

Climate Change Management

Walter Leal Filho *Editor*

Innovation in Climate Change Adaptation

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Preface

It is widely believed that climate change is one of the most important challenges of modern times. Its origins are global in scope, in the sense that greenhouse emissions, coupled with unsustainable models of development—most of which based on the depletion of natural resources and ecosystems—lead to disruptions in eco-geological cycles and to substantial changes in weather conditions. These, combined with socio-economic problems such as poverty and limited access to technologies, are leading to losses in agriculture production, reductions in water availability, sea level rise and damages to properties due to extreme events, among others.

There are currently hundreds of projects being undertaken around the world, focusing on matters related to climate change. They include both, schemes focusing on mitigation as well as on adaptation. Global expenditures on climate change are well in excess of US\$ 5 billion per year, a substantial proportion of which to fund projects in developing countries. Most of these schemes focus on capital projects on infrastructure, as well as schemes in the field of agriculture, water/rainwater or on research aimed at making fossil energy technologies cleaner and less harmful to the people. This includes photovoltaics, post-combustion capture of CO₂ from engines or power plants, and direct removal of greenhouse gases from the atmosphere, among others. A number of projects have therefore a technological focus, also based on the premise of agencies such as the Organisation for Economic Cooperation and Development (OECD), which believe that technological change is one of the keys to ensuring that climate change can be addressed without compromising economic growth.

But apart from technology-based initiatives, there is a perceived need to find new, innovative ways to pursue climate change adaptation. We need, in other words, more innovation in climate change, especially in respect of adaptation. The problem is that even though innovation on climate change adaptation has proven successful in a number of ways, and that there are many initiatives which show how effective it can be, there are very few publications which have focused on this topic.

This book fills in the gap. It gathers a set of 25 chapters from authors from various continents, which show how innovation in processes, in planning, use of resources or use of existing technologies, can help to foster climate change adaptation.

Bearing in mind the broad field of innovation on climate change, this book is divided into two parts. Part I, with chapters 1–11, deals with a wide range of innovation issues related to climate change adaptation, in different contexts, such as planning, reforms, technology and transformative processes. It also considers the environmental, social and economic elements which are associated with the implementation of some innovative approaches to climate change adaptation here documented, with examples from various parts of the world.

Part II, with chapters 13–25, focuses on innovation in sectorial approaches to adaptation, such as in agriculture and city planning. It also includes the health sector, an area which is often overlooked during discussions on climate change adaptation plans. Moreover, changes in organisations are also outlined in one of the chapters, a pre-condition for successful institutional climate change adaptation plans. Similarly to Part I, the second part of the book also contains examples and case studies from a wide range of countries and contexts.

Among other issues, one of the main lessons from this book is that innovative approaches to climate change adaptation also need to consider the acceptability issue, which varies substantially among countries and social groups and is influenced by various social and cultural factors. We need a greater willingness to adapt and to be creative in finding unconventional ways to use innovation to the advantage of climate change adaptation. Indeed, if innovation on climate change adaptation is to become more common and more widely practised, knowledge and communication gaps between citizens and policy makers also need to be reduced.

I want to thank all authors for sharing their know-how, as well as for the support they provided in producing this book. I hope this publication will provide a valuable support to international climate change adaptation efforts and will foster the use of innovative approaches round the world.

Hamburg, Germany
Winter 2015/2016

Walter Leal Filho

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Part I
Innovation in Planning, Reforms,
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Chapter 1

Innovative Approaches to Climate Change Adaptation

Walter Leal Filho

Abstract The process of climate change adaptation is characterised by a great deal of complexity. Its successful implementation may only be achieved by a combination of a wide range of approaches, methods and processes. Climate change adaptation also needs innovation. Based on the perceived need to explore the links between climate change adaptation and innovation, this paper defines how innovation can support climate change adaptation, and suggest a variety of approaches which may help to realise its potential.

Keywords Climate change • Innovation • Adaptation • Urban environment

Introduction

Thanks partly to the wide body of research and data deriving from many studies on the origins and consequences of climate change, the theme as a whole and its impacts in particular, has become very prominent. Indeed, as shown in Table 1.1, there has been a noticeable increase in the levels of emphasis and awareness about climate change over the past 25 years, which allows one to conclude that the topic has evolved considerably since 1990. Indeed, the current level of international interest afforded to this topic and the high levels of expenditures on climate change mitigation and adaptation allows one to conclude that climate change has become one of the most prominent scientific themes of modern times.

In addition to the increases in temperatures, which most people associate with climate change, some of the major challenges seen in this field include sea level rise, increases in the frequency of extreme events such as intense rainstorms, floods,

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Table 1.1 Increases in the emphasis given to climate change: 1990–2015

Items	Stand in 1990	Stand in 2015
Level of government interest	Low	High
Level of government commitment to climate change goals	Low (UNFCCC was approved at UNCED in Rio in 1992)	High
Levels of expenditures on climate change projects	Low, little statistics available	High, many statistics available
Level of public interest	Very low	High
Media coverage	Sporadic	Intensive
Engagement from developing countries	Low	Very high

droughts, and heat waves (Local Governments for Sustainability et al. 2013; Jabareen 2013; European Commission 2013c), among others. Impacts may also be seen in areas as varied as ecosystems and biodiversity, agriculture and forestry, water resources, marine resources and fisheries, which have been the subject of much research. In addition, they also affect at different levels of intensity areas such as:

- (a) Tourism
- (b) Energy supply
- (c) The built environment and infrastructure
- (d) Human health
- (e) Land management
- (f) Regional planning and
- (g) Insurance services (ETAP 2014)

It is here appropriate to remind that despite the wide range of affected areas, most people tend to associate climate change predominantly with increases in temperature. An example of this trend is the fact that a study performed in a number of European cities reported that 81 % of surveyed cities have experienced periods of very hot weather or heat waves, 78 %—flooding from heavy rainfall, 69 %—storms (Perks 2013).

In some occasions, climate change may lead to semi-permanent or permanent damages to economic activities and livelihood (such as in agriculture). In other areas—such as tourism—climate change may also yield positive impacts, since moderate temperature increases in temperate countries may help in the development of more tourism activities. Figure 1.1 illustrates the interrelations between these two (i.e. positive and negative) examples of climate change impacts from an economic standpoint.

Over and above the direct impacts of climate change, many communities face its indirect effects such as increased strains on materials and equipment, higher peak electricity loads (and their timing), voltage fluctuations, transport disruptions, increased need for emergency management, diminished air quality, and sub-optimal performance of key infrastructure (IPCC 2014; NPCC 2009, Wardekker et al. 2003 in Jabareen 2013; Perks 2013). Therefore, they are required to be more resilient and prepared to address the threats head-on, otherwise many

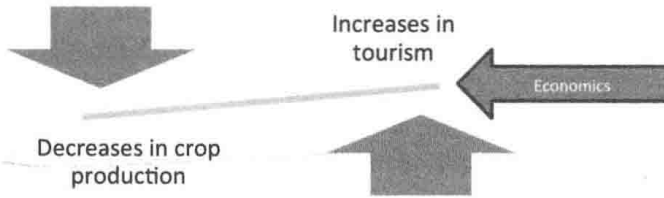


Fig. 1.1 Interrelations of climate change impacts

communities—especially in the developing world—are more and more likely to become even more vulnerable to risks (UNISDR 2010 in Jabareen 2013).

The most common approaches to address climate change impacts are mitigation and adaptation, whereas adaptation measures are considered as an indispensable complement to climate mitigation strategies (European Commission 2013b).

Adaptation may be defined as an adjustment in natural or human systems—in both urban and rural areas—in response to actual or expected climatic stimuli or their effects. This adjustment is needed in order to moderate (or alleviate) the potential negative consequences of climate change, or exploits beneficial opportunities (such as the example provided in the tourism sector). Climate change adaptation increases the ability of individuals, groups, or organizations to cope with current and future changes (Perks 2013; European Commission and European Environmental Agency 2015; Kazmierczak and Carter 2010). Adaptation approaches may include, for instance, the development or adoption of a technology and/or capacity building in form of improved risk management or knowledge enhancement (West and Gawith 2005 in Tompkins and Eakin 2012).

The development of an adaptation strategy that defines the main stages required to be fully implemented, is one of the initial steps in pursuing it. It is important to note that adaptation strategies are influenced by a variety of factors, which are illustrated in Table 1.2.

Other factors could be added to the list summarised in Table 1.1, whereas a deeper look at specific issues such as the limited emphasis to research on climate change adaptation in the countries which needs it most, is also needed. Also, the importance of well prepared climate change adaptation strategies cannot be emphasised often enough. Paradoxically, despite their relevance and the key role they can play, there are either non-existing or—when they do—not properly implemented.

One of the examples of an adaptation strategy for a whole region is a document produced by the European Commission, namely the “EU Strategy on Adaptation to Climate Change”. It aims to make Europe more climate-resilient (European Commission 2015). In particular, the document highlights the importance of implementing adaptation measures at city level (European Commission 2013c). Among the main actions of the EU Adaptation Strategy are:

- Bridging the knowledge gap,
- Facilitating the climate-proofing of the Common Agricultural Policy (CAP), and

Table 1.2 Some of the factors which influence adaptation strategies

Factors	Variable	Consequences
Geographical location	Developing countries more severely affected	More intensive climate change impacts
Access to financing	Unbalanced access	Some countries better able to finance adaptation than others
Access to technologies	Unbalanced access	Some countries better able to use innovation than others
Government climate change policies	When absent, lack of targets or a basis for long-term action	No guidance as to what needs to be done and where
Public awareness about climate change and its impacts	Lack of awareness perpetuates some practices	Increased vulnerability (e.g. buildings in river catchment area)
Knowledge basis	When low, limited capacity to adapt	Greater vulnerability and lower resilience

- Ensuring more resilient infrastructure and promoting insurance and other financial products for resilient investment and business decisions (European Commission 2013d).

But despite the progresses seen in the past, many needs regarding the development and the implementation of climate change adaptation remain today. Therefore, innovative ways to look at the problem and at its various variables, are needed. The subsequent parts of this paper will thus look at how innovation can assist climate change adaptation, focusing on some key areas.

Innovation in Climate Change Adaptation

Innovation can be defined as a process via which specific developments (or changes) in ways to handle a process, an issue or a problem, may take place. Innovation processes differ from others since they are continuous and tend to evolve. They sometimes—but not always—are connected with technologies. Indeed, much innovation is process-based.

In the particular case of climate change adaptation, innovation may have a technical/technological and a non-technical dimension. Technological innovation is on the one hand expensive and requires investments many countries are not promptly willing to make, but it could lower the cost of achieving environmental objectives, on the other. In cases where the estimated costs of reducing greenhouse gas emissions are influenced by the technological trajectory of a country's economy, technological innovation can offer the chance to leap frog from a given problem (for instance, dependence on coal fired power stations), going straight to its technical solution (e.g. use of hydroenergy to generate energy and to reduce emissions).

Due to their closeness, technological and non-technological adaptation options should be seen in a combined matter, both being therefore the emphasis of this chapter. The subsequent description will be divided into three different categories, all of which focusing on infra-structure: **soft non-structural or ‘social’ infrastructure approaches, grey and green infrastructures.**

Soft Non-structural or ‘Social’ Infrastructure Approach

The soft non-structural or ‘social’ infrastructure approach corresponds to the design and implementation of procedures, and employing, inter alia, land-use controls, information dissemination and economic incentives, to:

1. Reduce vulnerability
2. Encourage adaptive behaviour and
3. Avoid maladaptation

Some of these measures can facilitate the implementation of grey or green approaches (Local Governments for Sustainability et al. 2013; ACT—Adapting to Climate change in Time 2014).

Among the measures being applied at present, mentioned can be made to awareness raising campaigns. One example is the campaign. “The Netherlands Live with Water” (Kazmierczak and Carter 2010). Here the innovation is seen in respect of the active engagement of the relevant stakeholders (e.g. public, business), coupled with gathering data and information and defining baselines, which can be used for the development of climate change action plans, policies and standards.

In terms of policies and standards, **Eurocodes** can be mentioned as an example. It is a set of European Standards (EN) for the structural design of buildings and civil engineering works, produced by the European Committee for Standardisation (CEN) to be used in the European Union. They provide the requirements for mechanical strength, stability and safety as basis for design and engineering contract specifications (European Commission 2013a). Taking into account the damages climate can lead to both property and infra-structure, such standards can be very helpful. And so can tools such as

Insurance. It support adaptive practices by helping to manage climate change risks, providing incentives for climate risk prevention and disseminating information on climate change risks and risk prevention measures (European Commission 2013a). Moreover, **building codes and zoning** could directly regulate housing and indirectly influence housing markets through transportation and infrastructure planning and investment (World Bank 2011), also bearing in mind possible influences of climate change.

One of the examples of soft approaches implementation is development of proactive **heat alert system** in Toronto, Canada. The Heat-Health Alert system relies on computer modelling of various weather factors, including apparent temperature (a measure of human discomfort due to combined heat and humidity),