

PATHWAYS TO SUSTAINABILITY



# **DYNAMIC SUSTAINABILITIES**

**Technology, Environment,  
Social Justice**

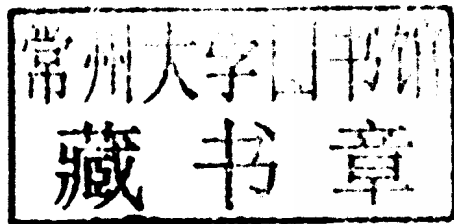
**Melissa Leach, Ian Scoones  
and Andy Stirling**

# Dynamic Sustainabilities

---

Technology, Environment, Social Justice

*Melissa Leach, Ian Scoones  
and Andy Stirling*



**earthscan**

publishing for a sustainable future

London • Washington, DC

First published in 2010 by Earthscan

Reprinted 2010

Copyright © M. Leach, I. Scoones and A. Stirling, 2010

The moral rights of the authors have been asserted.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, except as expressly permitted by law, without the prior, written permission of the publisher.

Earthscan Ltd, Dunstan House, 14a St Cross Street, London EC1N 8XA, UK  
Earthscan LLC, 1616 P Street, NW, Washington, DC 20036, USA  
Earthscan publishes in association with the International Institute for Environment and Development

For more information on Earthscan publications, see [www.earthscan.co.uk](http://www.earthscan.co.uk) or write to [earthinfo@earthscan.co.uk](mailto:earthinfo@earthscan.co.uk)

ISBN: 978-1-84971-093-0

Typeset by 4word Ltd, Bristol, UK  
Cover design by Susanne Harris

A catalogue record for this book is available from the British Library

Library of Congress Cataloging-in-Publication Data

Leach, Melissa.

Dynamic sustainabilities : technology, environment, social justice / Melissa Leach, Ian Scoones and Andy Stirling.  
p. cm.

Includes bibliographical references and index.

ISBN 978-1-84971-092-3 (hbk.) – ISBN 978-1-84971-093-0 (pbk.)

1. Sustainable development. 2. Economic development—Environmental aspects.  
3. Poverty. 4. Social justice. I. Scoones, Ian. II. Stirling, Andy. III. Title.

HC79.E5L393 2010

338.9'27—dc22

2010000818

At Earthscan we strive to minimize our environmental impacts and carbon footprint through reducing waste, recycling and offsetting our CO<sub>2</sub> emissions, including those created through publication of this book. For more details of our environmental policy, see [www.earthscan.co.uk](http://www.earthscan.co.uk).

Printed and bound in the UK by MPG Books,  
an ISO 14001 accredited company.  
The paper used is FSC certified.



‘The twin challenges of sustainability and ensuring that science and technology contribute to poverty reduction and social justice in a complex and dynamic environment are re-framed in this book. The alternative narratives offered are to be commended for showing that new thinking can lead to change.’

**David J. Grimshaw, Head of International Programme (New Technologies) at Practical Action, and Senior Research Fellow (New and Emerging Technologies) at the Department for International Development**

‘This book should be welcomed by all who take an holistic view of sustainable development and poverty reduction. For those of us rooted in the Appropriate Technology movement, the STEPS team provide analytical rigour for the notion that technological “silver bullets” are misconceived and that technology users have a range of options. Drawing from across disciplines, *Dynamic Sustainabilities* provides a contemporary approach to understanding the complicated and ever-changing world we live in; one which explicitly recognizes that there are different ways of understanding the world, and that development is indeed a political process.’

**Andrew Scott, Policy and Programmes Director, Practical Action**

‘Melissa Leach, Ian Scoones and Andy Stirling of the STEPS Centre put the finger on a fundamental challenge. How can we ensure that science and technology in a highly complex, dynamic and interconnected world help improve livelihoods and social justice in the quest for social-ecological sustainability? In their pathways to sustainability approach they constructively suggest novel and practical ways forward for issues like empowerment, styles of knowledge-making, governance, political engagement simultaneously confronting uncertainty, ambiguity and ignorance in comprehensive case studies. Their way of “normative framing” provides inspiring and significant food for thought and action. Highly recommended reading!’

**Carl Folke, Stockholm Resilience Centre and the Beijer Institute of Ecological Economics**

‘The old economic models are unlikely to serve us well on a planet of six billion, rising to nine billion people by 2050. A systems approach catalysing a transition to a low carbon, resource efficient, Green Economy is the only approach possible if all societies are to thrive let alone survive through the 21st century. *Dynamic Sustainabilities: Technology, Environment, Social Justice* outlines the challenges and barriers but also the pathways and opportunities to realize that change not least through illuminating real-world case studies. In doing so it offers a counterpoint to those trapped in old patterns of development and an inspiration to those keen to embrace a paradigm shift.’

**Achim Steiner, UN Under-Secretary General and Executive Director UN Environment Programme (UNEP)**

‘This book addresses critical issues associated with transitioning to a more sustainable world. It is both conceptual and practical – exactly what is needed to address issues such as climate change, food and water security and human health.’

**Professor Robert Watson, Chief Scientist, DEFRA**

‘This book provides orientation in a complex and uncertain world full of contradictions and ambiguous developments. It takes inclusive governance based on public participation, diversity of values and institutional plurality as an opportunity rather than a risk. Offering a new perspective on social capacity as the main resource for sustainability, the authors have produced an academically fascinating analysis and an innovative set of practical recommendations that link the dynamic interactions between social, technological and ecological processes and facilitate the transition to an alternative, progressive future.’

**Ortwin Renn, Director of the Interdisciplinary Research Unit on Risk Governance and Sustainable Technology Development, University of Stuttgart, Germany**

‘The recent confluence of crises – in financial, climate and social systems – has boosted political will to make fundamental institutional changes. Our leaders know that fixing the banks is not enough. Whether the political and business space is labelled “green economy”, “high-sustainability recovery” or simply “sustainable development”, a lot now rests on the pathways that will be taken by enlightened leaders. But their courage is also not enough, and – in a fast-changing world – neither is clinging to previous practices that had once helped them to muddle through. There is a need for sound theory and good empirical evidence if we are to make progress with confidence: Leach, Scoones and Stirling offer considerable conceptual advances of real value in this accessible volume.

**Steve Bass, Senior Fellow, International Institute for Environment and Development (IIED)**

# Dynamic Sustainabilities

# Pathways to Sustainability Series

---

This book series addresses core challenges around linking science and technology and environmental sustainability with poverty reduction and social justice. It is based on the work of the Social, Technological and Environmental Pathways to Sustainability (STEPS) Centre, a major investment of the UK Economic and Social Research Council (ESRC).

The STEPS Centre brings together researchers at the Institute of Development Studies (IDS) and SPRU (Science and Technology Policy Research) at the University of Sussex with a set of partner institutions in Africa, Asia and Latin America.

## **Series Editors:**

Melissa Leach, Ian Scoones and Andy Stirling  
STEPS Centre at the University of Sussex

## **Editorial Advisory Board:**

Steve Bass, Wiebe E. Bijker, Victor Galaz, Wenzel Geissler, Katherine Homewood, Sheila Jasanoff, Colin McInnes, Suman Sahai, Andrew Scott

## **Titles include:**

*Dynamic Sustainabilities*

*Technology, Environment, Social Justice*

Melissa Leach, Ian Scoones and Andy Stirling

*Avian Influenza*

*Science, Policy and Politics*

Edited by Ian Scoones

*Rice Biofortification*

*Lessons for Global Science and Development*

Sally Brooks

*Epidemics*

*Science, Governance and Social Justice*

Edited by Sarah Dry and Melissa Leach

# Preface and Acknowledgements

---

Linking environmental sustainability with poverty reduction and social justice, and making science and technology work for the poor, have become central practical, political and moral challenges of our times. These must be met in a world of rapid, interconnected change in environments, societies and economies, and globalized, fragmented governance arrangements. Yet despite growing international attention and investment, policy attempts often fail. Why is this, and what can be done about it? How might we understand and address emergent threats from epidemic disease, or the challenges of water scarcity in dryland India? In the context of climate change, how might seed systems help African farmers meet their needs, and how might appropriate energy strategies be developed?

This book offers a new ‘pathways approach’ to address sustainability challenges such as these, in today’s dynamic world. It lays out a framework for understanding and action that embraces the dynamic interactions between social, technological and ecological processes; takes seriously the ways that different people and groups understand and value these; and recognizes the political choices and institutional and governance requirements for seeking out pathways to sustainability. And it suggests a series of ways forward – in tools and methods, forms of political engagement, and styles of knowledge-making and communication – to enable a more inclusive politics of sustainability, and support for alternative, progressive pathways.

This is the first book in the Pathways to Sustainability series, and it lays out some of the conceptual and practical concerns picked up in subsequent volumes. As such, the book is very much a collective effort which draws on thinking and debate among members and partners of the STEPS Centre during its first few years. Like the STEPS Centre itself, the book also builds on longer-term strands of work at IDS and SPRU. These include work on environmental policy processes based in the Knowledge, Technology and Society Team at IDS; work on science and citizenship conducted under the auspices of the IDS-based Citizenship Development Research Centre; and work on energy systems appraisal and policy within the Sussex Energy Group at SPRU. We would like to acknowledge the contributions to this book of the following STEPS Centre members, past and present: Gerald Bloom, Adrian Ely, Henry Lucas, Fiona Marshall, Lyla Mehta, Erik



Millstone, Synne Movik, Hayley MacGregor, Paul Nightingale, Esha Shah, Adrian Smith, Sigrid Stagl, John Thompson, Linda Waldman and William Wolmer. We would also like to thank the following colleagues for their insights and contributions, especially as part of various review processes: Robert Chambers, James Fairhead, Wim van Damme, Katherine Homewood, David Leonard, Gordon McKerron, Alan Nicol, Geoff Tansey, Steve Bass and Andrew Scott, as well as other members of the STEPS Centre Advisory Committee. Our grateful thanks are also due to Harriet Le Bris, Naomi Vernon and Julia Day for supporting the process of editing and production.

# List of Acronyms and Abbreviations

---

BSE	bovine spongiform encephalopathy
CSERGE	Centre for Social and Economic Research on the Global Environment
DRC	Development Research Centre
ESRC	Economic and Social Research Council
FSR	Farming Systems Research
GM	genetically modified
GOARN	Global Outbreak Alert and Response Network
GRIP	(World Bank's) Grass Roots Immersion Programme
HPAI	highly pathogenic avian influenza
IAASTD	International Assessment of Knowledge, Agriculture, Science and Technology for Development
IDS	Institute of Development Studies
logframe	logical framework
MCM	multicriteria mapping
PRA	participatory rural appraisal
RRA	rapid rural appraisal
SARS	severe acute respiratory syndrome
SPRU	Science and Technology Policy Research
SSP	Sardar Sarovar Project
STEPS	Social, technological and environmental pathways to sustainability
TAC	Treatment Action Campaign
UNEP	United Nations Environment Programme

# Glossary

---

(Italicized terms are cross-referenced to their own individual definitions)

- ambiguity*: a state of knowledge in which there are acknowledged to exist divergent, equally valid ways to *frame* different possible outcomes.
- designs*: deliberate configurings of *social appraisal*, which may include a variety of methods and processes, involving qualitative interpretation or quantitative analysis and specialist expertise as well as inclusive participation.
- durability*: a *dynamic property* of a *system* involving the ability to sustain structure or functional value by controlling sources of long-term *stress*.
- dynamic property*: a feature of the *dynamics* of a *system* or its behaviour or context, for instance in the face of *shocks* or *stresses*.
- dynamics*: patterns of complex interaction and change observed in the behaviour over time of social, technological and environmental systems.
- environment*  
(of a system): those relevant parts of the external world which are seen in any given context to interact with a *system*.
- framing*: the different ways of understanding or representing a social, technological or natural *system* and its relevant *environment*. Among other aspects, this includes the ways system elements are bounded, characterized and prioritized, and meanings and *normative* values attached to each.
- governance*: political and institutional relationships including those of power and knowledge.
- ignorance*: a state of knowledge combining aspects both of *uncertainty* about probabilities and *ambiguity* over outcomes – in other words: exposure to the possibility of surprise.
- incomplete knowledge*: a general state of knowledge, which may take the form of various combinations of more specific conditions of *risk*, *uncertainty*, *ambiguity* or *ignorance*.

<i>normative:</i>	relating to norms, standards, priorities, values and meanings as embodied in contrasting ways in different institutional interests or social perspectives.
<i>pathways:</i>	the particular directions in which interacting social, technological and environmental <i>systems</i> co-evolve over time.
<i>reflexivity:</i>	recognition that <i>framings</i> of a <i>system</i> are partly constituted by the observer's own circumstances and so are conditioned by (as well as inform) intended action.
<i>resilience:</i>	a <i>dynamic property</i> of a <i>system</i> involving the ability to sustain structure or functional value by responding effectively to short-term episodic <i>shocks</i> .
<i>risk:</i>	a state of knowledge in which possible outcomes are held to be well characterized and it is also possible confidently to determine the probabilities associated with each.
<i>robustness:</i>	a <i>dynamic property</i> of a <i>system</i> involving the ability to sustain structure or functional value by responding effectively to long-term enduring <i>stress</i> .
<i>social appraisal:</i>	social processes, including tools and methods, through which knowledges are gathered and produced, learning performed and meanings constructed in ways that inform decision making and wider institutional commitments.
<i>stability:</i>	a <i>dynamic property</i> of a <i>system</i> involving the ability to sustain structure or functional value by controlling sources of short-term episodic <i>shocks</i> .
<i>sustainability:</i>	a normatively explicit form of the general term, referring to the capability of maintaining over indefinite periods of time specified qualities of human well-being, social equity and environmental integrity.
<i>shock:</i>	a short-term transient perturbation in conditions experienced by a <i>system</i> .
<i>stress:</i>	a long-term secular shift in conditions experienced by a <i>system</i> .
<i>system:</i>	a particular configuration of dynamic interacting social, technological and environmental elements.
<i>uncertainty:</i>	a state of knowledge in which possibilities are held to be well characterized, but there is little basis for assigning probabilities.

# Contents

---

<i>List of Figures, Tables and Boxes</i>	<i>vii</i>
<i>Preface and Acknowledgements</i>	<i>ix</i>
<i>List of Acronyms and Abbreviations</i>	<i>xi</i>
<i>Glossary</i>	<i>xiii</i>
1 Sustainability Challenges in a Dynamic World	1
2 Dynamic Systems: Environment and Development Challenges	15
3 Pathways to Sustainability: Responding to Dynamic Contexts	37
4 Governance in a Dynamic World	65
5 Opening Up, Broadening Out: Empowering Designs for Sustainability	99
6 An Alternative Politics for Sustainability	125
7 Towards Pathways to Sustainability	155
<i>Notes</i>	<i>173</i>
<i>References</i>	<i>175</i>
<i>Index</i>	<i>205</i>

# List of Figures, Tables and Boxes

---

## Figures

3.1	Multiple framings	44
3.2	Variability in assessment of policy options for electricity supply	50
3.3	Variation in policy judgements on alternative agricultural policy options	52
3.4	Dimensions of incomplete knowledge	53
3.5	GM foods and crops: Dimensions of incomplete knowledge in African settings	56
3.6	Avian and human pandemic influenza: Dimensions of incomplete knowledge	58
3.7	Dynamic properties of sustainability	59
3.8	Combining dynamic properties of sustainability	62
4.1	Closing down towards risk	79
4.2	Closing down towards planned equilibrium	84
5.1	Characteristics of appraisal methods	106
5.2	Appraisal methods for addressing contrasting aspects of incomplete knowledge	109
5.3	Permutations of breadth and openness in appraisal	122
6.1	Three lenses on the policy process	130
6.2	Types of knowledge-making	152
7.1	Realizing pathways to sustainability	170

## Tables

3.1	Creating narratives: Practices	46
4.1	Comparing adaptive, deliberative and reflexive approaches to governance	95
5.1	Examples of appraisal approaches	101
5.2	Framing effects in appraisal	112
5.3	Empowering designs: Five principles, two cases and some questions	121

6.1	Policy spaces – and strategies for opening them up	138
7.1	Water resources in dryland India: Dominant and alternative narratives	158
7.2	Seeds in Africa: Dominant and alternative narratives	160
7.3	Epidemics and health systems: Dominant and alternative narratives	163
7.4	Energy and climate: Dominant and alternative narratives	165

## **Boxes**

3.1	Dimensions of framing	45
-----	-----------------------	----

## *Chapter 1*

# Sustainability Challenges in a Dynamic World

---

Today's world is highly complex and dynamic. Environmental conditions are changing fast as water, land and other ecological systems interact with climate change and new patterns of disease incidence. Developments in science and technology are proceeding faster than ever, with the spread of technologies shaped by new and often highly globalized patterns of investment and information. Social systems are changing rapidly too, linked to population growth, urbanization and market relationships. Such dynamics are, in turn, driven by shifting patterns of mobility – of people, practices, microbes, ideas and technologies – and globalized economic change, as some areas of the world transform, while others remain in deep poverty.

Yet the policies and institutions that have to deal with this new dynamic context are often premised on far more static views of the world. Where the rapidity of change is acknowledged, it is often seen to follow relatively clearly determined, single linear trajectories. Either way, assumptions of stability, equilibrium and predictable, controllable risks dominate. Yet the failures of such approaches to intervention and policy are everywhere to see. Simple blueprints, technological fixes or the transfer of technologies and regulations developed elsewhere frequently fail to work and create further problems. Standard approaches all too often betray their intended beneficiaries. Complex, dynamic contexts often undermine the neat assumptions of imported models. Emerging backlashes – from nature, from social movements, from politics – reveal this widening gap between standard policy approaches and dynamic systems.

Indeed, a major contradiction is emerging in contemporary responses to environment and development challenges. On the one hand, there is now a wide recognition of growing complexity and dynamism – evident across high science, popular media and the experiences of daily life. On the other hand, there appears to be an ever-more urgent search for big, technically driven managerial solutions – whether in the form of 'magic bullet' seeds and drugs, continent-wide roll-outs of high-impact solutions or top-down emergency-type responses aimed at shoring up stability and providing



security. When such responses falter in the face of local dynamics and uncertainties, the response tends to be to implement with greater force or to blame locals or critics – rather than to question the underlying assumptions. The result can be a perpetuating cycle that narrows options, excludes alternative and dissenting voices, and fails to learn from mistakes and failures. This matters because it ultimately fails to tackle big problems of environment and development that affect us all, while often perpetuating inequalities and injustices.

All this raises some major policy and development challenges. For instance, how are shifting human–animal interactions and food production systems altering the likelihood of new global pandemics? How can the world respond to these interactions in ways that do not constrain poor people's livelihoods and freedom? What are the challenges of sustainability in rapidly growing Asian cities? As technology and economic growth bring wealth for some, how can the fall-out for those living on the margins – in overcrowding, pollution, ill-health and hazard – be addressed? How are farmers in dry parts of Africa coping with the challenges of climate change and disease? Can the potentials of new agricultural and health biotechnologies be harnessed to help, or will they provoke new uncertainties and missed opportunities to build on farmers' own adaptations? And how, in a world of rapidly advancing technologies and markets for drugs, seeds, energy and water use, can supply and regulatory arrangements be developed that suit the interests of the poor? How must global models of regulation be rethought to work in dynamic social and political settings? And how can these models respond to poorer and marginalized people's own perspectives on risk and uncertainty, grounded in their everyday lives and livelihoods?

Today, such questions are becoming ever more pressing. This book offers a way of thinking about these core relationships between ecology, technology, poverty and justice in a world of pervasive and growing inequality. Our starting point is that linking environmental sustainability with poverty reduction and social justice, and making science and technology work for people who are poor have become central practical, political and moral challenges of our times. We argue that meeting these challenges in a dynamic world requires an approach that embraces the dynamic interactions between social, technological and ecological processes; takes seriously the ways that diverse people and groups understand and value these; and acknowledges the role of economic and institutional power in shaping the resulting choices. In short, we need to recognize the essentially plural and political nature of our quest for pathways to sustainability.