to the work for which I had been recruited. Quickly I had to recruit staff for the GEF Unit, and had to rely much on (very) short-term consultants.

Dr Pak Sum Low was one key member of my team, and the two of us, with Dr Ramachandran from WMO, prepared the GEF funding document for developing country participation in the IPCC process. Our proposal was originally opposed by the World Bank, but support from UNDP and Dr Watson, who had become Chair of the Scientific and Technical Advisory Panel (STAP) of the GEF, and Chair of IPCC, helped to get it approved. This financing made it possible for developing country scientists to fully take part in the IPCC process for the Second Assessment Report (1995). Without the full participation of developing country scientists, IPCC reports would have been lacking in political acceptance, and could also have been short on scientific support.

Dr Tolba gave me much independence, but when scientific issues started to cause friction with the institutional interests of other partners, it became customary for UNEP to have a senior staff member to accompany me (as an 'overcoat'), while I still was responsible for the statements and positions, with my own professional support staff.

An early success for Dr Tolba, UNEP and STAP were to influence the World Bank so that they stopped trying to leverage regular lending by the GEF add-ons, a practice which would not have been sustainable. Had Tolba remained at UNEP, this body might have had a stronger environmentally normative profile in the GEF, instead of being somewhat marginalized by the World Bank. However, the World Bank eventually 'greened' quite a bit, perhaps also thanks to their GEF experience, with its science-based priorities and portfolio reviews, and Dr Watson becoming Director of the Environment Department.

When Dr Tolba left UNEP in 1992, I truly was lost, feeling that I no longer had high-level support in defending the scientific integrity of the GEF process. Dr Tolba had always been quick to understand complex scientific, multidisciplinary issues, with his background as Under-Secretary of Higher Education in Egypt. It was a clever choice by Dr Tolba to promote Dr Robert Watson to head STAP of the GEF, which the United States readily accepted, and eventually Dr Watson was called by President Bill Clinton to become his Science and Technology Adviser and had to leave STAP. The Asian members in the first STAP were Dr Yingzhong Lu, a nuclear scientist from China; Dr Amulya J. K. Reddy, an energy expert from India; Dr Edgardo Gomez, a marine biologist from the Philippines; and Dr Michio Hashimoto, an environmental policy expert from Japan. It was a great privilege to work closely with Dr Tolba in setting up STAP in consultation with governments. Dr Tolba also assigned me to provide the Secretariat to STAP. I also helped to set up the second STAP for 1995–1996, Dr Emil Salim of Indonesia being the Asian member of the Search Committee. The confirmed Asian members of the second STAP were Professor Jyoti K. Parikh, an energy expert from India; Dr Mohd Nor Salleh, a forestry specialist from Malaysia; Professor Chirico Watanabe from Japan; and Professor Helen T. Yap, a marine biologist from the Philippines.

Remembering Dr Mostafa Kamal Tolba

SÁLVANO BRICEÑO

I first met Dr Tolba when I attended the 1978 UNEP Governing Council meeting in Nairobi, representing the Government of Venezuela. At my first international meeting, 29 years old, I was strongly impressed by his gentle and diplomatic manner coupled with shrewd and canny negotiating skills. Between 1978 and 1983, I met with him regularly at UNEP meetings and must admit, I kept learning from his selling capacities.

Little did I know that a few years later, in 1986, I was going to be hired by him to conduct, as its first Coordinator, the Caribbean Environment Programme, based in Kingston, Jamaica, my first UN job. In that capacity, our interaction, of course, evolved into a closer and more personal relationship. In our discussions in Nairobi, I was often accompanied by two other shrewd managers, Stjepan Keckes and Tony Brough, who usually smiled as I tried to convince Dr Tolba of something they knew he would probably not agree with. In perspective, I must recognize that whenever I was not able to convince him, at least I left having learned a lot from his arguments and reasoning.

During my tenure in the Caribbean, Dr Tolba helped me greatly in many ways, in particular in dealing with major countries, which usually were more concerned for their own national priorities and less inclined to accept the general interest that multilateral environmental negotiations represented for humankind, mainly due to their fear of having to foot the bill. Instead of accepting the will of the majority and then looking for more open or universal ways of sharing the cost, they tended to close the door too early, hindering a more positive outcome. Dr Tolba was one of the few international managers I knew who was able to convince them to go along and, in consequence, allow for a substantive investment in environmental projects around the world.

Dr Tolba belonged to a generation of international civil servants that not only effectively led international organizations and programmes but also managed to change international policy-making. It was the time of the Cold War, though, when the United Nations had a greater role to play.

Following many successes in facilitating international negotiations, and after 17 years at the helm of UNEP, Dr Tolba lost support from key governments, which preferred to shift negotiations, in particular on climate change, to the UN Secretariat, withdrawing from UNEP one of its major areas of involvement. Coupled with a few other divergences, it led to his decision to separate from UNEP, which I believe was a trying experience for him. He left, however, a solid and impressive legacy that still infuses UNEP's work, as well as the work of ministries of environment around the world.

Remembering Dr Mostafa Kamal Tolba

NAIGZY GEBREMEDHIN

An obituary in a leading international paper referred to Dr Tolba as 'The Green Giant'– an apt moniker. He was a gentle Green Giant, but one who demanded much from his staff members. I had the fortune to serve under him for 17 years at the headquarters of the United Nations Environment Programme (UNEP) in Nairobi, Kenya. In retrospect, it was an exciting time.

One of his favourite admonishments was to remind us all 'not to dig shallow wells'. I got the sense that he expected us to strive for depth and thoroughness in carrying out our assigned duties.

He read everything submitted to him with meticulous care: page after page coming back, marked with that ubiquitous red pen of his. He found time for everything and everyone. I remember once receiving a heavily edited draft statement I had submitted for his comments. In the corner of the draft he had entered the day and time he had read it … Sunday at 2:00 a.m. From then on, I simply gave up complaining about working long hours. If he, a much older person, with so much more responsibility, could stay up late working on a Sunday … why shouldn't I?

He expected programme officers to defend the format and substance of the programme for which they were responsible. These presentations took place periodically in front of the entire programme staff. Dr Tolba's questions were always thorough and relentless.

He directed his sharpest comments to the presumptuous: those who assumed that their Oxford or Cambridge accents imbued them with innate intellectual depth. In the end, whatever our individual accents were, we all buckled down and learned not to dig shallow wells. That life-long lesson continues to serve us well, years after Dr Tolba's tutorials at UNEP headquarters.

Dr Mostafa Kamal Tolba graduated from Cairo University in 1943, after which he earned his Doctor of Science degree from Imperial College. He taught at Cairo and Baghdad universities, and after serving in government in various capacities, including one as chairman of Egypt's Olympic Committee, led his country's delegation to the Stockholm World Environment conference in 1972. He joined UNEP as Deputy Executive Director, and later took over the leadership from Maurice Strong. He led UNEP for 17 years, retiring in 1992.

Dr Tolba had an amazing understanding of the environment. He was convinced that the environment was not a 'sector', like education, agriculture, population, or the welfare of children. As a 'cross-cutting' issue, it needed to be housed in an institution able to influence – subtly but effectively – the work of specialized UN agencies (like the World Health Organization or the Food and Agriculture Organization). In partial fulfilment of his conviction, he pioneered a complex and ambitious System-wide Medium-term Environment Programme, or SYMTEP. Programme officers worked hard with their respective partners in the specialized agencies, to define and implement SYMTEP. It was not an easy task, but clearly, it was the right thing to do.

He shunned the pressure to turn UNEP into a specialized agency because, he argued, it would lose its critical role to influence specialized agencies. The UNEP Dr Tolba envisioned was an intricate organization with an incredibly complex mandate. Only the genius of Dr Tolba could make it work effectively.

He worked brilliantly to build consensus. He pioneered, indeed, created 'environmental diplomacy', making it an effective tool for global environmental protection. Among his successes were the Vienna Convention for the Protection of the Ozone Layer (1985) and its Montreal Protocol on Substances that Deplete the Ozone Layer (1987); the Convention on Biological Diversity (1992); the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1989); and almost ten conventions to protect regional seas, such as the Mediterranean and the Red Sea. He led teams that developed action plans to protect regional waters, such as the Zambezi Action Plan and the Chad Basin Action Plan. Without Dr Tolba's active participation, the United Nations Convention to Combat Desertification would not have been set in motion.

Codification is the final, possibly the most challenging stage in a continuum that identifies, analyses, organizes, and prioritizes environmental protection issues. Most efforts end up midway. Dr Tolba made sure that the organization he led for 17 years, UNEP, ran the full course. He was never one to dig a shallow well, after all.

I said he found time for everything and everyone. I would like to share one encounter that reminds me of this generous quality. It was during a difficult time in my life. I had lost my father and was unable to travel to Ethiopia to bury him because of the political turmoil underway at the time. I was walking along the corridor when I met Dr Tolba. He greeted me warmly and asked if I could walk with him to his car. As we walked he said something that I had never expected. He said that he had been thinking about me and was saddened by the fact that the rules of equitable geographic distribution (the euphemism for the 'quota' system) would make it difficult for him to recommend my promotion to the Director (D2) level. However, he had just received a note from Geneva to recommend a candidate for the position of Director of the United Nations Disaster Relief Organization (UNDRO). Dr Tolba said he would be sad to see me leave UNEP, but if I wanted it, he would recommend me. Here was a man with so many pressing responsibilities and yet he had my interest at heart. I was deeply touched. I went back to my room and 'communed' with my father in spirit, telling him not to worry about me because I was in good hands. True to his word, Dr Tolba sent in the recommendation. I never got the position, however … and it was just as well. I stayed in UNEP four years beyond Dr Tolba's retirement. And I never told the gentle Green Giant about my father. In some ways, I regret that.

The gentle Green Giant died on 28 March 2016. A Facebook admirer wrote, 'Even giants need to rest'. The world is fortunate: he inspired a generation of environmental practitioners to go beyond the first stages of the action continuum and proceed to the ultimate, decisive action**: Codification**. He was the scientist who became the father of environmental diplomacy.

Acronyms and abbreviations

AASHE	Association for the Advancement of Sustainability in Higher Education
AATHP	ASEAN Agreement on Transboundary Haze Pollution
ABC	Australian Broadcasting Corporation
ACA	Agency for Cultural Affairs
ACIAR	Australian Centre for International Agricultural Research
ADB	Asian Development Bank
ADC	Austrian Development Cooperation
Adh	Alcohol dehydrogenase
AERB	Atomic Energy Regulation Board
AfDB	African Development Bank
AF	Adaptation Fund
AHTEG-BDCC	Ad Hoc Technical Expert Group on Biological Diversity and Climate Change
AIIB	Asian Infrastructure Investment Bank
AILAC	Independent Association of Latin America and the Caribbean
AIT	Asian Institute of Technology
ALBA	Bolivarian Alliance for the Peoples of Our America
ALGAS	Asia Least-cost Greenhouse Gas Abatement Strategy
AMS	ASEAN Member States
ANU	Australian National University
ANZSEE	Australia-New Zealand Society for Ecological Economics
AOSIS	Alliance of Small Island States
A-P	Asia and the Pacific
APEC	Asia-Pacific Economic Cooperation
AR	Annual Report
AR5	Fifth Assessment Report
AREAS	Asian Rhino and Elephant Action Strategy
ARECOP	Asia Regional Cookstove Programme
ASEAN	Association of Southeast Asian Nations
asl	above sea level
ATREE	Ashoka Trust for Research in Ecology and the Environment
AusAID	Australian Agency for International Development
AvH	Alexander von Humboldt
BAF	Biosecurity Authority of Fiji
BASIC	Brazil, South Africa, India and China
BBC	British Broadcasting Corporation
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BCCRF	Bangladesh Climate Change Resilience Fund
BCCTF	Bangladesh Climate Change Trust Fund

BCE	Before the Common Era
BEE	Bureau of Energy Efficiency
BPBD	Badan Penanggulangan Bencana Daerah (Regional Disaster Management Agency)
BPoA	Barbados Programme of Action
BRI	Belt and Road Initiative
BTI	Bhutan Transparency Initiative
C40	Cities climate action network
C2ES	Center for Climate and Energy Solutions
CAIT	Climate Analysis Indicators Tool
CANSEE	Canadian Society for Ecological Economics
CARICOM	Caribbean Community
CAS	Complex Adaptive Systems
CAT	Climate Action Tracker
Cb	Cumulonimbus
CBD	Convention on Biological Diversity
CC	Climate Change
CCCCC	Caribbean Community Climate Change Centre
CCS	Carbon Capture and Storage
CDM	Clean Development Mechanism
CDP	Carbon Disclosure Project
CEA	Central Electricity Authority
CECR	Centre for Environment and Community Research
CEDAW	Convention on the Elimination of All Forms of Discrimination against Women
CEEST	Centre for Energy, Environment, Science and Technology (Tanzania)
CENWOR	Centre for Women Research
CEPF	Critical Ecosystem Partnership Fund
CER	Certified Emission Reduction
CERED	Centre for Environment Research, Education and Development
CFC	Chlorofluorocarbon
CIFOR	Centre for International Forestry Research
CIS	Colo-i-Suva forest reserve
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMA	China Meteorological Administration
CNR	Consiglio Nazionale delle Ricerche
COP	Conference of Parties
COP10	Tenth Session of the Conference of the Parties
CORRENSA	Collaborative Regional Research Network in South Asia
CoV	Coefficient of Variation
CPC	Communist Party of China
CRU	Climatic Research Unit
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSOs	Civil Society Organizations
DAC	Development Assistance Committee
DAL	Department of Agriculture and Livestock
dbh	diameter at breast height
DEQP	Department of Environment Quality Promotion
DFID	Department for International Development
DG	Director-General
DGPC	Druk Green Power Corporation
DIE	Direct Access Entity

DISCOM	Distribution Company
DMH	Department of Meteorology and Hydrology
DNV	Det Norske Veritas
DoE	Department of Environment
DoF	Department of Forests
DPRK	Democratic People's Republic of Korea
DPSEE	Driving Force, Pressure, State, Exposure and Effects
DPV	Discounted Present Value
EAs	Executing Agencies
EAEC	East Asian Economic Caucus
EBA	Endemic Bird Areas
EBRD	European Bank for Reconstruction and Development
EC	European Commission
ECLAC	Economic Commission for Latin America and the Caribbean
Ecodev	Ecology and Economic Development Company Limited
ECOSOC	United Nations Economic and Social Council
EEZ	Exclusive Economic Zone
EGTT	Expert Group on Technology Transfer
EHCA	Eastern Himalayas Conservation Alliance
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
ENERGIA	International Network on Gender and Sustainable Energy
ENSO	El Niño Southern Oscillation
EOS	Earth Observing System
EPI	Environmental Performance Index
ESD	Education for Sustainable Development
ESDIS	Earth Science Data and Information System
ESI	Environmental Sustainability Index
ESMAP	Energy Sector Management Assistance Programme
ESP	European Society for Photobiology
EU	European Union
ETM+	Enhanced Thematic Mapper Plus (Landsat 7)
FAO	Food and Agricultural Organization of the United Nations
FDI	Foreign Direct Investment
FINNIDA	Finnish International Development Agency
FREDA	Forest Resource Environment Development and Conservation Association (Myanmar)
FSU	Former Soviet Union
FS-UNEP	Frankfurt School-United Nations Environment Programme Centre
FYP	Five-Year Plan
G7	Group of Seven (advanced economies, without Russia)
G8	Group of Eight (industrialized nations, with Russia)
G20	Group of Twenty (leading economies)
G77	Group of developing nations (now with more than130 members)
GARP	Global Atmospheric Research Programme
GBCA	Green Building Council of Australia
GBRMPA	Great Barrier Reef Marine Park Authority
GCF	Green Climate Fund
GCP	Gross Cogenerated Power
GDI	Gender Development Index
GDP	Gross Domestic Product

GEF	Global Environment Facility
GEM	Global Earthquake Model
GFDRR	Global Facility for Disaster Reduction and Recovery
GHGs	Greenhouse gases
GII	Gender Inequality Index
GIS	Geographic Information System
GISP	Global Invasive Species Programme
GMO	Genetically Modified Organism
GNH	Gross National Happiness (Bhutan)
GNHC	Gross National Happiness Commission
GNI	Gross National Income
GNP	Gross National Product
GPS	Global Positioning System
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit GmbH (German Agency for Technical Cooperation)
GWP	Global Warming Potential
GOMA	Gallery of Modern Art
HCFC	Hydrochlorofluorocarbon
HDI	Human Development Index
HEC	Higher Education Commission
HESS	Pakistan Household Energy Strategy Study
HFCs	Hydrofluorocarbons
HI	High-Income
HIV/AIDS	Human Immunodeficiency Virus Infection and Acquired Immune Deficiency Syndrome
HLPF	High-Level Political Forum
HQ	Headquarters
IA	Implementing Agency
IAEA	International Atomic Energy Agency
IAP	Indoor Air Pollution
IAS	Invasive Alien Species
IASWG	Invasive Alien Species Working Group
IAU	International Association of Universities
ICA	Intelligence Community Assessment
ICCCAD	International Centre for Climate Change and Development
ICIMOD	International Centre for Integrated Mountain Development
ICJ	International Court of Justice
ICL	International Consortium on Landslides
ICRAF	International Centre for Research in Agroforestry (became World Agroforestry Centre in 2002)
ICSU	International Council for Science (formerly International Council for Scientific Unions)
ICVBC	Institute for the Conservation and Valorization of Cultural Heritage
IDB	Inter-American Development Bank
IDRL	International Disaster Response Laws, Rules and Principles programme
IEA	International Energy Agency
IEMP	International Ecosystems Management Partnership
IFAD	International Fund for Agricultural Development
IFC	International Finance Corporation
IFRC	International Federation of the Red Cross and Red Crescent Societies
IGCMC	Indira Gandhi Conservation Monitoring Centre
IGO	Intergovernmental Organization
IHDI	Inequality Adjusted Human Development Index
IIED	International Institute for Environment and Development

IIGCC	Institutional Investors Group on Climate Change
IISc	Indian Institute of Science
IISS	International Institute for Strategic Studies
IIT	Indian Institute of Technology
ILA	International Law Association
ILC	International Law Commission
ILO	International Labour Organization
IMF	International Monetary Fund
IMO	International Maritime Organization
INDC	Intended Nationally Determined Contribution
INSTAAR	Institute of Arctic and Alpine Research
IOC	Intergovernmental Oceanographic Commission
IPCC	Intergovernmental Panel on Climate Change
IRDR	Integrated Research on Disaster Risk
IRENA	International Renewable Energy Agency
IRRI	International Rice Research Institute
ISC	International Science Council
ISRO	Indian Space Research Organization
ISSC	International Social Science Council
IST	Indian Standard Time
IT	Information Technology
IUCN	International Union for Conservation of Nature
IUFRO	International Union of Forest Research Organizations
IVALSA	Istituto per la Valorizzazione del Legno e delle Specie Arboree (Italian) (Trees and Timber Institute)
IVL	Swedish Environmental Research Institute
IWRAW	International Women's Rights Action Watch
JICA	Japan International Cooperation Agency
JPoI	Johannesburg Plan of Implementation
JMA	Japan Meteorological Agency
KJMA	Koalisi Jambi Melawan Asap (Jambi Coalition Against Smoke)
KP	Kyoto Protocol
KPK	Khyber Pakhtunkhwa
LA21	Local Agenda 21
L&D	Loss and Damage
LANCE	Land, Atmosphere Near real-time Capability for Earth Observing System
LCC	Life Cycle Costing
LDCs	Least Developed Countries
LDCF	Least Developed Countries Fund
LEAD	Leadership for Environment and Development
LFP	Labour Force Participation
LFPR	Labour Force Participation Rate
LI	Low-Income
LIFE	Life International Foundation for Ecology
LMB	Lower Mekong Basin
LMDC	Like-Minded Developing Countries
LMP	Land Management Programme
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MAB	Man and Biosphere Programme
MAIRS	Monsoon Asia Integrated Regional Study

MASP	Mapping Agriculture Systems Project
MCCW	Myanmar Climate Change Watch
mcwb	moisture content wet basis
MDG	Millennium Development Goal
MEA	Millennium Ecosystem Assessment
MEAs	Multilateral Environmental Agreements
MEE	Ministry of Ecology and Environment
MERGeR	Marine Ecological Resilience and Geological Resources
MI	Middle-Income
MIE	Multilateral Implementing Entities
MIGA	Multilateral Investor Guarantee Agency
MIT	Massachusetts Institute of Technology
MNRE	Ministry of New and Renewable Energy
MoA	Ministry of Agriculture
MoAF	Ministry of Agriculture and Forests
MODIS	Moderate Resolution Imaging Spectroradiometer
MoFA	Ministry of Foreign Affairs
MoEFCC	Ministry of Environment, Forest, and Climate Change
MoLHR	Ministry of Labour and Human Resources
MP	Member of Parliament
MPCs	Master-Planned Communities
MRC	Mekong River Commission
MRV	Measurement, Reporting and Verification
NAPCC	National Action Plan for Climate Change
NASA	National Aeronautics and Space Administration
NAZCA	Non-State Actor Zone for Climate Action
NBCA	National Biodiversity Conservation Areas
NBL	North Bank Landscape (Brahmaputra River)
NBSAP	National Biodiversity Strategy and Action Plan
NC	National Communication
NCEA	National Commission for Environmental Affairs
NDC	Nationally Determined Contribution
NEA	National Environment Agency
NEC	National Environment Commission
NESDB	National Economic and Social Development Board
NGO	Non-Governmental Organization
NIAS	National Institute of Advanced Studies
NIE	National Implementing Entity
NISAP	National Invasive Species Action Plan
NORAD	Norwegian Agency for Development Cooperation
NSB	National Statistics Bureau
NZ	New Zealand
OCHA	Office for the Coordination of Humanitarian Affairs
ODA	Official Development Assistance
ODS	Ozone Depleting Substances
OECD	Organization for Economic Cooperation and Development
OGM	Oil, Gas and Mining
4-P	Place, Programme, People and Perception
PABITRA	Pacific-Asia Biodiversity Transect Network
PCD	Pollution Control Department

PES	Payments for Ecosystem Services
PFC	Plant Functional Complexity
PFT	Plant Functional Type
pH	Hydrogen ion concentration
PHI	Poverty Headcount Index
PIC	Products of Incomplete Combustion
PIER	Pacific Island Ecosystems at Risk
PII	Pacific Invasive Initiative
PILN	Pacific Invasive Learning Network
PNG	Papua New Guinea
PNGRIS	Papua New Guinea Resource Information System
PPEW	Platform for the Promotion of Early Warning
PPP	Public-Private Partnership
PPPUS$	Purchasing Power Parity US$
PRC	People's Republic of China
PRISMSS	Pacific Regional Invasive Species Management Support Service
PRSP	Poverty Reduction Strategy Paper
PWHR	Pressurized Heavy Water Reactor
RAF	Resource Allocation Framework
R&D	Research and Development
RCE	Regional Centre of Expertise on Education for Sustainable Development
REDD	Reducing emissions from deforestation and forest degradation
REDD+	Reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries
RGB	Royal Government of Bhutan
RIBA	Royal Institute of British Architects
RIMES	Regional Integrated Multi-Hazard Early Warning System (Thailand)
Rio+20	United Nations Conference on Sustainable Development
RPO	Renewable Purchase Obligation
RWEDP	Regional Wood Energy Development Programme
SAARC	South Asian Association for Regional Cooperation
SAGAR	Security and Growth for All in the Region
SAR	Special Administrative Region
SBI	Subsidiary Body for Implementation
SBSTA	Subsidiary Body on Scientific and Technological Advice
SCBD	Secretariat of the Convention on Biological Diversity
SCCF	Special Climate Change Fund
SC/DRR	Steering Committee for Disaster Risk Reduction
SCOPE	Scientific Committee on Problems of the Environment
SD	Sustainable Development
SDC	Swiss Agency for Development and Cooperation
SDG	Sustainable Development Goal
SDSN	Sustainable Development Solutions Network
SEADRIF	Southeast Asia Disaster Risk Insurance Facility
SEB	State Electricity Board
SEC	Securities and Exchange Commission
SEEPP	Social, Economic, Environmental, Physical and Political
SE4ALL	Sustainable Energy for All
SELF	Solar Electric Light Fund
SERD	School of Environment, Resources and Development

SFDRR	Sendai Framework for Disaster Relief Risk Reduction
SGESE	School of Geography, Earth Science and Environment
SIDA	Swedish International Development Cooperation Agency
SIDS	Small Island Developing States
SLCP	Sloping Land Conversion Programme
SLI	Sejahtera Leadership Initiative
SNR	Strict Nature Reserve
SOAS	School of Oriental and African Studies
SPC	Secretariat of the Pacific Community
SPICES	Spiritual, Physico-Psychological, Intellectual, Cognitive, Cultural, Ethical, Emotional, Ecological, Economic and Societal
SPREP	South Pacific Regional Environment Programme
SSTA	Sea Surface Temperature Anomalies
STAP	Scientific and Technical Advisory Panel
TCB	Tourism Council of Bhutan
TCG	Tripartite Core Group
TDRI	Thailand Development Research Institute
TEC	Tsunami Evaluation Coalition
THK	Tri Hita Karana
TM	Thematic Mapper (Landsat)
TGICA	Task Group on Data and Scenario Support for Impact and Climate Assessment
TNRICP	Tokyo National Research Institute for Cultural Properties
TWAS	The World Academy of Sciences
UCA	University of Central Asia
UEA	University of East Anglia
UK	United Kingdom
UN	United Nations
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNCC	United Nations Compensation Commission
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development
UNCLOS	United Nations Convention on the Law of the Sea
UNCSD	United Nations Commission on Sustainable Development
UNCTAD	United Nations Conference on Trade and Development
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
UNEP	United Nations Environment Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNGA	United Nations General Assembly
UN-Habitat	United Nations Human Settlements Programme
UNHCHR	UN High Commissioner for Human Rights
UNICEF	United Nations Children's Fund
UNIDO	United Nations Industrial Development Organization
UNISDR	United Nations International Strategy for Disaster Reduction
UNODC	United Nations Office on Drugs and Crime
UNREDD	United Nations Reducing Emissions from Deforestation and Forest Degradation
UQ	University of Queensland

USA	United States of America
USD	United States Dollar
USGS-NPS	United States Geological Survey – National Park Service
USM	Universiti Sains Malaysia
USP	University of the South Pacific
UV	Ultraviolet
UV-B	UV radiation wavelengths 280–315 nm
VAR	Vector Autoregressive
VLCL	Varsity Lakes Community Limited
WAAS	World Academy of Art and Science
WAIM	World Academy of Islamic Management
WB	World Bank
WCDR	World Conference on Disaster Reduction
WCED	World Commission on Environment and Development
WCP	World Climate Programme
WCRP	World Climate Research Programme
WCDR	World Conference on Disaster Reduction
WCED	World Commission on Environment and Development
WCMC	World Conservation Monitoring Centre
WEDO	Women's Environment and Development Organization
WEF	World Economic Forum
WEN	Wood Energy News
WFP	World Food Programme
WHO	World Health Organization
WIM	Warsaw International Mechanism
WMO	World Meteorological Organization
WOCAN	Women Organizing for Change in Agriculture and Natural Resource Management
WRI	World Resources Institute
WRM	World Rainforest Moment
WSSD	World Summit on Sustainable Development
WTO	World Trade Organization
WTTC	World Travel and Tourism Council
WWAP	World Water Assessment Programme
WWF	World Wide Fund for Nature

SI prefixes

Prefix	Abbreviation	Factor
deca-	da	10
hecto-	h	10^2
kilo-	k	10^3
mega-	M	10^6
giga-	G	10^9
tera-	T	10^{12}
peta-	P	10^{15}
exa-	E	10^{18}
deci-	d	10^{-1}
centi-	c	10^{-2}
milli-	m	10^{-3}
micro-	μ	10^{-6}
nano-	n	10^{-9}
pico-	p	10^{-12}
femto-	f	10^{-15}
atto-	a	10^{-18}

Unit abbreviations

Linear measure	
millimetre	mm
centimetre	cm
decimetre	dm
metre	m
kilometre	km
Square measure	
square metre	m^2
kilometre	km^2
hectare	ha
Cubic measure	
cubic centimetre	cm^3
cubic metre	m^3
Capacity measure	
millilitre	ml
litre	l
Weight	
milligram	mg
gram	g
kilogram	kg
gigagram	Gg
tonne	t
dry tonne	dt
Other units	
pascal	Pa
joule	J
watt	W
kilowatt	kW
kilowatt of electricity	kWe
megawatt	MW
kilowatthour	kWh
terawatthour	TWh
second	s
year	yr

Chemical formulae

CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
K	potassium
N	nitrogen
NO	nitrogen oxide
N_2O	nitrous oxide
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
O_2	oxygen
O_3	ozone
OH	hydroxyl radical
P	phosphorus
Si	silicon