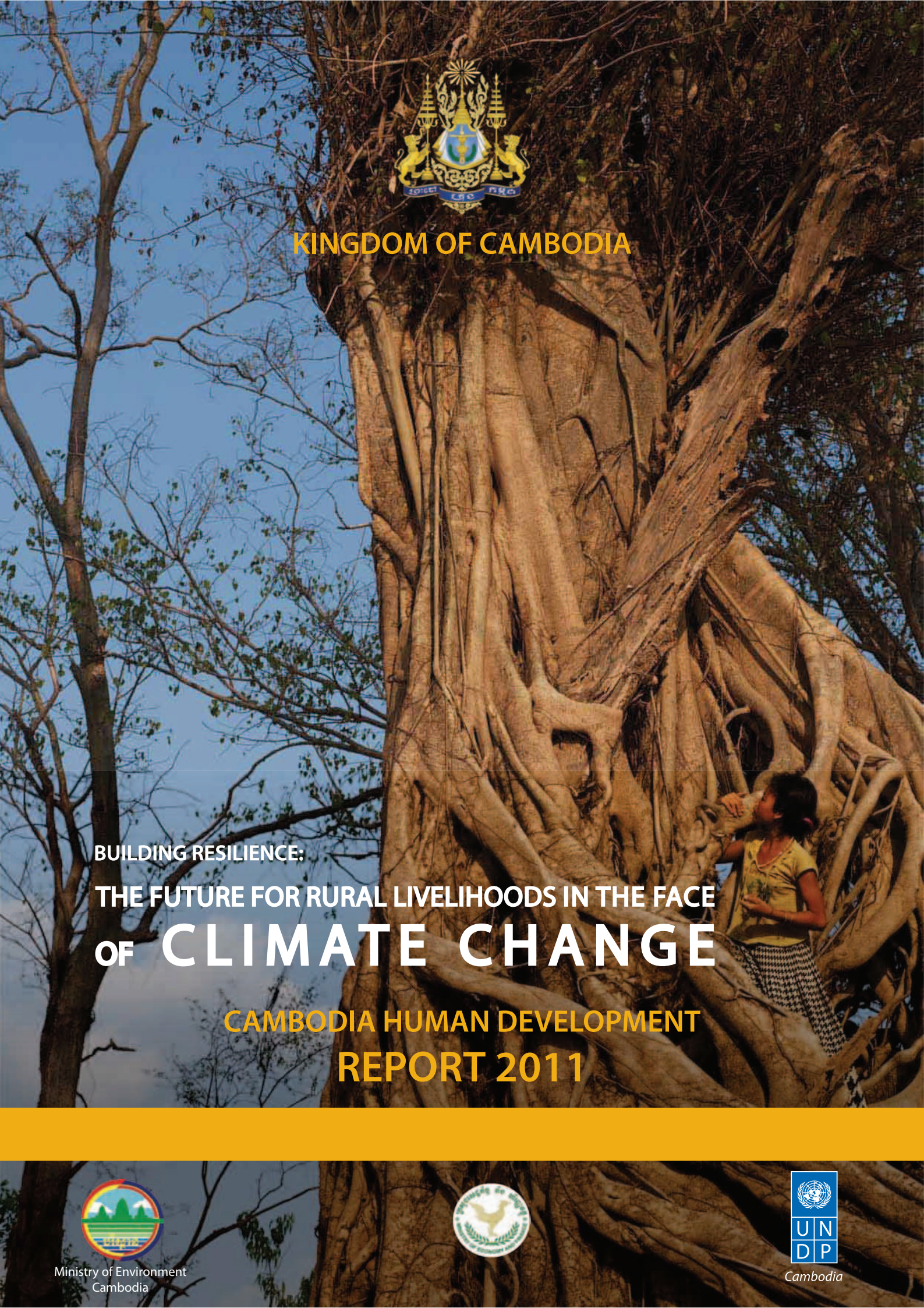

KINGDOM OF CAMBODIA

BUILDING RESILIENCE:

THE FUTURE FOR RURAL LIVELIHOODS IN THE FACE OF CLIMATE CHANGE

CAMBODIA HUMAN DEVELOPMENT REPORT 2011

Ministry of Environment
Cambodia

UNDP
Cambodia

CAMBODIA HUMAN DEVELOPMENT REPORT 2011
Building Resilience: The Future of Rural Livelihoods in the Face of Climate Change

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BUILDING RESILIENCE

THE FUTURE OF RURAL LIVELIHOODS IN THE FACE OF CLIMATE CHANGE

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Climate change can no longer be denied or simply ignored.
It is real, it is happening now, and it is as much
a human development issue as
it is an environmental issue.

The *Cambodia Human Development Report* is about people's well-being. This is an in-depth, national policy analysis document. This report will inform Cambodia's responses to the development challenges of climate change at all levels, changing people's perceptions of what this will mean for their futures.

FOREWORD

Around the world, climate change has become the focus of urgent discussion and action. It presents a multi-dimensional challenge, but can also be seen as providing opportunities. Dealing with climate change marks a new paradigm for development. While the more visible impacts of climate change on the country are only now emerging, Cambodia has been active in taking measures to address climate change for more than a decade.

Recent natural phenomena, such as the delayed rains in 2010, further demonstrate the extreme dependence of rural people's well-being on the regularity of seasons, controlled by the climate, and the availability of natural resources like water. The late onset of the rainy season resulted in record-low water levels on the Tonle Sap and Mekong Rivers, and raised concerns in the public media regarding climate change. Many poor farmers were already in a tenuous position, having lost their crops in the previous year to the highly unusual and devastating Typhoon Ketsana in September 2009.

It is in this context that the topic of climate change, with an emphasis on adaptation, was selected for this Cambodia Human Development Report (CHDR), with a particular focus on the implications and opportunities for livelihoods in rural areas, where many of Cambodia's human development challenges lie.

National Human Development Reports (NHDRs) apply the human development approach to specific development challenges that particular countries face. They are independent and neutral, prepared through a process of research, analysis and consultation, supported by UNDP, but involving a wide range of national stakeholders from the government, civil society and the private sector. The overall purpose of NHDRs is to introduce the concept of human development into national policy dialogue, and to open a public platform for such dialogue.

Climate change is a relatively new area of study in Cambodia, but the potential threats arising from such change could be devastating to agricultural communities. At the same time, as a result of the development of the REDD (Reducing Emissions from Deforestation and Forest Degradation) financing mechanism, emergence of carbon markets and increasing donor funds for climate change mitigation and adaptation, new opportunities are becoming available to Cambodia.

In producing this CHDR, the emphasis has been on initiating a process to open up debate on the implications of climate change for rural livelihoods, and the potential for building resilience. The report was guided by a multi-sectoral Senior Advisory Panel drawn from various Ministries, development partners, NGOs, academic institutions, and private companies, and drafted with technical inputs from multiple sources. In addition, focused consultations were held with a variety of experts on health,

agriculture, forestry, water, social protection and climate change, complemented by interviews with rural Cambodians and development practitioners on their personal experiences and perspectives.

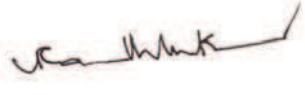
It is important to note that the CHDR is a companion report to Cambodia's Second National Communication (SNC) to the United Nations Framework Convention on Climate Change (UNFCCC). It is firmly rooted in the science and findings of the SNC, but this report takes a human development perspective, based on a Human Development Index (HDI) carried out in partnership with the Ministry of Planning (MoP) and the National Committee for Sub-National Democratic Development (NCDD).

With the ever-growing interest in and recognition of climate change challenges across the country and the region, the importance of viewing and discussing these challenges through a human development 'lens' has become particularly apparent. This approach, which both examines the dimensions of people's well-being beyond their income and promotes the active role of households and communities in decisions affecting their livelihoods, allows us to take a broader view, to link the analysis to the sustainability of progress and to develop well informed policies in an inclusive and responsive manner. It also allows us to see the differences and disparities between areas and population groups affected to differing degrees by shocks and crises arising from climate change.

This CHDR has been prepared with several diverse audiences in mind. This is a document for policy makers, development organisations, civil society, students and academic figures. Additional materials derived from this report will bring the dialogue to rural communities, who will be most severely affected by climate change, as well as to the youth of Cambodia, who will continue to be affected by climate change. This report provides a basis for sustained and informed learning and dialogue on climate change and human development in Cambodia.

Working together we actively seek to stimulate debate on the report's recommendations in different forums, and hope that it will engage Cambodians throughout the country as well as international partners in creating opportunities that strengthen and advance human development as the country adapts to climate change.

H.E. Keat Chhon
Deputy Prime Minister
Minister of Economy and Finance



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ACRONYMS AND ABBREVIATIONS

ACIAR	Australian Centre for International Agricultural Research
ADB	Asian Development Bank
ASEAN	Association of Southeast Asian Nations
CARD	Council for Agriculture and Rural Development
CBD	Convention on Biological Diversity
CBHI	Community Based Health Initiatives
CDB	Commune Database
CDM	Clean Development Mechanism
CDRI	Cambodia Development Research Institute
CEDAC	Centre d'Etude et de Développement Agricole Cambodgien (Cambodian Centre for Study and Development in Agriculture)
CFs	Community Forests
CFi	Community Fishery
CHDR	Cambodia Human Development Report
CH4	Methane
CISRO	Commonwealth Scientific and Industrial Research Organisation (Australia)
CLUP	Commune land use planning
CMDG	Cambodia Millennium Development Goals
CNMC	Cambodian National Mekong Committee
CO_2	Carbon dioxide
CPAs	Community Protected Areas
D&D	Decentralization and Deconcentration
DRR	Disaster risk reduction
EC	Enterprise centres
ECHAM	European Centre Hamburg Model
EIA	Environmental impact assessment
FA	Forest Administration
FBAs	Farmer Business Advisors
FiA	Fisheries Administration
FO	Farmer Organisation

GDP	Gross domestic product
GHG	Greenhouse gas
HDI	Human Development Index
HEF	Health Equity Funds
ICZM	Integrated coastal zone management
ILO	International Labour Organization
IPCC	Intergovernmental Panel on Climate Change
IWRM	Integrated Water Resources Management
JICA	Japan International Cooperation Agency
KAP	Knowledge, attitudes and practices
MAFF	Ministry of Agriculture, Forestry and Fisheries
MEF	Ministry of Economy and Finance
MIME	Ministry of Industry, Mines and Energy
MoE	Ministry of Environment
MoH	Ministry of Health
MoWRAM	Ministry of Water Resources and Meteorology
MRC	Mekong River Commission
NCCC	National Committee on Climate Change
NCDM	National Committee for Disaster Management
NSDP	National Strategic Development Plan
OAA	Other aquatic animals
OECD	Organisation for Economic Co-operation and Development
REDD	Reduced Emissions from Deforestation and Degradation
RGC	Royal Government of Cambodia
SEA	Strategic environmental assessment
SLMC	State Land Management Committee
SNC	Second National Communication (to the UNFCCC)
TSA	Tonle Sap Authority
UNDP	UN Development Programme
UNEP	UN Environment Programme
UNFCCC	UN Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
WB	World Bank
WFP	World Food Programme
WHO	World Health Organization
WSSD	World Summit on Sustainable Development

EXECUTIVE SUMMARY

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Even though Cambodia is changing rapidly and the distinctions between urban and rural are becoming less clear, most people continue to depend on a rural economy and natural resources.

Climate change is real, and by all accounts is already being felt in Cambodia. Assessments by scientists (MoE 2002, 2005 and 2010) and perceptions of rural people (MoE/BBC Trust 2011) themselves point to significant and recent changes that are compelling people to take action. In turn, these changes have far-reaching implications for rural livelihoods in Cambodia – and for the future of national development.

The focus in this *Cambodia Human Development Report* (CHDR) is on climate change and rural livelihoods. While this captures only part of the picture of climate change in Cambodia, it is an essential starting point. Even though Cambodia is changing rapidly and the distinctions between rural and urban are becoming less clear, most people continue to depend on a rural economy and natural resources. Although numerous transformations have occurred in this area in recent years, the rural economy remains the cornerstone of national development (UNDP 2009a, WB 2009c).

Overall, Cambodia has experienced one of the highest rates of economic growth in the world and has made important progress in tackling poverty (MoP 2010). But performance has not been even, and costs have been significant. Many aspects of human development remain precarious, and many people remain poor or vulnerable to becoming poor in the face of shocks and crises.

Climate change is a global challenge, but many of the effects will be felt most acutely by poorer countries

and poorer people (WB 2010, IPCC 2007). While the international community struggles to formulate the kinds of binding commitments that might be able to halt further climate change, the emphasis for action is shifting toward national adaptation, mitigation where possible, and building resilience.

The CHDR aims to contribute to more informed public debate in Cambodia by discussing what will be required to build climate-resilient rural livelihoods in the country that will contribute to meeting long-term development objectives.

Climate change: A development challenge for Cambodia

The term 'climate change' has a very specific meaning. While the climate of the earth has always gone through periods of change, scientific evidence now demonstrates that the changes we are now witnessing – and that are termed **'climate change'** – are the result of man-made actions related to industrialisation, deforestation and changes in land use (IPCC 2001). Moreover, these changes are of a pace and magnitude that the world has never before experienced, and they are irreversible.

Our understanding of the science of climate change has improved enormously in recent years. The most comprehensive scientific review in Cambodia thus far was prepared in 2010 by the Royal Government of Cambodia (RGC), as the Second National Communication (SNC) to the United Nations Framework Convention on Climate Change (UNFCCC). It clearly demonstrates that temperatures in the country have risen steadily over the last 50 years and that **"rapid increase in temperature is expected to occur after 2030"** (MoE 2010). Rainfall patterns are also shifting (Eastham et al 2009). Predicted changes for the future also need to be considered alongside more recent changes.

The ecological landscape of Cambodia has changed dramatically over the last 30 years, possibly influencing changes in more localised weather patterns. With the forces of global climate change and local ecological change coming together in Cambodia, the climate of the future will be markedly different from that of the recent past.

This Human Development Report looks at climate change as a human development challenge. There are two aspects in responding to this challenge:

- To **address current vulnerabilities,** and the kinds of shocks and crises associated with climate change; and
- To **forge a new development pathway** for the future that is resilient to climate change, and that also reduces poverty, ensures equity and secures livelihoods.

These two dimensions are of particular importance from the human development perspective, which puts people at the centre of development and for which sustainability, equity and empowerment are key elements.

Human development is defined in the 2010 global Human Development Report as:

"...the expansion of people's freedoms to live long, healthy and creative lives; to advance other goals they have reason to value; and to engage actively in shaping development equitably and sustainably on a shared planet. People are both the beneficiaries and the drivers of human development as individuals and in groups."

Limited adaptive capacity[1] is arguably the main factor in Cambodia's vulnerability to climate change. This is related to limited capacity at all levels, and deep-rooted and longstanding challenges: persistent poverty according to key indicators; inequality; insecure access to land and key productive resources; and institutional and governance constraints.

At the same time, Cambodia is becoming well positioned to deal with these challenges and to respond to climate change effectively. There has been significant

progress in reducing many aspects of poverty and generating economic development. The ongoing public administration and decentralization reforms provide a framework for improving governance. New climate change funding mechanisms[2] present a significant opportunity for leveraging investment for the country.

Dealing with climate change means dealing with risk and uncertainty

Climate change puts risk and uncertainty at the heart of development. Current scientific assessments provide a good, broad understanding of the ways in which Cambodia will be vulnerable. Yet the climate change science cannot state categorically what will happen where, or when it will happen. The effects of climate change will be felt differently by different people in different localities and contexts.

While climate change responses need to be well informed and based on the best available science, it is not possible or desirable to simply 'predict and act'. This means that there is a need for more adaptive, responsive, inclusive and accountable development institutions and processes that draw on wide sources of information, and that create space for informed, critical public debate and decision-making.

'No regrets' actions as priorities

Despite the significant degree of risk and uncertainty that climate change brings, there are measures that can be adopted that are 'no regrets'. Such measures would provide benefits by addressing current development priorities, thus strengthening resilience, which will also respond to climate change impacts.

Foremost among these actions in the context of Cambodia today is the need to address key factors in people being poor and or being vulnerable to becoming poor: existing challenges in human health service delivery, and improving disease monitoring and surveillance; establishing social safety nets; and improving Disaster Risk Reduction (MoH and WHO 2010).

In addition, much of the response to climate change in the country will depend on putting in place effective mechanisms for management of water and land resources. These are already main development priority areas under the Government development strategy. Within the key rural productive sectors of water resources, agriculture, fisheries and forestry, there are significant opportunities to improve overall planning and management, while also promoting climate resilient technologies and practices.

For forestry, the new finance mechanism available through the Reducing Emissions from Deforestation and Forest Degradation (REDD+) programme creates

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Much of the response to climate change in the country will depend on putting in place effective mechanisms for management of water and land resources. These are already main development priority areas under the Government development strategy.

an opportunity to generate financial support to manage forest resources across the country in such a way that local communities can derive economic benefits from sustainable forest management, while also contributing to national and local development. The Royal Government of Cambodia has actively started to prepare for tapping into this mechanism, but there is still a long way to go before the scheme becomes operational. Central to realising the potential of REDD+ will be the need to put in place effective mechanisms for monitoring and ensuring equitable benefit sharing.

Across all of these key sectors, it is essential that the rights of access to key productive resources – most importantly, land – are secured to allow households and communities to make the long-term commitments to resource management that will create tangible livelihood benefits, while securing the sustainability of these resources.

The importance of local action

It is at the sub-national level that much of the action for building resilient rural livelihoods will occur. The need for local action is clearly enshrined in international agreements for sustainable development, as well as a broad range of climate change literature. The ongoing decentralization and deconcentration (D&D) reform based on the Organic Law (2008), and other governance reforms of the last decade, have positioned Cambodia to deal with climate change at the local level.

Cambodia is thus at an important juncture. These reforms provide a new agenda in the country for ensuring democracy and promoting development, based on principles of local strategic planning and action, accountability, transparency and participation. It is at the sub-national level that the potential is greatest for area-based planning and action, bringing different sectors together in an integrated development approach in line with local needs and circumstances.

As part of the reform process, the Government and other stakeholders are currently going through a review of the functions (roles and responsibilities) of different tiers of Government. This presents a timely opportunity to open up a debate on what is required for mainstreaming climate change in local development, and what the roles are for different actors – communities, Government, private sector and civil society.

The need for action at multiple scales

As significant as the action at local level is, ultimately there is also a need for action according to different, overlapping scales – local, national and also regional (trans-boundary). With much of the country lying within the Mekong River basin, action will need to be in partnership with Cambodia's neighbours. Again this requires new ways of acting, new partnerships at different scales, and new finance mechanisms. More significantly, it will require new governance mechanisms.

Rethinking the meaning, direction and values of development

Climate change is essentially a challenge of governance – about what development means, how it can be realised, and who should be involved in the process of making decisions and taking action.

While limited adaptive capacity is considered the main factor in Cambodia's vulnerability to climate change, much of the groundwork – through policy reform – that could allow the country to rise to the challenges is now being prepared.

Despite hurdles, the new mechanisms for climate change finance and technology transfer promised by international agreements could provide new opportunities for Cambodia. In all, having put in place many of the institutional arrangements for addressing climate change, the country is well placed to take advantage of these opportunities.

Clearly, finance alone will not solve the problems associated with climate change. Ensuring that finance is used wisely – in ways that benefit all, but particularly the most vulnerable, and that provide lasting solutions – will require new ways of working, new partnerships and more informed public debate. This means that institutions will need to work to build cross-sectoral coordination, strengthen mechanisms for public participation and accountability, and build partnerships with the private sector.

This will also require strengthening rights of access as well as decision-making frameworks that relate to development options and their impacts. The decisions and actions that are taken today will have far-reaching implications for future generations. It is essential that these decisions are well informed, and represent the needs and interests of the many Cambodians whose lives remain insecure. For this to occur, rural people, and particularly poor people, must be able to participate effectively in setting development objectives, and making decisions about how development is done.

The decisions and actions that are taken today will have far-reaching implications for future generations.


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CHAPTER OVERVIEW

The threat of climate change raises more fundamental questions about what constitutes 'development,' and how it can be achieved.

CHAPTER OVERVIEW

Chapter 1
Introduction

This chapter sets out the context for the entire report by defining the focus – rural livelihoods and climate change – putting climate change in the context of a human development challenge, and providing an overview of the report structure. The chapter also provides an overview of global agreements and national actions on climate change to date.

The threat of climate change raises more fundamental questions about what constitutes *'development'*, and how it can be achieved.

Responding to climate change impacts is often presented as simply a matter of ensuring 'good development'. But realising good development is no easy task. While there have been obvious areas of progress in recent years in Cambodia and elsewhere, the reality is that despite investments in development, periods of economic growth and favourable global market conditions, the achievements of development can easily be undone and still have to reach more people. Even though poverty rates have declined, the lives of most people in Cambodia remain insecure.

Equally, development – or rather, certain development pathways – may actually exacerbate long-term vulnerability to climate change. The pathways of industrialisation and economic growth pursued by developed countries over the last 200 years may no longer be as viable as they once were. For example, excessive emission of greenhouse gases (GHG) into the earth's atmosphere, over-extraction of water resources, pollution, changes to the landscape as a result of changing cropping systems, and changes to farming systems may generate short-term economic benefits for some, but at the same time increase vulnerability to changing rainfall and seasonal patterns, undermining food security objectives and exerting pressure on the very resources that already face greater pressure with climate change.

Chapter 2
Understanding climate change: Predictions, perceptions and concepts

This chapter gives an overview of the currently available climate change predictions for the world, the region and for Cambodia, drawing on the most updated technical assessments, including the SNC of the Ministry of Environment (MoE).

Climate change predictions can be summarised as being:

- Increases in temperature – Cambodia's temperature has already been increasing and will keep increasing
- Shifts in the timing and duration of the seasons – with shorter, wetter rainy seasons, and longer, drier dry seasons
- Increased frequency and intensity of floods and droughts
- Sea level rise in coastal areas

By definition, looking into the future is an uncertain science. It is not possible to determine exactly what the future of climate change will look like. With many factors in play, the impacts of climate change will vary significantly across different localities. For decision-making, it is necessary to move beyond trying to 'predict and act', toward drawing on a wide range of technical information and wide sources of knowledge, and promoting informed debate among stakeholders.

The perception that something is changing in the climate appears to be gaining ground among people from all walks of life across Cambodia. It is sometimes difficult to determine if people are talking about changes in the 'weather' or in the 'climate' – and indeed, the Khmer language does not make this distinction clear. But whatever is happening, the changes that people are observing and experiencing appear to correspond to the kinds of changes that climate science predicts for the country. For Cambodians, the terms 'climate change' and 'global warming' are closely linked to concerns about deforestation, drought, floods, windstorms and an increase in diseases, which are among the most important issues for the country.

Vulnerability and adaptation

Despite global efforts to reduce climate change people will need to adapt to the inevitable consequences of climate change, to the extent to which they will be able to cope and adjust. Central to this thinking are concepts of 'vulnerability' and 'adaptation'.

Within the arena of climate change, the Intergovernmental Panel on Climate Change (IPCC) in 2001 defined vulnerability to climate change as "the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes."

Vulnerability to climate change depends on the interrelationship of three key elements (Adger 2006):

- **Exposure of a system:** The extent to which it experiences environmental or socio-political stress, in terms of magnitude, frequency, duration and extent
- **Sensitivity of the system:** The degree to which it is modified
- **Adaptive capacity of the system:** Its ability to evolve to accommodate environmental hazards or policy changes and to expand the range of variability with which it can cope

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Despite global efforts to reduce climate change, people will need to adapt to the inevitable consequences of climate change, to the extent that they will be able to cope and adjust.

Building resilience

Addressing vulnerability centres on strengthening resilience. The term resilience is often used to indicate the ability of systems – whether natural, social or economic – to bounce back from shocks and crises and return to their 'normal' condition. However, the term has come under criticism for the way it is used in developing countries that face persistent poverty and inequality. While these conditions might be somehow 'normal', they are certainly not desired outcomes. Resilience to shocks and crises for these countries is not simply a matter of bouncing back to these conditions, but of being able to absorb shocks and crises in such a way that overcoming poverty and inequality are still possible.

Chapter 3

Human development analysis: Current poverty and vulnerability

Human development considers people as the real wealth of a nation. It is about ensuring freedom to live long, healthy and creative lives with human dignity. History has shown that growth in a country's overall economy alone does not guarantee improved welfare of its people. On the other hand, experiences from across the world have demonstrated that substantial achievements in development are indeed possible even without fast economic growth.

The human development approach considers people not just as the beneficiaries, but also as the key drivers of development, as individuals and in groups. The key elements of the human development approach include:

- **Sustainability:** Development gains may be fragile and vulnerable to reversal. Special efforts are needed to ensure that human development endures – that it is sustainable.
- **Equity:** Human development is also concerned with addressing structural disparities – it must be equitable.
- **Empowerment:** People, as drivers of development, should be empowered to exercise individual choice and to participate in, shape and benefit from processes at the household, community and national levels.

The starting point for thinking through Cambodia's current capacity to respond to climate change and ways to build resilient rural livelihoods is an analysis of the current dynamics of poverty and vulnerability (human development challenges).

Since the early 1990s, Cambodia has made important progress in addressing key drivers of poverty and vulnerability.

However, when viewed through different analytical frameworks, poverty remains persistent in Cambodia. While the number of people below the official poverty line has fallen consistently, inequality remains a concern, with a large proportion of the population living in precarious circumstances, leaving them close to becoming poor – and thus highly vulnerable to climate change impacts.

The extent and characteristics of poverty and vulnerability differ significantly across provinces and districts. There is clearly a localised dimension to poverty – and a need for locally based action.

Levels of development vary across the country

Limited assets and entitlements, institutional constraints, limited capacity and knowledge, and fundamental governance challenges remain key factors leading to persistent poverty. The factors pushing people into poverty include vulnerability to shocks and crises, which are also closely associated with climate change, such as poor health, and the impacts of floods and droughts.

Agriculture (on which 71 percent of men and women in Cambodia are dependent) and natural resources management, will be central for (medium-term) adaptation and to reduce vulnerability.

Climate change and the response to it are a part of the environment, energy and climate change section of the Ministry of Women's Affairs' five-year Neary Rattanak III plan (MoWA 2009) and the Government is encouraging women in rural areas to take advantage of available extension services.

Agriculture remains the single largest source of primary employment for women and men. However, yields are very low and agricultural extension services are limited. Although women comprise 51 percent of the primary workforce in subsistence agriculture and 57 percent

of the workforce in market-oriented agriculture, they receive only 10 percent of agricultural extension services (MoWA 2008).

Women are actively engaged in off-farm income generating activities to supplement household income, however, there is very little understanding of or support for the development and promotion of these activities.

Chapter 4
Implications of climate change

This chapter discusses impacts of climate change according to key sectors, outlining the vulnerability context, predictions of climate change impacts, and discussing the implications of these impacts for human development.

Changes to the hydrological cycle will have important implications for water availability, quality and distribution, with risks of increased competition and conflict between sectors, as well as water users within and between river basins. Cambodia's dependence on Mekong hydrological flow regimes makes it extremely vulnerable to upstream changes that will have enormous implications for all key sectors of rural livelihoods and human well-being.

Changes in temperature and shifts in the seasons have important implications for agricultural production. Studies in the region suggest that rice production could decline significantly for a 1°C rise in temperature, making rice farming unviable for many farmers.

At the same time, the inland capture fisheries of Cambodia are among the most productive in the world and provide the main source of protein in rural diets. Capture fisheries production is highly sensitive to hydrology and land use changes – and thus, to climate change. Any declines in natural productivity would have serious food security implications that could not be offset by other forms of food production. It is likely that the poorest would suffer most from ensuing food insecurity, while increased competition over remaining fishery resources would most likely lead to poor people being denied access to fishery resources.

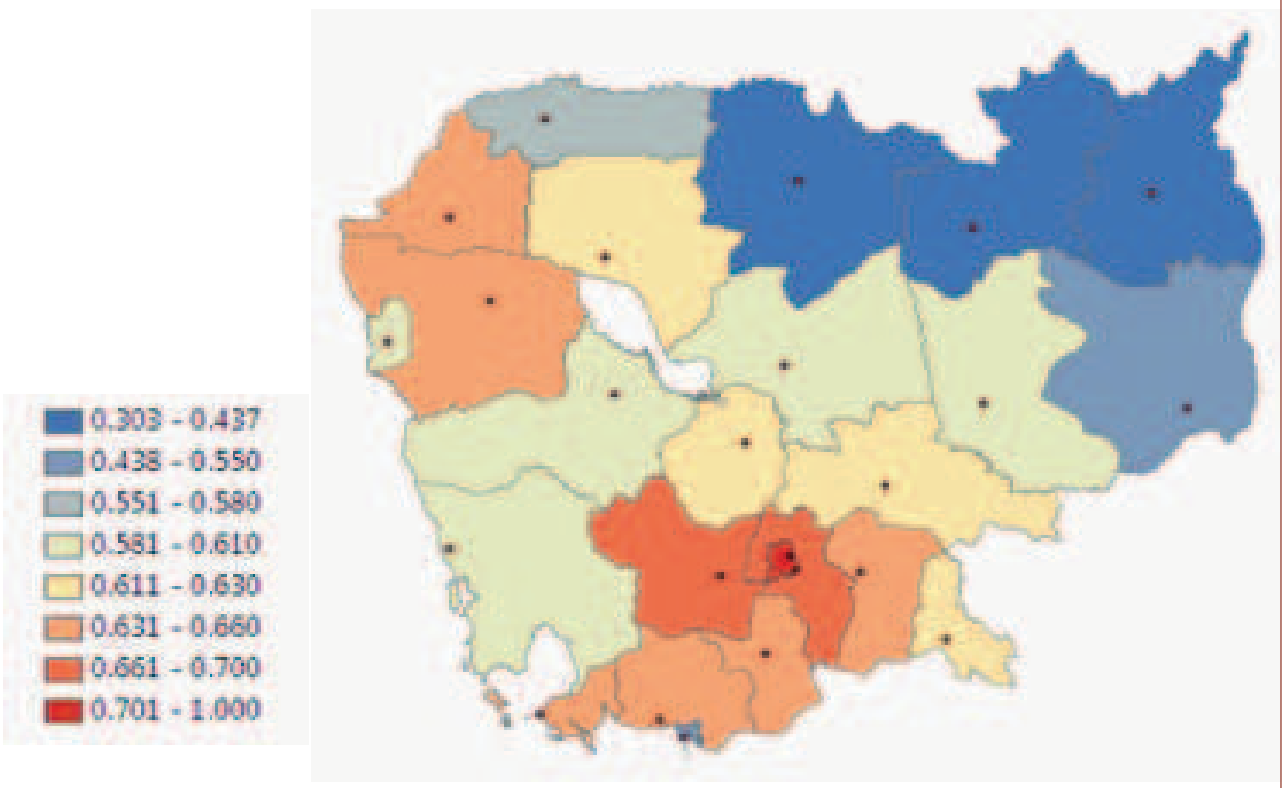
With continuing pressure on forest and land resources – which make the largest contributions to GHG emissions in Cambodia – forest resources are likely to be further degraded by human activities. The impact of climate change may also contribute to changes in forest types in the future. Almost 4 million people are dependent on forest resources, which have also traditionally provided safety nets in times of crisis. Rural people also see a clear connection between the changes in local weather that they have witnessed, and changes in forest cover and land use.

Ill health is also one of the main factors pushing people into poverty and destitution, and it is in the area of health that some of the main challenges in meeting the Cambodia Millennium Development Goals (CMDGs) targets remain. Climate change is predicted to intensify health challenges, putting greater pressure on health care systems and putting the well-being of rural people at risk. It is in the area of health that Cambodian people most fear the negative impacts of climate change (MOE/BBC Trust 2011).

In addition to poor health, floods and droughts are key factors in people becoming poor. While people have been able to withstand such disasters in the past, more frequent and intense floods and droughts will intensify existing pressures, and make it all the more difficult for people to recover.

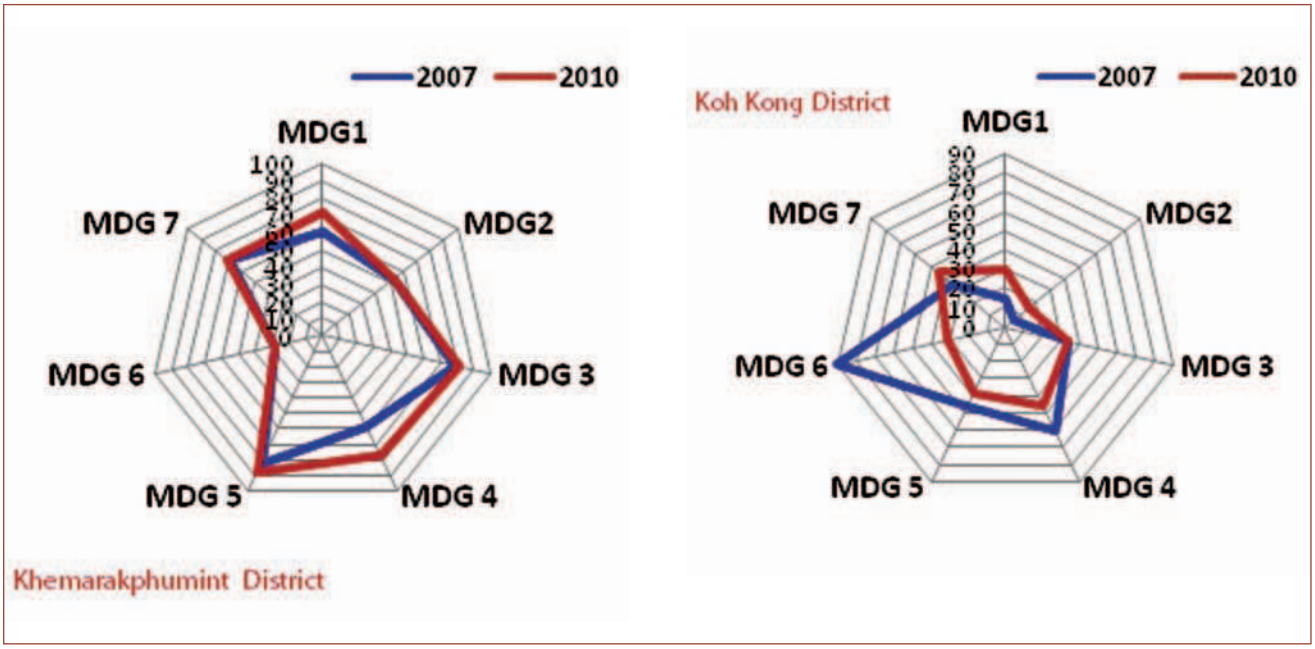
Climate change will impact different areas of the country in different ways. The Coastal Zone is most vulnerable to sea level rise (SLR) and increased salinisation, affecting rural people who already have limited assets and entitlements and few alternatives to working within the rural economy. The Tonle Sap supports the largest proportion of the agricultural population, but changes in natural hydrology, combined with existing land use and resource pressures, threaten

Human Development Index 2010



Source: Boret 2010 (see annex)

Examples of local (district) CMDG scoring: Development profiles are different even within a province
Koh Kong: Khemarakphumint District and Koh Kong District



Source: MoP 2010

to affect both fisheries and agricultural production. The Upper Mekong is also an area dependent on natural hydrological systems and the productivity of natural forests. While there is a relatively smaller population in this area, they are among the poorest in the country and already face significant development constraints. The delta region is the main agricultural area of the country, but it is also susceptible to floods and droughts, with implications for the viability of rice production.

Chapter 5
Principles for building resilient rural livelihoods

Based on the analysis of vulnerability and likely impacts discussed in the previous chapters, this chapter considers principles and options for building resilient rural livelihoods, highlighting the need for more:

- *Informed, strategic and participatory approaches to planning and decision-making*
- *Rights-based approaches to protecting the interests of the poor and marginalised*
- *Integrating area-based approaches*
- *Placing ecological considerations at the heart of development*
- *Building of adaptive, flexible, and learning-oriented institutions*
- *'No regrets' options*

Two aspects in responding to climate change are highlighted:

1. The need to address current vulnerabilities and short-term shocks and crises (based on health, social safety nets and Disaster Risk Reduction [DRR])
2. The need to forge a long-term development pathway, including a discussion of the options for adaptation according to sectors (water, agriculture, fisheries and forestry)

Options for building resilient livelihoods according to various key sectors are of these two types.

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People, as drivers of development, should be empowered to exercise individual choice and to participate in, shape and benefit from processes at the household, community and national levels.

Chapter 6
Addressing immediate needs – Safety nets and Disaster Risk Reduction

This chapter discusses the importance of addressing current drivers of vulnerability as a means of building resilience to climate change, focusing on promoting social safety nets and social protection, and strengthening DRR.

Despite the significant degree of risk and uncertainty that climate change brings, there are measures that can be adopted that are 'no regrets' – or 'safe to fail'. Such measures will provide benefits by addressing current development priorities, thus strengthening resilience for responding to climate change impacts.

Foremost among these actions, in the context of Cambodia today, is the need to address key factors in people being poor and vulnerable to becoming poor. These include challenges in ensuring universal access to health care and enhancing the quality of health service delivery, and in improving disease monitoring and surveillance; establishing social safety nets; and strengthening DRR.

These climate change priorities fit well with current development priorities and figure prominently in national development strategies and action plans. However, there is greater urgency in addressing these challenges. By strengthening these critical areas of vulnerability and poverty, the likely impacts of climate change can be reduced. At the same time, the human capital of the country can be strengthened and directed toward the kinds of actions needed to make positive longer-term development changes.

At the same time, there is a critical institutional challenge to avoid creating specific 'sectors' from the crosscutting issues of social protection and DRR, and to make sure that these ways of acting shape more integrated development strategies at both the national and local levels.

Chapter 7
Sectoral actions

This chapter considers the current challenges and opportunities for securing people's well-being through the following key rural sectors: water resources, agriculture, forestry, fisheries and rural energy.

Across all sectors, there is a need to put in place the planning, implementation and decision-making institutions and processes that allow for a more integrated approach to sectoral responses. These will need to address the degradation of key natural assets as well as the limited access and entitlements of poor people. For all sectors, addressing constraints to poor people's access to productive resources, as well as limited access to extension support, market opportunities, and information and technology, will be necessary.

Specific examples of technologies and practices that are appropriate for poor people, and that adhere to the principles of climate change resilience are also discussed, based on experience within Cambodia It is also in this area of appropriate technologies that many new climate change related financing opportunities will be made available.

Chapter 8
Local action for climate change resilience

This chapter then moves into the critical discussion of thinking through what it would take for Cambodia to put these options into practice. It is framed firmly within the governance reforms for strengthening decentralization and deconcentration, and a discussion of how these can be oriented to take on board the challenges of climate change.

The chapter provides an overview of local governance reform under the Organic Law, which shapes the direction of democratic development in Cambodia. It argues that the ongoing reform provides a basis for

dealing with the core recommendations for climate change adaptation that emerge from international literature and experience. However, climate change considerations have long-term, far-reaching implications that have not yet received enough attention in the country, and in some cases, that pose fundamental challenges for local institutions and processes.

The chapter discusses the potential for sub-national level planning and development to move toward:

- More strategic, long-term planning processes
- Assessments of options and impacts – including through Strategic Environmental Assessments and Environmental Impact Assessments
- 'Climate change screening' of existing national and sectoral strategies
- Moving from sectoral approaches to territorial approaches
- Promoting effective stakeholder participation
- Building adaptive, flexible, learning-oriented institutions

The chapter highlights the importance of access to information. For climate change action to be capable of dealing with uncertainty and risk and meet the needs of the poor and marginalised, it is essential that decision-making processes are based on good-quality, locality-specific information and data analysis, and that information is accessible and acceptable to decision makers and stakeholders.

Examples of technologies, techniques and practices discussed for climate-resilient rural livelihoods:

- Multi-purpose farming
- Conservation agriculture
- System of Rice Intensification (SRI)
- Farmer Business Advisor (FBA) model
- Improved crop varieties
- Improved weather forecasting and crop insurance
- Low-cost and small-scale infrastructure/water management schemes
- Improved post-harvest processing and trade
- Community forestry
- Alternative rural energy – e.g. biogas, improved cook-stoves
- Floodplain fish refuges and rice field fisheries
- Agro-forestry

Chapter 9
Way forward: Conclusions and policy considerations

The final chapter presents conclusions and issues for policy considerations around the need to strengthen assets and entitlements as well as institutions; information, knowledge and capacity; and decision-making and governance. Timeframes for different actions are also discussed.

The chapter considers the need for action at different scales. Strengthening national-level policy framework and coordination – for example, through a National Strategy and Action Plan for Climate Change, as recognised in the National Strategic Development Plan (2009-2013) – will be critical for forging long-term climate change resilience. In addition, climate change intensifies the need for regional cooperation, particularly within the Mekong region.

Build awareness, knowledge and capacity

Three key areas need to be addressed in responding to climate change in order to build awareness, knowledge and capacity:

- Improving knowledge and education
- Building research capacity
- Improving data and information systems

Ensure secure and reliable access to finance

The costs of climate change adaptation and mitigation will be considerable. Yet the clearest opportunity from climate change appears in the growing availability of international finance to support countries such as Cambodia.

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The extent and characteristics of poverty and vulnerability differ significantly across provinces and districts. There is clearly a localized dimension to poverty and a need for locally based action.

This finance represents a significant addition to current official development assistance (ODA), and as such, an opportunity to overcome Cambodia's underlying vulnerabilities to climate change while also creating conditions for investment in more long-term, low-carbon development pathways. Given the long-term nature of building climate change resilience, it is essential that the availability of finance is secure to allow for the kinds of long-term planning and investments required.

Ensuring that climate change funding does indeed add value to development efforts rather than dilute them, and ensuring that the funding is put to good use, depends on building upon donor harmonisation efforts, as well as the transparency and accountability of funding allocations.

Strengthen access rights

Underpinning these policy options is the need to strengthen governance and decision-making – to allow for more participatory, deliberative and informed debate, and to ensure that appropriate checks and balances are in place to protect the rights of vulnerable people.

Running through the discussion in this report is the need, on the one hand, for capacity development and awareness raising, and on the other hand, for the promotion of rights of access to information, participation, and redress and remedy.

As climate change takes hold, it will be increasingly important to monitor and debate the significance and implications of changes, and to determine the extent to which human actions are either creating further vulnerability or strengthening resilience. For this to occur, information must be freely available.

The media and civil society have a vital role to play in making information available and in holding both the State and the private sector accountable.

It is timely that the Government of Cambodia is in the process of going through consultations on the development of legislation regarding the right to information (MoNASRI 2007). Putting in place such a legal framework will go a long way to opening up space for public debate about many important aspects of climate change, while further strengthening overall transparency and accountability. Including specific guidelines on access to information as it relates to climate change issues will strengthen the country's capacity to respond.

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Part

Introduction

The ecological landscape of Cambodia has changed dramatically over the last 30 years, also influencing changes in more localized weather patterns. With the forces of global climate change and local ecological change coming together in Cambodia, the climate of the future will be markedly different from that of the past.

CHAPTER 1

Climate Change Globally and in Cambodia

Introduction

Climate change is real, and by all accounts is already being felt in Cambodia. Assessments by scientists (MoE 2002, 2005 and 2010) and the perceptions by rural people (MoE/BBC Trust 2011) themselves point to significant and recent changes that are compelling people to take action. In turn, these changes have far-reaching implications for rural livelihoods in Cambodia – and for the future of national development.

The focus in this Cambodia Human Development Report (CHDR) is on climate change and rural livelihoods. While this captures only part of the picture of climate change in Cambodia, it is an essential starting point. Even though Cambodia is changing rapidly and the distinctions between rural and urban areas are becoming less clear, most people continue to depend on a rural economy and natural resources. Although significant transformations have occurred in this regard in recent years, the rural economy remains the cornerstone of national development.

Overall, Cambodia has experienced one of the highest rates of economic growth in the world and has made important progress in tackling poverty (MoP 2010, UNDP 2009b). But performance has not been even, and costs have been significant. The question for the CHDR is how recent successes can continue to be realised and weaknesses and challenges addressed, thereby ensuring the well-being of future generations.

Climate change is a global challenge, but much of the effects will be felt most acutely by poorer countries and poorer people (WB 2010, IPCC 2007). While the international community struggles to formulate the kinds of legally binding commitments that might be able to halt further climate change, the emphasis for action is shifting toward national adaptation, mitigation where possible, and building resilience.

The CHDR aims to contribute to more informed public debate in Cambodia by discussing what will be required to build rural livelihoods to be resilient to climate change and to be able to contribute to meeting long-term development objectives. A human development perspective needs to be central to this kind of public debate – to ensure that there is effective public participation, so that vulnerable and affected people and communities can engage in analysis and decision-making.

The challenge of climate change

The effects of changes in climate are not new for Cambodia. Indeed, recent historical analysis suggests that the collapse of the mighty Angkor Empire that stretched across much of mainland South-East Asia was partly attributable to shifts in climate patterns (see Box 1 below).

The kinds of climate shifts that influenced Cambodia during the Angkor period were part of natural climatic cycles and variations. However, the climate change that the country now faces is of a very different order. Scientific evidence demonstrates that what we now know as climate change is the result of man-made actions related to industrialisation, deforestation and land use patterns (IPCC 2001), which have resulted in excessive emission of greenhouse gases (GHG) into

the earth's atmosphere. Moreover, the climate change that we are witnessing is of a pace and magnitude that the world has never before experienced, and the changes beginning to appear are irreversible. Yet for Cambodia, many aspects remain remarkably similar to the Angkor period: the central importance of water resource management for national development, and the dependence of the population on agriculture, fisheries and natural resources.

Our understanding of the science of climate change has improved enormously in recent years. The most comprehensive scientific review thus far was prepared in 2010 by the Royal Government of Cambodia (RGC), as the Second National Communication (SNC) to the United Nations Framework Convention on Climate Change (UNFCCC). It clearly demonstrates that temperatures in the country have risen steadily over the last 50 years, and that **"rapid increase in temperature is expected to occur after 2030"** (MoE 2010). Rainfall patterns are also shifting (Eastham et al 2009). At the same time, predicted changes for the future also need to be considered alongside more recent changes.

The ecological landscape of Cambodia has changed dramatically over the last 30 years, also influencing changes in more localised weather patterns. With the forces of global climate change and local ecological

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The changes beginning to appear are irreversible. Yet for Cambodia, many aspects remain remarkably similar to the Angkor period: the central importance of water resource management for national development, and the dependence of the population on agriculture, fisheries and natural resources.

Box 1: The effects of climate variability on the Angkor Empire

A recent study suggests that two severe droughts, punctuated by bouts of heavy monsoon rain, may have weakened the Angkor Empire by shrinking water supplies for drinking and agriculture, and by damaging the Empire's vast irrigation system, which was central to its economy. The kingdom is thought to have collapsed in 1431 after raids from Siam.

The Empire was already facing numerous social, political and cultural problems. These were exacerbated by a drought thought to have lasted 30 years, putting pressure on the complex system of irrigation reservoirs, canals and embankments. It is thought that this led to crop failures and the spread of infectious diseases, undermining the Empire's ability to feed its large population.

The problem of droughts was compounded by intense rainy seasons during some years. Unusually heavy rains after periods of drought caused the siltation of the irrigation infrastructure, further undermining the viability of the water management on which Angkor had depended.

References: Buckley et al (2010), and Cook et al (2010)

change coming together in Cambodia, the climate of the future will be markedly different from that of the recent past.

From a human development perspective, there are two dimensions in responding to this challenge – both the need to reduce current vulnerabilities and respond to shocks and crises, and also the need to forge a development pathway that will improve the well-being of people in a just and equitable manner in the face of a changing climate.

In addressing these two dimensions of climate change, Cambodia has the opportunity to revisit development objectives, to reassess what is possible and what is desirable, and to determine how long-term development objectives can be met.

In many ways, Cambodia is well placed to do this. Since the 1990s, progress in reconstructing the country and in forging economic and social development has been significant. Cambodia has achieved remarkable levels of economic growth and has made notable reductions in poverty. Institutions have been strengthened and infrastructure improved. But climate change threatens to undermine this progress, at a time in which the foundations of these recent achievements still remain weak. This puts the well-being and livelihoods of Cambodian people at risk, while placing development ambitions in jeopardy.

To its credit, Cambodia has already taken specific measures to begin the process of climate change adaptation and mitigation, and to access international financial and technical support. Yet many challenges still must be overcome. Climate change increases uncertainty and risk; existing pressures will exacerbate vulnerability to climate change. Paramount among these is the persistent poverty and inequality evident throughout the country, along with current limitations of national and local institutions. Climate change will also bring its own specific challenges and pressures.

For Cambodia, climate change is inescapably a development challenge. With huge numbers of people in the rural economy making a large contribution to national development, the question at the heart of this challenge is rural livelihoods.

Cambodia's vulnerability to climate change

Predicting climate change is fraught with difficulty. While the technical methodologies and findings of climate change assessments differ to some degree in detail, there exists remarkable consensus on the types of changes Cambodia can be expected to experience. Much of the work has focused on predicted changes in temperature and shifts in rainfall patterns, with the rapid increases in temperature noted above expected in less than two decades (see Chapter 2 for more details).

These changes will lead to greater variability and less predictability. Much of the impact will be felt through water resources, with changes in availability, quantity and quality. Natural hazards such as floods, droughts and storms are likely to become more prevalent and more intense. It is also expected that changes will occur in the timing, duration and intensity of the two main seasons – the wet season and the dry season. In short, this will mean that the dry season will be longer and drier than before, while the wet season will start a few weeks later and will be shorter and wetter than previously (MoE 2010). These types of shifts in seasonal patterns will have enormous implications for the ways that people in Cambodia farm: changes to the growing time, changes to water availability, and reduced productivity of traditional crop varieties (Johnston et al 2010, Eastham et al 2009, TKK & SEA START RC 2009, MRC 2009). But the impacts will also have broader implications for key areas of economic activity that are profoundly influenced by water and temperature – fisheries, forestry, food security, and health.

Cambodia's vulnerability to climate change is widely regarded to lie in its limited capacity to absorb and adapt to the shocks that such change would pose (ADB 2009, Yusuf and Francisco 2009, ACIAR 2009).

Some places, such as low-lying small island states and arid zones, are by their geography and nature highly exposed to climate change, facing rising sea levels or serious water shortages. But Cambodia's vulnerability is largely a product of its social, political and economic circumstances: levels of poverty; the importance of highly seasonal natural cycles of hydrology and rainfall for agriculture and economic development; the capacity of State, legal and market institutions; and the high dependency on foreign aid (about 9 percent of gross domestic product, or GDP)[3] (UNDP (2010). As the map above illustrates, Cambodia stands out among other nations in South-East Asia as having lower levels of adaptive capacity to climate change (Yusuf and Francisco 2009).

Thus, for Cambodia climate change is inescapably a development challenge. With huge numbers of people in the rural economy making a large contribution to national development, the question at the heart of this challenge is the future of rural livelihoods – the future of small-scale agriculture, of water and natural resources use, and of the well-being, education and health of the rural population.

This represents an enormous challenge at all levels in Cambodia, and for its relations with neighbouring countries. Indeed, many of the climate change impacts that will be felt most acutely in Cambodia originate outside the country. Critically, most of the country lies within the Mekong River basin, so that water resources are highly dependent on the Mekong system from its source in the Himalayas all the way through China, Myanmar, Lao PDR, Thailand and Viet Nam (TKK & SEA START RC 2009, MRC 2009).

It is at the local or sub-national level that these challenges will be most distinctly felt, and also at this level that actions are most needed (Agrawal 2009, IFRC and ProVention Consortium 2009). It is also at this level that many of the efforts to deliver development results and engage citizens already occur. The CHDR therefore pays careful attention to how future actions might be shaped, placing special emphasis at sub-national level, in provinces, districts, communes, communities and villages, and of course, among households and individuals.

Climate change as an economic and development challenge

The economic implications of climate change are extremely high everywhere – all the more so for developing countries like Cambodia.

The Stern Review, one of the most comprehensive and most influential reports on the economics of climate change, has described climate change as the greatest and widest-ranging market failure ever seen (Stern 2006). It argued that the annual costs of stabilising GHG emissions are likely to be around 2 percent[4] of global GDP by 2050, while inaction against global warming can lead to a reduction in GDP by 5 to 20 percent. The 4th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) (2007) also predicted that global mean losses could be 1 to 5 percent of GDP if warming of 4°C occurs, while developing countries are expected to experience larger percentage of losses.[5] Estimates of global costs and investment requirements in developing countries for adaptation – i.e. living with existing and unabated climate change – vary greatly, but those by recent major reports range from US$4 billion to US$86 billion per year. On the other hand, climate change mitigation – i.e. stopping the problem from growing further – is estimated to cost between US$200 billion and US$3,000 billion annually worldwide (WB 2008a, also IPCC 2007[6]).

A recent study that examined four countries in the region (Thailand, Viet Nam, Indonesia, Philippines), concludes that, in a 'business as usual' scenario, climate change-related economic losses could even rise to 6.7 percent of GDP for these countries by the next century (ADB 2009). Given Cambodia's higher degree of vulnerability, the costs that it may have to bear could be even higher.

Thus, the poorest countries and most vulnerable citizens will suffer the earliest, most damaging setbacks to their economies, their livelihoods and their overall human development, even though they have contributed least to the problem. And not only does climate change have the potential to prevent further socioeconomic progress, failure to address climate change also threatens to

Table 1: Various estimates of the costs of climate change mitigation and adaptation

Study (date)	Estimate
Mitigation cost estimates	
WBG, Clean Energy Framework (2006)	US$30 billion/annum for power sector in developing countries
Stern Review (2006)	US$1,000 billion/annum
UNFCCC (2007)	US$200-210 billion/annum
IPCC (2007)	5.5% to -1% (gain) reduction in global GDP
OECD Environmental Outlook (2008)	US$350–3,000 billion/annum
IEA Energy Technology Perspectives (2008)	US$400-1,100 billion/annum for energy sector
Adaptation cost estimates	
World Bank, as revised by the Stern Review (2006)	US$4-37 billion/ annum
IPCC (2007)	1-5% of GDP for 4°C warming
Oxfam (2007)	US$50-80 billion
UNFCCC (2007)	US$28-67 billion in 2030
UNDP (HDR 2007–08)	US$86 billion/annum by 2015 (equals 0.2% of GDP of developed countries

Source: Adapted from WB 2008 (DCCSFT), Annex 2 (pp. 65-66) and UN 2009.

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The poorest and most vulnerable citizens will suffer the earliest, most damaging setbacks to their economies, their livelihoods, and their overall human development, even though they have contributed least to the problem.

reverse much of the development that has taken place. In this sense, climate change is recognised as the gravest threat currently facing humanity (UNDP 2007).

Climate change – Potential finance

A fundamental principle underpinning the UNFCCC and the Rio Declaration, is that of **"common but differentiated responsibilities"**. This principle recognises that problems of environmental degradation and climate change are global in nature, and thus common across the world. But the principle also recognises that countries' historical and current contributions toward these problems differ, as do the impacts that they will receive and their abilities to respond. In short, this recognises that the industrial world has largely contributed to causing global problems such as climate change, but that the impacts will be most acutely felt in the developing world. While international negotiations to agree actions to curb GHG emissions are struggling forward, the international community has agreed to finance mechanisms to support developing countries to meet the additional costs of adaptation and to fund mitigation measures. One of the major tangible outcomes of the 16th Conference of Parties (COP 16) of the UNFCCC in December 2010 in Cancun was a commitment to a US$100 billion per year by 2020 for Green Climate Fund to address the needs of developing countries (See Box 2).

Through the growing arsenal of carbon financing schemes, technology transfers and increased energy efficiency, and with enhanced involvement of the private sector, it is more and more possible to leverage the kind of support needed for dealing with climate change.

The international carbon market has the potential to generate revenues for developing countries. In 2006 alone, the official market established by the Kyoto Protocol of the UNFCCC (see Box 2), the Clean Development Mechanism (CDM), was worth US$30 billion. In just one year, by 2007, it more than doubled, to US$64 billion.

Most CDM projects are sourced from Asia, particularly China and India. Sharp increases in carbon transaction volumes are also reported in Malaysia, Philippines and Thailand, although these still represent a small percentage of the global total (World Bank 2008b). However there are also concerns that the process for approval of CDM finance is prohibitively bureaucratic and costly for the kinds of smaller-scale projects that would be most appropriate for developing countries and for rural communities (De Lopez et al 2009).

One of the firm commitments agreed in Cancun was to support a framework for reducing emissions from deforestation – known as Reduced Emissions from Deforestation and Forest Degradation, or REDD+. This scheme has considerable potential for tropical countries with rich forest cover such as Cambodia. REDD+ constitutes the first global programme aimed at preventing the loss of tropical forests through carbon payments for forest conservation, sustainable forest management and the enhancement of carbon stocks by developing countries. By credibly measuring, monitoring, and valuing forest carbon stocks, REDD may mobilise substantial funding for the forest sector. The scale of the programme can be potentially very large, since the world loses 13 million hectares of forest each year, much of it in tropical developing nations. Destruction of these forests, along with other land use activities, contributes 17 percent of the GHGs that humans emit into the atmosphere each year. Commitments from negotiations in Cancun could lead to new and additional resource, including forest and investments through international institutions, approaching US$30 billion for the period from 2010 to 2012, with the balance allocated between adaptation and mitigation in developing countries.[7]

Voluntary carbon markets refer to finance mechanisms under which the private sector, including individuals, are able to offset carbon from developing countries by purchasing carbon credits. The UNFCCC estimates that the private sector is to provide 80 percent of mitigation financing and a significant share of adaptation financing. In developing countries, it is estimated that the private sector has contributed to more than 75 percent of investments in renewable energy and energy efficiency (World Bank 2008a). Such voluntary carbon markets

Box 2: The United Nations Framework Convention on Climate Change

The United Nations Framework Convention on Climate Change (UNFCCC) emerged from the 1992 United Nations Conference on Environment and Development (UNCED), known as the Earth Summit, held in Rio de Janeiro.

The UNFCCC now has 195 parties as signatories, including Cambodia. The ultimate objective of the Convention is to stabilise GHG concentrations in the atmosphere at a level that will prevent dangerous human interference with the climate system. This should be achieved within a timeframe sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed sustainably.

The Convention is complemented by the 1997 Kyoto Protocol, which now has 193 Parties. Under this treaty, 37 industrialised countries and the European Community have committed to reducing their emissions by an average of 5.2 percent between 2008-2012 (the so-called 'first commitment period') against 1990 levels. Industrialised countries must first and foremost take domestic action against climate change. But the Protocol also allows them to meet their emission reduction commitments abroad through so-called 'market-based mechanisms.' For example, the Clean Development Mechanism (CDM) permits industrialised countries to earn emission credit through investment in sustainable development projects that reduce emission in developing countries.

Because the timeframe of the first commitment period of the Kyoto Protocol will expire in 2012, the international community is busy in negotiating agreements for the future. The COP16, held in Cancun, Mexico in December 2010, proved an important milestone. While no firm commitments to reduce GHGs were agreed, the negotiation process will continue until the next COP in Durban, South Africa, in 2011. However, negotiations in Cancun did agree to finance mechanisms, particularly related to forests.

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Climate change puts ecological considerations back at the heart of development. It reminds us that the most fundamental resources on which we depend are finite, and that the capacity of the Earth to absorb the impacts of economic development is also limited.

are regarded as more easily accessed due to lower transaction costs and less complex bureaucratic procedures (Bayon et al 2009).

Significant finance opportunities likewise are emerging for Cambodia. On the mitigation front, Cambodia is believed to have good potential to benefit from carbon trading, whether through CDM or non-CDM 'voluntary market' reforestation, as well as in the areas of energy efficiency, renewable energy and waste management (MoE 2002).

Wisely utilised, many such sources could help leverage climate change mainstreaming in various sectors and ensure 'climate proofing' of ongoing development initiatives. Even so, there are also risks associated with climate finance, much of which has yet to materialise despite international commitments (Roberts and Parks 2007). More fundamentally, where governance is weak and tenure insecure, concerns exist that market mechanisms can undermine rights to resources and that the benefits they generate will not reach rural communities and poorer people.

National actions and policy on climate change

Cambodia acceded to the UNFCCC in December 1995 and ratified the Convention in December 1996. As a least developed country party to the UNFCCC, Cambodia agreed to undertake a series of commitments to the global community, including regular reporting to the UNFCCC regarding the status of climate change actions, vulnerability, GHG emissions levels, and mitigation and adaptation strategies. This includes assessments of climate change impact on key sectors. Since ratification of the UNFCCC, Cambodia has adopted many policies to address issues of climate change. In 2006, the first National Adaptation Programme of Action to Climate Change (NAPA) was approved, identifying priority projects in agriculture, water resources, coastal zone, and health. As part of Cambodia's reporting commitments to UNFCCC, two scientific assessments have been undertaken – the Initial National Communication (INC), in 2002, and the Second National Communication (SNC), prepared in 2010 and 2011 by the Ministry of Environment (MoE).

The first national forum on climate change was held in October 2009, chaired by the Prime Minister.

Institutional arrangements have also been strengthened. The National Climate Change Committee (NCCC) was established in April 2006 as a high-level inter-ministerial body to provide policy coordination and guidance on climate change. Since 2009, the Prime Minister is the Honorary Chair of the NCCC. Within the MoE, a Climate Change Office had been promoted to department level in 2009.

Important moves have also occurred in developing national policies and strategies. In 2010 MoE and the Ministry of Agriculture, Forestry and Fisheries (MAFF) worked together to complete the 'road map' required as part of the preparations for REDD financial support.

Increasingly, climate change is being incorporated into national and sectoral strategies. The Rectangular Strategy II (2008) identifies climate change as a major threat to the country's economic and growth prospects. In addition, both the National Strategic Development Plan Update (NSDP) 2009-2013 and the Implementation Plan for Decentralization and Deconcentration 2011-2013, under the National Programme for Sub-National Democratic Development (NP-SNDD) 2010-2019, call for the need to mainstream climate change (NCDD 2010). The sectoral National Strategy on Disaster Risk Reduction, the National Social Protection Strategy and the draft National Environment and Health Action Plan also recognise the importance of addressing climate change.

The RGC has also moved forward on carbon markets, having developed guidelines for CDM projects; seven projects were developed by late 2010, which amount to 574,804 tonnes of CO_2 eq reduction per year generating carbon credits (IGES/MoE 2010). At least four projects under voluntary carbon markets are operating or being proposed in the country, mainly by civil society organisations (CSOs).[8]

Furthermore, in recent years donor funding for Cambodia to address climate change has increased. With the continued importance of development assistance, the incoming funding earmarked for climate change could play a significant role in supporting the country's efforts to move on a climate-resilient development pathway. All this, however, will require massive coordination efforts among Government and donor agencies alike to ensure that such funding is fully and equitably used.

Climate change projects currently being implemented in Cambodia include:

- NAPA follow-up project on Climate-Resilient Water Management and Agricultural Practices in Rural Cambodia is funded by GEF, UNDP and Government with US$3.09 million.
- PPCR (Pilot Project for Climate Resilience) is funded by WB and ABD with a total budget US$105 of which US$50 million grants and US$55 million soft loan.
- CCCA (Cambodia Climate Change Alliance) is being implemented by MoE and funded by EU, UNDP, SIDA, and Danida for approximately US$9 million.
- National REDD Road Map is being funded by WB, UNDP, FAO and UNEP with over US$6 million committed and it is expected to reach more than US$10 million.
- Vulnerability Assessment and Adaptation Programme for Climate Change within the Coastal Zone of Cambodia Considering Livelihood Improvement and Ecosystems is being funded by UNEP for US$1.6 million.
- Helping Address Rural Vulnerabilities and Ecosystem STability (HARVEST), funded by USAID, will support natural resources management, forestry and climate change from 2011-2015.

Developing with climate change?

The threat of climate change raises more fundamental questions about what constitutes 'development,' and how it can be achieved. The human development approach that puts people, their strengths and capabilities at the centre - provides a framework for guiding responses to climate change in ways that empower people to expand their capabilities, freedoms and choices for just and sustainable outcomes.

Responding to climate change impacts is often presented as simply a matter of ensuring 'good development'. But realising good development is no easy task. While there have been obvious areas of progress in recent years in Cambodia and elsewhere, the reality is that despite investments in development, periods of economic growth and favourable global market conditions, the achievements of development can be easily undone and still have to reach more people. Such economic growth does not always translate into human development. Even though GDP growth has been strong and poverty rates have declined, the lives of most people in Cambodia remain insecure.

Equally, development – or rather, certain development pathways – may actually exacerbate long-term vulnerability to climate change. The pathways of industrialisation and economic growth pursued by developed countries over the last 200 years may no longer be as viable as they once were. For example, over extraction of water resources, pollution, changes to the landscape as a result of changing cropping systems, and changes to farming systems may generate short-term economic benefits for some. But at the same time, they may increase vulnerability to changing rainfall and seasonal patterns, undermining food security objectives and exerting pressure on the very resources that already face more pressure with climate change, putting greater pressure on poorer people.

Box 3: Rethinking the meaning, values and direction of development

Climate change has encouraged a burgeoning critical review of what 'development' and 'sustainability' should mean and how these should be achieved. Underpinning this critical review is a concern that the world is no longer able to absorb the impacts of human economic activity. Indeed, the kind of economic growth that has characterised much of the economic history of the last 200 years would now put additional unmanageable strains on the global ecology.

There is also an argument that the model of economic development that has dominated post-Second World War has not necessarily met human needs and aspirations in the developed world, while barely touching the lives of billions of people who cannot meet most basic human needs. There is no automatic link between economic growth and human development.

Increasingly, there is a call to revisit the meaning, values and direction of development and sustainability, putting both people and ecological considerations centre-stage. Human development – founded on principles of sustainability, equity, empowerment, efficiency and participation – are critical for helping people influence their daily lives, today and in the future (UNDP 2010b).

That is not to say that growth is not possible or desirable. Interest is shifting to 'green growth' and 'low-carbon development.' Essentially, this means a different type of development in which impacts on the environment and climate are minimised, human development objectives are prioritised and in which people are able to influence development processes. The challenge is framed as being "how to design a new model for human progress and development that is climate-proof and climate-friendly and gives everyone a fair share of the natural resources on which we all depend" (Jackson 2009).

Climate change puts ecological considerations – the natural processes that drive the climate – back at the heart of development. It reminds us that the most fundamental resources on which we depend, such as water, land and air, are finite, and that the capacity of the Earth to absorb the impacts of economic development, whether land use change, deforestation or pollution, is also limited. The concern that humankind is approaching the point at which the Earth is no longer able to absorb the environmental impacts of economic activity has led to questioning whether the development pathways of the past are still viable, or whether a new model of economic development, more shaped by the limitations and constraints of the natural world, is needed (Jackson 2009).

Thus, it becomes vitally important to reflect critically on what constitutes 'good development,' for whose benefit such development should be, and how it can be achieved (see Box 3). A growing consensus indicates that the 'business as usual' development model is no longer viable, but formulating a new development agenda requires reviewing development progress and identifying gaps and weaknesses to prepare for future challenges.

This, then, becomes a matter of societal choice, of identifying what society wants to achieve and how it can best be realised, as well as negotiating between interests (sectors, regions, countries) and between 'winners' and 'losers' to ensure just, equitable outcomes, with those who 'lose' protected in some way. These 'losers' include not only the silent voices of the natural world, but also vulnerable and marginalised people, both now and in future generations. Ensuring that people are empowered to participate in and influence decisions is critical.

What such a new development agenda for Cambodia should look like remains unclear. Indeed, defining the new agenda should be the subject of open, informed discussion and negotiation. This CHDR attempts to contribute to these processes.

It aims to open a broad debate on the implications of climate change for different people and different sectors, and on how appropriate responses can be framed by putting people at the centre of attention as challenges are thought through.

It is intended that this CHDR will be a companion report to the SNC report, the most sophisticated scientific work on climate change undertaken by the RGC thus far. It draws on much of the science in the SNC to assess the implications of climate change for current poverty and vulnerability, and for the future development of Cambodia.

Part II

PREDICTIONS, VULNERABILITY, IMPACTS AND IMPLICATIONS

For Cambodia and much of the Lower Mekong Basin, the most important climate variables will be related to changes in hydrology of the river, its many tributaries and floodplains, and the Tonle Sap Lake.

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CHAPTER 2

PREDICTIONS, VULNERABILITY, IMPACTS AND IMPLICATIONS

What is climate change?

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Increases in global temperature lead to changes in climatic patterns due to heating up of both land and ocean, and to melting of ice caps at the poles. In turn, these lead to phenomena such as sea level rise, changes in rainfall patterns, hot and cold waves, increasing frequency and intensity of droughts and floods, and other extreme weather events.

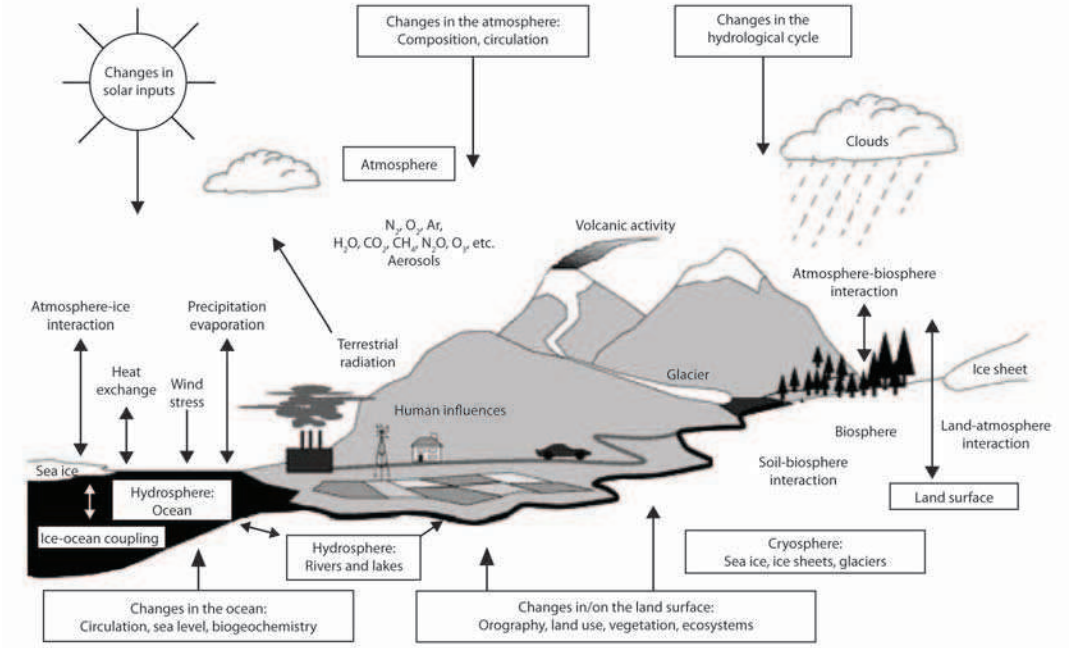
Throughout history, the Earth's climate has undergone different types of changes. In most cases, these changes have been in response to naturally occurring events. However, in the second half of the 20th Century new types of changes became evident that were not part of the natural cycle of climatic variation and were instead a consequence of human activity. The scientific evidence clearly demonstrates that these changes, characterised by rapid increases in average temperature, are likely to continue. The scientific evidence clearly demonstrates that these changes – that are termed as **'climate change'** – characterised by rapid increases in average temperature, are likely to continue.

Climate change or climate variability?

Climate change – A change in climate that persists for decades or longer, arising from human activity that alters the composition of the atmosphere (i.e. greenhouse gas emissions). Climate change is not the same as changes in the weather – these may be more localised, and more short-term.

Climate variability – Natural variations in the climate that are not caused by greenhouse gas emissions (e.g., variability in rainfall and temperature patterns from year to year).

Figure 1: The components of the global climate system



Source: IPCC 2001

The trend of increased global temperatures over the 50 years from 1956 to 2005 is on average 0.13°C per decade (MoE 2010). This is nearly twice the rate of temperature increase for the 100-year period of 1906 to 2005. This suggests that the dramatic rates of increasing temperatures since the European Industrial Revolution have begun to accelerate.

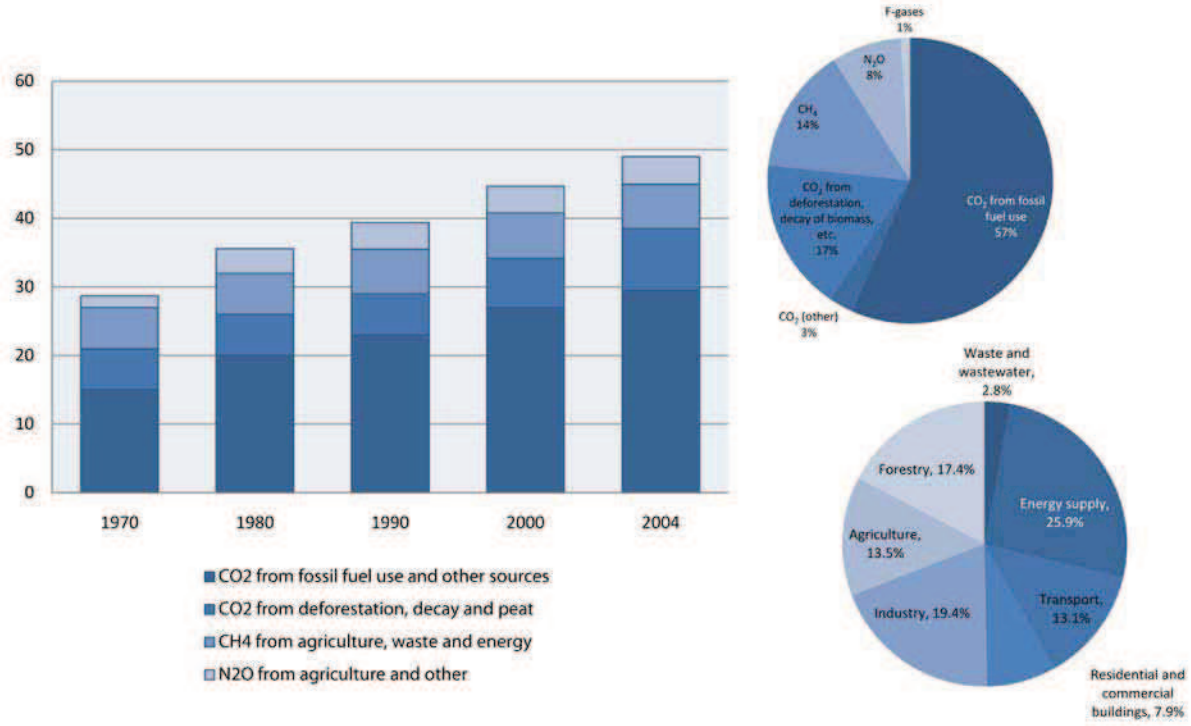
These increases in global temperature lead to changes in climatic patterns due to heating up of both land and ocean, and to melting of ice caps at the poles. In turn, these lead to phenomena such as sea level rise, changes in rainfall patterns, hot and cold waves, increasing frequency and intensity of droughts and floods, and other extreme weather events. Already, warming trends have been observed both on land and ocean corresponding to the period of temperature rise, while sea level rise, snow and ice melt, as well as precipitation changes, also have been recorded globally (IPCC 2007, p. 30).

Humans have never before witnessed such dramatic changes, which threaten the fundamentals of human life. The 2007 IPCC scientific assessment concludes with high confidence that changes in temperature have already had observable impacts on physical and biological systems of the Earth (IPCC 2007, p. 31).

Figure 1 shows a schematic view of the components of the global climate system (bold), their processes and interactions (thin arrows) and some aspects that may change (bold arrows).

The mechanism by which human activities have caused this profound change in global climate systems is primarily the increase in Greenhouse Gases (GHGs[9]) generated by human economic activities, which are most closely associated with industrialisation, the burning of fossil fuels, transportation, agriculture, land use change and deforestation. The concentrations of GHGs in the atmosphere influence the ability of the Earth to reflect and absorb energy from the sun. The higher the concentration of GHGs, the more energy the atmosphere retains, and the higher the average temperature. The atmospheric concentrations of GHGs are a balance between GHG emissions created when carbon compounds (such as fossil fuels or biological materials) are oxidised, and the natural processes whereby GHGs are removed from the atmosphere and stored as new carbon compounds, mostly in plants.

Figure 2: The growth in greenhouse gases from 1970 to 2004



a) Global annual emissions of anthropogenic (i.e. man-made) GHGs from 1970 to 2004.
b) Share of different anthropogenic GHGs in total emissions in 2004 in terms of CO_2 eq.
c) Share of different sectors in total anthropogenic GHG emissions in 2004 in terms of CO_2 eq.

Source: IPCCSR, p. 36.

According to the IPCC, the largest growth in GHG emissions between 1970 and 2004 came from energy supplies (25.9 percent in 2004), transport (13.1 percent) and industry (19.4 percent), while emissions from residential and commercial buildings (7.9 percent), deforestation and land use change (17.4 percent) and agriculture (13.5 percent) have been growing at a lower rate (see Figure 2) (IPCC SR 2007, p. 36). However, largely as a result of deforestation, the ability of the planet's ecosystems to absorb (or 'sink') GHGs has also decreased, leading to an overall increase in GHG concentrations.

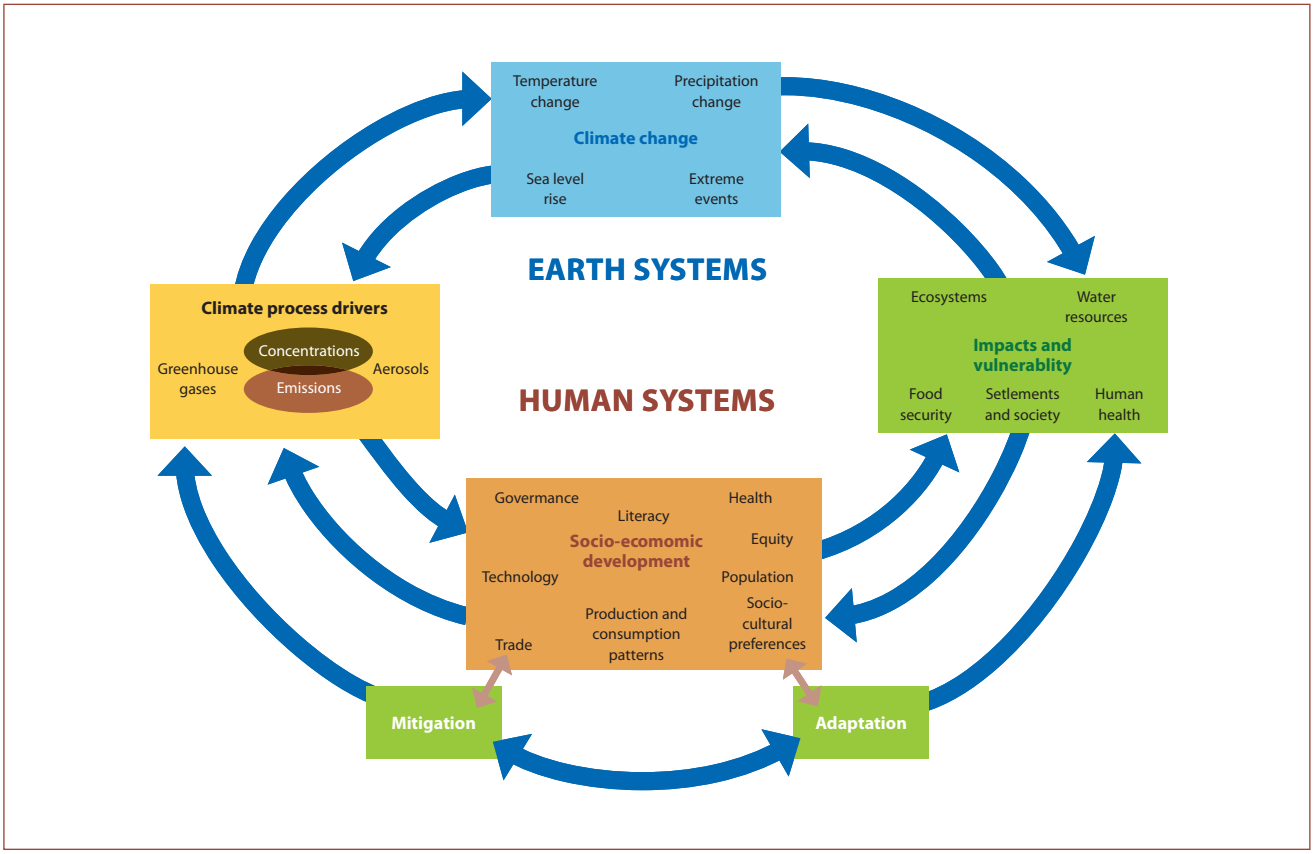
As such, climate change is the result of human economic activity – the way we use and exchange our resources. As seen in Figure 3, the climate of the Earth has already been changing, and these changes are already having negative impacts on the environment and on the lives of people across the world.

Moreover, with this current, human-induced climate change, the phenomena and effects are cumulative, global – and irreversible. It will therefore be necessary to respond and adapt, but at the same time, to identify ways that reduce GHGs and minimise further changes.

These climatic changes also have unequal impacts across the world. As indicated in Chapter 1, people who have contributed least to global warming – the poorest and least equipped to respond – are expected to feel the effects of climate change the most.

Climate change leads to both short-term shocks and long-term gradual changes in the environment, society and economy. It should also be stressed that climate change not only brings new threats and issues, but can also exacerbate and multiply the underlying environmental drivers to many existing problems, to an extent for which people and societies are not prepared.

Figure 3: Anthropogenic climate change drivers, impacts and responses



Source: IPCC SR 2007, p. 26

Climate change predictions

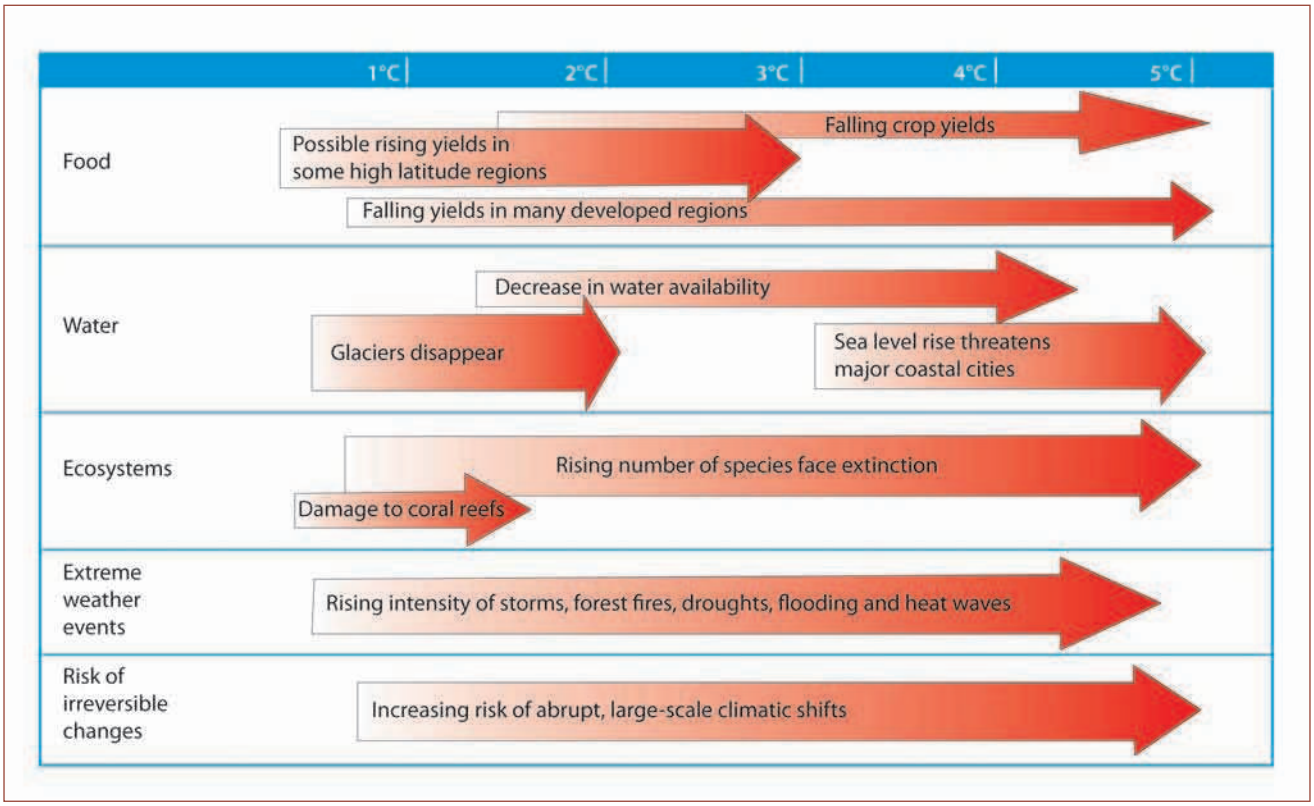
Looking into the future is inevitably uncertain, and the science of projecting the extent of future climate change is far from clear-cut, relying on complex mathematical models (Tadross 2010, Lempert 2004). Various climate models are used to cross-reference and thereby improve accuracy. At finer geographical scales (i.e. local level) and for longer projection times, the accuracy of these models declines, but at the global level, the findings are remarkably consistent.

Of course, the future also depends on what humans do to arrest or exacerbate climate change. Various scenarios are used which describe different possibilities, and it is clear that the extent of such change in the future is highly dependent on how the world is able to curb further emissions today. However, the path that humans will choose is not clear as to whether we act in ways that reduce or increase GHG emissions, and this further complicates the ability to gain useful guidance from projections.

Therefore, the science of projecting future climate change always involves a degree of **uncertainty**. Predictions of climate change in the future are firmly grounded in empirical science, but can only provide an impression of the future that is 'possible' or 'plausible'. These are neither forecasts nor oracles.

Climate change predictions therefore need to be interpreted in order to be able to make decisions based on them (Giddens 2009). The scenarios indicate the directions, ranges and magnitude of possible future changes, in a very broad sense. The various predictions can be informative, but they are **never perfect and should be used with great caution**. It is simply not possible to state how the climate will change for a particular place at a given point in the future. In other words, it is not possible at this time – or desirable – to just 'predict and act': This means that there needs to

Figure 4: Examples of impacts associated with global average temperature change



Source: Adapted from Stern Review 2006

be more informed public debate for more flexible, adaptive responses (Tadross 2010).

While it is clear that climate change will require major action, the degree of uncertainty means the decisions people and societies will need to make will not be clear-cut. Thus, it is all the more important to have access to various sources of information, different scientific disciplines and different stakeholder perspectives for decision-making while actions arising from decisions must be diligently monitored and reviewed (Jones et al 2009, Munton 2003). The risk is that the uncertainties involved in climate predictions will lead to decisions that may not work, may not be fair and may contribute to inequality.

Projecting future climate is still a new science, and improved methods and techniques for generating more accurate models are being developed. Summarised below is the best information available at this time on climate change globally, as well as in the Mekong Basin and Cambodia.

Global prediction

The best available global projection by IPCC indicates a wide range of temperature change during the 21st Century; estimates range between 1.8-4.0°C, depending on different GHG emission scenarios.

The projected changes in temperature, along with associated changes in precipitation, sea level rise, and increase in extreme weather events, will have a wide range of impacts on human activities across the world. Impacts of climate change will be felt most acutely in water resources, ecosystems, coastal zones, agriculture, forestry, fisheries and health; types of impacts are summarised in Figure 4.

Different parts of the Earth are likely to experience different levels of warming and associated changes in different sectors. The latest IPCC projections of major impacts for Asia (IPCC 2007) include:

- By the 2050s, freshwater availability in Central, South, East and South-East Asia, particularly in large river basins, is projected to decrease
- Coastal areas, especially heavily populated mega-delta regions in South, East and South-East Asia, will be at greatest risk of increased flooding from the sea and, in some mega-deltas, flooding from rivers
- Climate change is projected to compound the pressures on natural resources and the environment associated with rapid urbanisation, industrialisation and economic development
- Endemic morbidity and mortality from diarrhoeal disease, primarily associated with floods and droughts, are expected to rise in East, South and South-East Asia because of projected changes in the hydrological cycle

Closer to Cambodia, other climate change projections conducted in the Mekong Basin (TKK & SEA START RC 2009) indicate that:

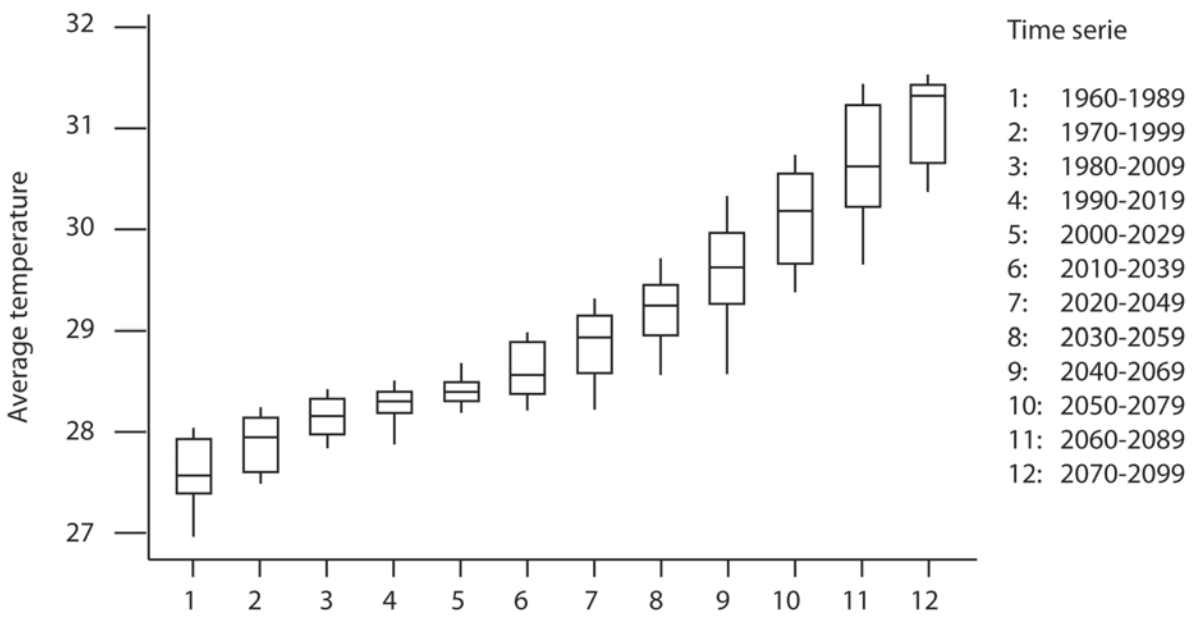
- The whole region will tend to be warmer, but the hot area will be much wider
- The hot period of the year will be much longer. The dry season will be longer and drier
- The wet season will start later (by around two weeks to a month), and will be shorter but also wetter
- Increases will be recorded in both daily maximum temperature and daily minimum temperature
- Precipitation will be higher and of increasing intensity
- Precipitation will fluctuate in the first half of the 21st Century, but will increase during the latter half of the century

These predictions of change across the Mekong Basin are likely to be observed within Cambodia.

Changes in average annual daily temperature can arise due to changes in actual daily temperature as well as in the number of hot days per year. Similarly, increased average rainfall does not only mean heavier rain, as

The science of predicting future climate change always involves a degree of uncertainty. Predictions of climate change in the future are firmly grounded in empirical science, but can only provide an impression of the future that is 'possible' or 'plausible'.

Figure 5: Historical and future mean temperatures over land area of Cambodia



Adapted from MoE 2010 (using SRESS model)

changes the number of rainy days will also change the annual average. Overall, the use of averages belies the complex nature of climate change effects, which can manifest as changes in duration of seasons, onset of seasons, or intensity of specific events such as typhoons, floods and droughts, There will be major differences across space and time within the region – but the day-to-day consequences may be much more complex.

For Cambodia and much of the Lower Mekong Basin, the most important climate variables will be related to changes in hydrology of the river, its many tributaries and floodplains, and the Tonle Sap Lake (TKK & SEA STARTRC 2009).

Predictions for Cambodia

Temperature change

According to the latest technical assessment by the MoE (MoE 2010), Cambodia's temperature has been rising steadily over the past 50 years (see figure 5). The country can expect further increases in temperature during the course of this century, with an acceleration expected after 2030. A number of studies covering Cambodia indicate greatly varying degrees of the temperature change by the end of the century, depending on the model used and the level of anticipated GHG emissions. Assessments by two General Circulation Model (GCM) models indicate that under the High Emissions scenario, the rate of temperature increase will be at least 2°C, and possibly as high as 2.5°C, by the end of the century. Other studies suggest temperatures will increase from 0.7°C to 2.7°C by the 2060s (McSweeney et al 2008).

Even within Cambodia, variations in temperature increase are expected depending on location. The rate of temperature increase is predicted to be high in low-altitude areas such as central Cambodia and the northeast (0.036°C per year) and lower in high-altitude areas such as the south-west (0.013°C per year).

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Inventories in 1994 showed that Cambodia was a net sink country, able to absorb more GHGs (through its forests) than it was emitting through economic activities. However, by 2000 Cambodia had turned into a net emitter – the amount of GHGs emitted into the atmosphere exceeded the amount the country could absorb.

Despite variations in predictions, a common story still emerges: of very significant changes in temperature in Cambodia.

Precipitation

Projections of precipitation depend on the GHG emission scenarios that are used as well, as the selection of climate models and the duration of the time period that is covered. Analysis of past and future rainfall changes is complex due to lack of reliable data and the technical challenges of such aspects as modelling rainfall and runoff. While there is a clear need for more data and further research, the picture that emerges is of variations in precipitation expected in different locations and at different periods during this century, leading to an increase in variability and uncertainty of water availability (Johnston et al., 2010).

> "In 1979, we had thick forest. But now there is neither forest nor flooded forest. As a result, there is no shade on the land, and that is why the land is becoming dry. According to my parents, when large forests are destroyed, then there is no moisture in the soil, because the forest conserves the water."
>
> *Village Chief, Kampong Chhnang (MoE/BBC Trust 2011)*

Sea level rise

The SNC projects coastal inundation in Cambodia based on the rate of sea level rise predicted by IPCC (2007), which indicates a rate of about 1.7 cm per year under the 'high GHG' emission scenario. At this

pace, the permanent inundation of some 25,000 ha of coastal zone following a 1m rise in sea level is expected within 90 years. However, modelling sea level rise is notoriously complex, and historical evidence suggests that this figure might be a significant underestimate. Current experience in coastal areas also points to the risks of increased salinisation.

Cambodia's contribution to global warming

Calculation of GHG emissions by source likewise is complicated and intensive. In Cambodia, the MoE has conducted such calculations twice, as GHG inventories for the years 1994 and 2000.

Figure 6 shows that total emissions in Cambodia for the year 2000 amounted to 47,002.85 Gg CO_2 eq, of which 24,908.82 Gg was CO_2, 973 Gg was CH_4 and 9. 82 Gg was N_2O (MoE 2010).

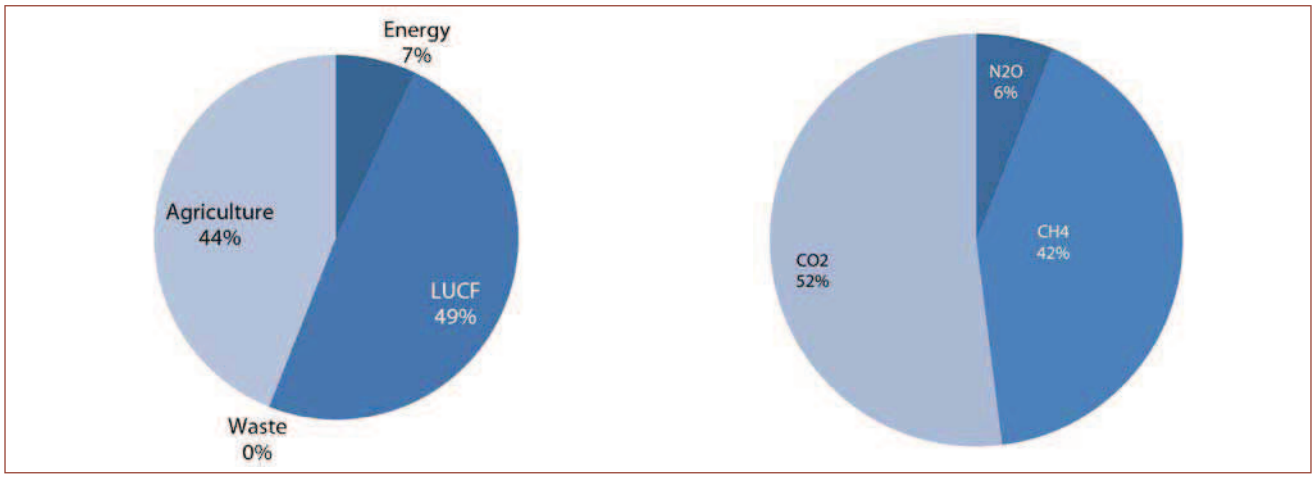
The inventories in 1994 show Cambodia was a net sink country, able to absorb more GHGs (through its forests) than it was emitting (through economic activities such as industries, transportation, housing, agriculture and land use change). However, by 2000 Cambodia had turned into a net emitter (i.e. the amount of GHGs emitted into the atmosphere exceeded the amount the country could absorb).

> "The seasons are not regular now. Before, we used to have rain in April or May. In April we would have some rain, then in May we had a lot of rain that allowed us to farm. But nowadays, we have a lot of rain in April, but none in May. It was dry in May. A lot of rice failed. That is climate change. It changes even the seasons. We could not produce anything from the rice paddy. Normally, we sow rice in May when there is some rain. But at the end of May, all the rice failed because we did not have rain. And the rain is not regular. Furthermore, there are many storms. This year is very strange. We have not had much rain; we have only had storms. You can see many houses were destroyed by the storms."
>
> *Village Chief, Kampong Thom (MoE/BBC Trust 2011)*

Unlike the breakdown of the global contribution to GHG emissions, in which industries account for the largest proportion, the largest emission source in Cambodia in 2000 was land use change and forestry/grassland conversion (49 percent), followed by agricultural activities (44 percent) and energy (7 percent). Thus, Cambodia became a net GHG emitter even without large-scale industrialisation, a trend that findings of the SNC suggest is increasing rapidly (MoE draft).

It is therefore important that future development can be achieved with reduced GHG emission. As in any other country, the reduction of emissions in Cambodia

Figure 6: Cambodia GHG emissions breakdown by sources (in CO_2 eq)



Source: MoE 2010

has the same potential for global benefits. This means that Cambodia can benefit from the financing and technical assistance being made available to reduce global GHG emissions. Such assistance includes carbon financing, technology transfer, and official development assistance (ODA) targeting low-carbon development. This has the potential to open new development pathways to assist Cambodia's economic growth and at the same time reduce potential emissions by addressing current drivers – land use change, deforestation and agriculture.

Perceptions of climate change among Cambodian people

The perception that something is changing in the climate appears to be gaining ground among people from all walks of life across Cambodia. It is sometimes difficult to determine if people are talking about changes in the 'weather' or in the 'climate' – and indeed, the Khmer language does not make this distinction clear. But whatever is happening, the changes that people are observing and experiencing appear to correspond with the kinds of changes that climate science predicts for the country.

According to the recent study "Understanding Public Perceptions of Climate Change in Cambodia" (MoE/BBC Trust 2011),[10] among 2,401 Cambodians interviewed across 24 provinces, many said that the weather and environment are changing.

Almost all interviewees recognised the terms 'climate change'[11] and 'global warming'. Of those who knew the terms, 98 percent said that climate change was affecting the country already, and 75 percent said that it will affect it in the future.

The survey also demonstrated that, for Cambodians, the terms 'climate change' and 'global warming' are closely linked to concerns about deforestation, drought and increase in disease, which are among the most important issues for the country.

During mid-2010, Cambodia experienced an unusually long dry season, late rains and occasional storms. Farmers had to replant their rice crop, in some cases three times, struggling with water shortages. The media widely reported on people's worries for the year's harvest. The low levels in the Mekong River, the lowest since 1992, were also widely reported – sometimes attributed to upstream dam development, sometimes to climate change – but again with fears for the annual fish catch.

Yet rural people's explanations for why the climate has been changing are remarkably similar. The changes are firmly linked to perceptions of deforestation and land use change, which in turn are associated with economic land concessions and the privatisation of public natural resources. Significantly, these changes in the local environment are explained by failures in governance, but with clear, tangible and immediate impacts on people's well-being and livelihoods (MoE/BBC Trust 2011).

Current state of knowledge on Cambodia

With increasing concern for climate change in Cambodia and the region, associated research and publications have seen an upsurge. This has created a growing body of knowledge on the country, and research activities, both domestic and international, are expanding.

As Figure 7 illustrates, most of this research has focused in key sectors on issues relating to vulnerability and adaptation. This focus is consistent with the emphasis placed on research activities around the broader issues of poverty, natural resource management and sustainable development in the last decade. There has been some study of low-GHG emission options, including renewable energy and

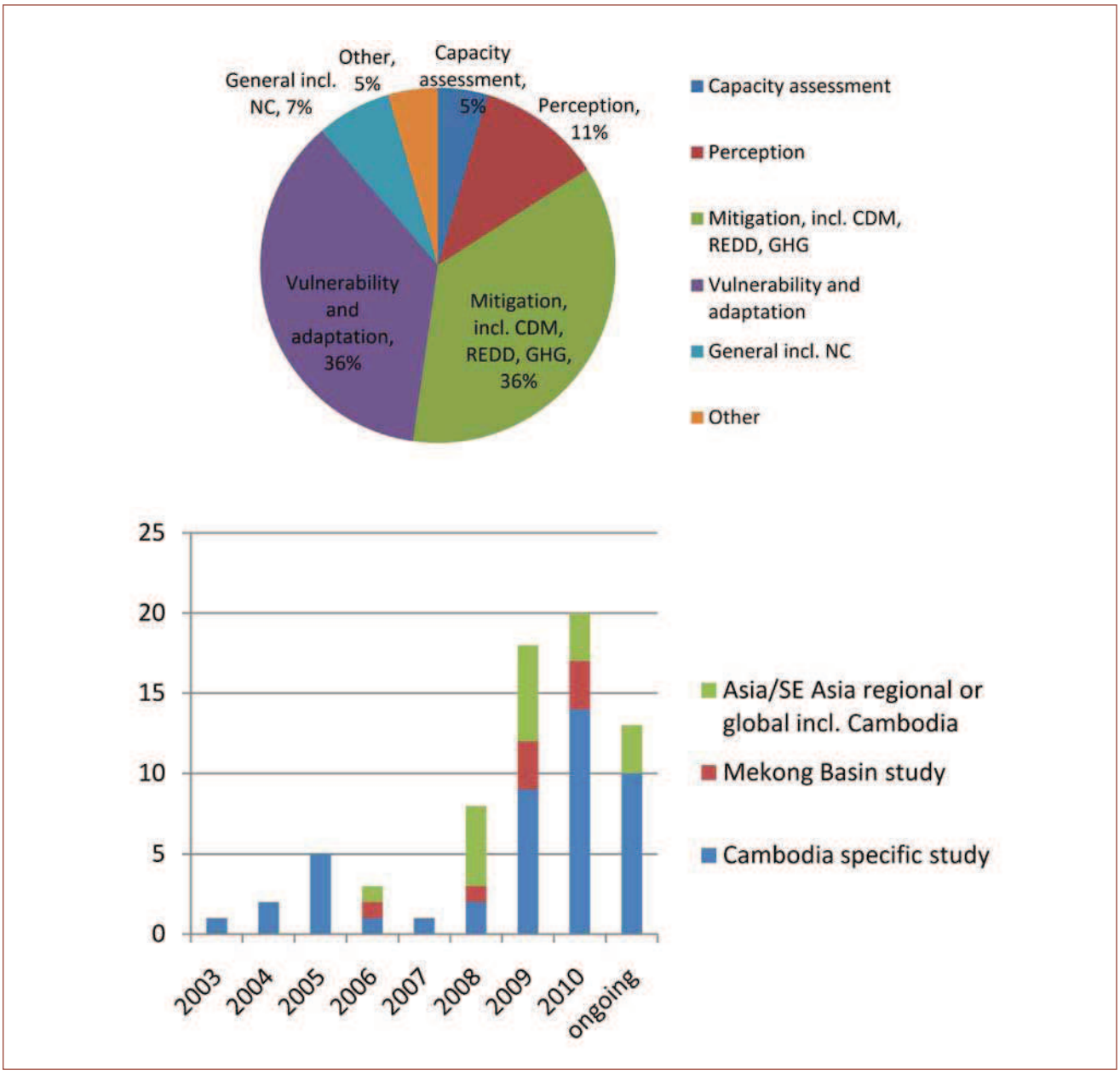
energy efficiency, but far less work on the social and economic dimensions of climate change. Often knowledge is generated from the perspective of a particular sector (such as agriculture or water) or from a particular thematic interest (such as climate change and children). These studies clearly add valuable insight. However, capturing the inter-related dimensions of climate change has proved to be more complex.

In general, this is consistent with major research gaps evident in the South-East Asia region. The main gaps in current research efforts related to understanding local and informal institutions, and issues of equity including gender (Resurreccion et al 2008).

Key climate change concepts for building resilience

Climate change science has concluded irrefutably that the world is experiencing changes that are the result of man-made GHG emissions. However, the ability and willingness of the global community to take the

Figure 7: Breakdown of studies in each sector.



Source: Based on reports available with UNDP / authors by December 2010.

The Tonle Sap Great Lake

The vulnerability of the Tonle Sap Great Lake is a function of exposure, sensitivity and adaptive capacity. The Tonle Sap Great Lake is exposed to flooding as part of the annual cycle. It is extremely sensitive to changes in flooding patterns as the natural productivity depends on the reverse flow from the Mekong into the Tonle Sap river and into the Great Lake. The complex hydrology is critical for natural fisheries and agricultural productivity on which millions of people depend, and which contributes to national economic development – any slight changes in flooding and hydrology will influence this. The sensitivity of the Tonle Sap should also be seen in relation to the high incidence of poverty among the large numbers of people who live there. Adaptive capacity – the ability to cope with exposure and sensitivity – is also limited. Rural people have few viable livelihood options, while the institutions and legal frameworks for managing the lake are not fully in place.

necessary actions to reduce global GHG emissions has yet to be fully demonstrated.

Actions to reduce sources of GHG emissions or increase sinks for emissions are referred to as mitigation. Despite the lack of concerted global action thus far, there still exist important opportunities for mitigation – for finance and technology transfer based on global climate change finance agreements – and mitigation will very much shape future economic and social development.

Nonetheless, much of this type of action will not bear fruit for many years to come. In the meantime, the current rate of increase in GHG concentrations is such that the adverse effects of climate change will certainly be experienced.

Subsequently, people will need to adapt to the inevitable consequences of climate change, to the extent to which they will be able to cope and adjust. Central to this thinking are concepts of 'vulnerability' and 'adaptation'.

Within the arena of climate change, the IPCC (2001) defines vulnerability to climate change as *"the degree to which a system[12] is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes."*

Vulnerability to climate change can be thought to depend on the inter-relationship of three key elements (IPCC 2000):

- **Exposure of a system:** The extent to which it experiences environmental or socio-political stress, in terms of magnitude, frequency, duration and extent
- **Sensitivity of the system:** The degree to which it is modified or affected by perturbations
- **Adaptive capacity of the system:** Its ability to evolve in order to accommodate environmental hazards or policy change and to expand the range of variability with which it can cope

In the broader context of development, climate change is just one factor contributing to people's overall vulnerability. Thus, exposure, sensitivity and adaptive capacity can be seen as being themselves determined by variables of political economy and, critically, how

Box 4: Key concepts: Climate risk and adaptation

Climate risk denotes the result of the interaction of physically defined hazards with the properties of the exposed systems – i.e. their sensitivity or social vulnerability. Risk can also be considered as the combination of an event, its likelihood and its consequences; risk equals the probability of climate hazard multiplied by a given system's vulnerability (UNDP, APF 2005).

Climate change adaptation refers to the actions that people and institutions make in anticipation of, or in response to, a changing climate. This concept includes both what it is that people and institutions do, and the way in which they act.

Climate change adaptation	Varieties of adaptation
Adaptive capacity – The potential of individuals, communities, societies (organisations/institutions) to be actively involved in the processes of change, in order to minimise negative impacts and maximise the benefits from changes in the climate. **Climate change resilience** - When referring to natural systems, the amount of change a system can undergo without changing state. If referring to human systems, resilience is often synonymous with adaptive capacity (IPCC TAR 2001). **Beyond resilience** – The term resilience is often used to indicate the ability of systems – whether natural, social or economic – to bounce back from shocks and crises to their 'normal' condition. However, the term has come under criticism for the way it is used in developing countries that face persistent issues of poverty and inequality. While these conditions might be somehow 'normal,' they are certainly not desired outcomes. Resilience to shocks and crises for these countries is not simply a matter of bouncing back to these conditions – but being able to absorb shocks and crises in such a way that overcoming poverty and inequality can still be possible.	• **Planned adaptation** - The result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain or achieve a desired state (IPCC 2007). • **Autonomous adaptation** – Refers to adaptation that does not constitute a conscious response to climatic stimuli, but rather is triggered by ecological changes in natural systems and by market or welfare changes in human systems. Also referred to as spontaneous adaptation (IPCC 2007). • **Climate-proofing** – Ensuring that existing efforts (including infrastructure) are adapted so that they are more capable of absorbing climate-related shocks. • **Maladaptation** - An action or process that increases vulnerability to climate change-related hazards. Maladaptive actions and processes often include planned development policies and measures that deliver short-term gains or economic benefits, but lead to exacerbated vulnerability in the medium- to long-term.
Source: Adapted from the World Bank Adaptation Guidance Notes – Key Words & Definitions (http://beta.worldbank.org/climatechange/content/adaptation-guidance-notes-key-words-and-definitions)	

people cope in the broader context with risk and uncertainty. Vulnerability to climate change should therefore not be seen in isolation from other drivers of change and factors in vulnerability. From a human development perspective, addressing current vulnerabilities is a critical starting point for strengthening adaptation (cf. Kelly and Adger 2000).

A common theme emerging across the literature is that change – whether environmental, social or political – has different impacts on different people, creating positive opportunities for some and serious negative impacts for others (see Sen 1983). The degree to which people are vulnerable, and their capacity to cope and adapt, is determined by the combination of socioeconomic factors (exposure, sensitivity and adaptive capacity) – from the range of resources and assets they have available and are able to make use of, their wealth and poverty, power and influence, where people reside and where their resource base is located – and how these risks and responses are interpreted and perceived.

Inequality in terms of wealth and access to resources is closely associated with increased vulnerability to shocks and crises, including natural disasters. But conversely, social equity is strongly associated with greater resilience. This is particularly true for gender equity, given the different vulnerabilities of men and women and their different roles in household livelihood strategies. Greater gender equality – for example, in access to health and education, access to productive assets, to information and knowledge and to political participation and decision-making processes – can be central to climate change resilience (Foa 2010, p. 5).

Adaptation to climate change, therefore, is not a simple technical or financial matter. It is inevitably tied up with political and institutional processes and critical governance challenges that shape policy implementation and outcomes of shocks (Foa 2010). As such, democratic governments and civic rights with robust civil society institutions become critical elements in facilitating adaptation to climate induced risks (Foa 2010).

Building people's adaptive capacity in the face of high degrees of risk and uncertainty represents a core development challenge. This is often termed as building 'resilience' – ensuring that natural and socioeconomic systems are able to cope with change, shocks and crises by bouncing back to stable and sustainable conditions. For developing countries, this also entails ensuring continued reductions in poverty and improvements in well-being. For people – individuals and communities – resilience is about ensuring the full range of material, economic, social assets, entitlements and rights so that they can cope with shocks and crises, without becoming poorer and while continuing to improve their well-being.

The analysis of human development challenges presented in this report, and the discussion of options for building climate-resilient rural livelihoods, applies a framework for climate change vulnerability that draws on all this recent literature (Kelly and Adger 2000,

Actions to reduce sources of GHG emissions or increase sinks for emissions are referred to as mitigation. Despite the lack of concerted global action thus far. There still exist important opportunities for mitigation.

Mearns and Norton 2000a, IUCN et al 2004, Schipper 2007, Brown et al 2007, Prowse and Scott 2008, Davies et al 2009):

- **Asset base.** People's assets include the combination of different capitals – physical (housing, infrastructure), natural (land, forests, fisheries, water), social-political (kinship, friends, networks), financial (capital, savings), and human (knowledge, skills, good health)
- **Institutions, entitlements and rights.** The ability of people to convert their asset base into positive outcomes and livelihood benefits is influenced by social rules and norms (whether in communities, markets or states), legal frameworks and rights of access to and control over resources, protection of the rule of law, and wider dimensions such as social structure, class, gender and ethnicity
- **Knowledge and information.** This set of vulnerability variables also includes how people perceive and assess risks, their access to reliable information, their knowledge, and their capacity
- **Decision-making and governance.** This set of factors relates to the political economy, how decisions are made and by whom, how people are able to participate and influence outcomes, and issues of voice, power and influence

There exist several aspects of adaptation to climate change. (For a full discussion on adaptation options for Cambodia, see section 2.4, 3.1, 3.2 and 3.3).

Summary: Moving forward from 'predict and act'?

Climate change makes the future less certain and less predictable, and at the same time increases a wide range of risks.

As discussed above, the most thorough scientific investigations ever undertaken point clearly to climate change as a process that has already begun. Broadly, the science is clear on what to expect, albeit to varying degrees. Anecdotal evidence from across Cambodia corresponds with much of what the science predicts for the country.

However, although climate change science is critical for informing how Cambodia addresses climate change, science alone cannot be expected to provide all the answers. It is essential to move beyond simply 'predict and act' (cf. McGray et al 2007, Giddens 2009, Tadross 2010). Responding to an uncertain future is best achieved by drawing on a wide range of sources of information and different types of knowledge, and ensuring that different stakeholders can influence how decisions are made.

The starting point should understand current vulnerabilities as a way of thinking through the implications of climate change, and appropriate responses for building resilience.

CHAPTER 3

Assessment of Cambodia's human development: Poverty, vulnerability and adaptive capacity

Why we are interested in human development?

"The processes by which risk is converted into vulnerability in any country are shaped by the underlying state of human development, including the inequalities in income, opportunity and political power that marginalize the poor. Developing countries and their poorest citizens are most vulnerable to climate change. High levels of economic dependence on agriculture, lower average incomes, already-fragile ecological conditions, and location in tropical areas that face more extreme weather patterns are all vulnerability factors." (UNDP 2008, pp. 78-79)

Many of the "underlying states of human development" described above are clearly evident in Cambodia. As the discussion of climate change predictions reveals (Chapter 2), the sectors that are most vulnerable – water resources, agriculture, fisheries, forestry and health – are the same sectors that are most critical for rural livelihoods and human well-being. The changes predicted – in shifting agricultural and natural resource productivity, increased frequency and intensity of hazards and disasters, and changing patterns of disease and health problems – are those most closely associated with people becoming poor and destitute in Cambodia.

The sectors that are most vulnerable – water resources, agriculture, fisheries, forestry and health – are the same sectors that are most critical for rural livelihoods and human well-being.

Poverty is still very much a rural issue for Cambodia. Most of the population is rural, and by all estimates, the vast majority of poor people are in rural areas (up to 90 percent, according to World Bank 2007). The challenge of poverty reduction in the face of climate change is firmly grounded in addressing rural livelihoods and rural futures.

Understanding the dynamics of current poverty and vulnerability – why and in what ways people are poor

Box 5: What is Human Development?

"The contrast between what great things human beings can achieve, and what limited lives most women and men end up living, is truly remarkable."

Amartya Sen , 1998 Nobel Laureate in Economics

The human development approach arose as a result of growing recognition during the 1960s to 1990s that high economic growth rates do not translate automatically into an expansion of human welfare opportunities, and that poor countries have failed to prosper because they neglected the basic development of their people, and undermined people's freedoms and choices.

Human development considers people as the real wealth of a nation. It is about ensuring freedom to live long, healthy and creative lives with human dignity, empowering people to influence their lives and how decisions are made, founded on social justice and greater government accountability. Just as history has shown that a country's economic growth does not guarantee improved welfare of its people, experience from across the world has demonstrated that substantial development achievements are possible even without high growth. The human development approach considers people not just as the beneficiaries, but also as the key drivers of development, both as individuals and in groups.

Key elements of the human development approach include:

- Capabilities, freedoms and choices: Human development is both a goal and a process of empowering people to lead the lives they value by expanding their capabilities, freedoms and choices
- Equity: Human development is also about addressing structural disparities, focusing on the poor and other socially, politically and/or economically excluded groups defined by sex, age, income, ethnicity, location, physical/mental ability, etc.
- Sustainability: Human development places special consideration on environmental, social, economic and political sustainability. Policy options can be explored that offer win-win solutions by being sustainable in terms of environment, growth and human development
- Empowerment and Participation: Human development sees people as drivers of development, to be empowered to exercise individual choice and to participate in, shape and benefit from processes at the household, community and national levels
- Efficiency: Economic efficiency involves looking at whether people and institutions can be made better off by reallocating resources or goods, without making others worse off over time or across locations

From the human development perspective, poverty is a multi-dimensional condition defined as the denial of choices and opportunities to lead a tolerable life – including lack of necessities for material well-being (such as income, education, health and safe water) plus denial of opportunities to enjoy dignity, self-respect and other basic rights.

The human development approach has made an enormous contribution to the development thinking of the world, even as the concept continues to evolve with emerging needs for seeking sustainability and addressing global challenges such as climate change.

References: UNDP 2009c, Huq and Ponzio 2008

and vulnerable to becoming poor – is therefore central to understanding the human implications of climate change, and to identifying who is likely to be vulnerable. This is critical for thinking through appropriate actions.

Over the last decade enormous advances have occurred in our understanding of why people are poor, and how they manage their lives in the face of adversity. Across these various theoretical approaches, there is remarkable consistency in many important respects. This report now looks at climate change through a human development lens (see Box 5).

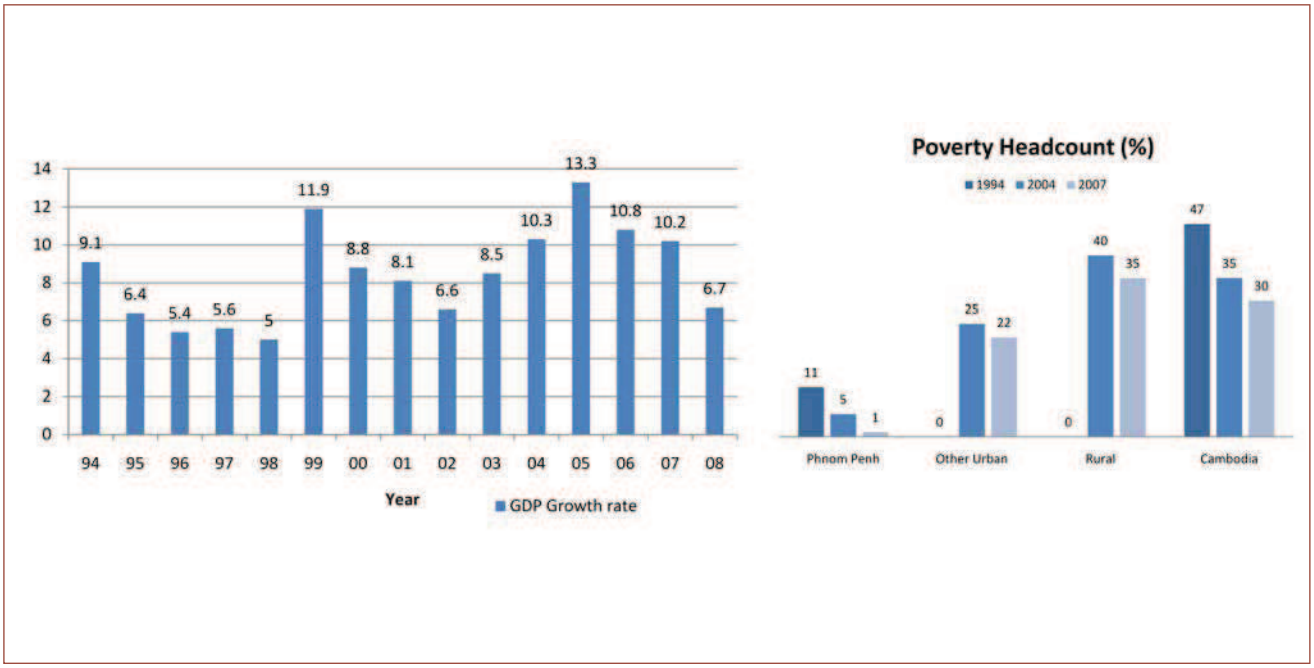
Human development is defined in the global Human Development Report (UNDP 2010b) as:

"...the expansion of people's freedoms to live long, healthy and creative lives; to advance other goals they have reason to value; and to engage actively in shaping development equitably and sustainably on a shared planet. People are both the beneficiaries and the drivers of human development as individuals and in groups".

Underpinning these understandings of poverty is the focus both on people's assets – physical, natural, financial, human, social and political – and the ways in which people can access and convert assets into tangible benefits. The focus on assets draws attention to diverse types of assets: land, labour, livestock, natural resources (forests and fisheries), agricultural inputs and credit, health services, safe drinking water and sanitation, food and nutrition, knowledge and information, and skills. But it is also important to consider entitlements, or the ways in which people are able (or not) to convert these assets into benefits, and how these are shaped by institutions and processes such as the influence of markets, community structure, local development planning institutions, how decisions are made, laws and policies, and the accountability of state processes.

In the analysis of human development in Cambodia that follows, poverty is not simply a matter of a lack of income, although income is centrally important. Instead, the analysis presented in this chapter is based on an understanding that poverty and vulnerability have many dimensions. The discussion pays attention to some of the most critical aspects of poverty in rural Cambodia as the basis for assessing future climate change vulnerability and adaptation options.

Figure 8: Annual economic growth rate:1994-2008 and poverty headcount (%)



Figures show the annual economic growth rate 1994-2008 (RGC 2010), compared to the poverty headcount 2004-2008
Source: CSES 2007, WB 2009b

Assessing human development in Cambodia

Poverty trends in Cambodia

There exist many ways of looking at human development, poverty and vulnerability. Typically, measurement of poverty has been based on indicators of income and consumption.

Over the past decade, Cambodia has experienced rapid economic growth. The GDP growth rate in 2003-2008 "averaged around 10 percent per year, with a record annual rate of growth of 13.3 percent in 2005" (MoP 2010). Economic performance declined in 2008 compared with previous years, as a result of the global financial crisis (MoP 2010).

During this time of economic growth, poverty has also decreased substantially. However, a third of the population still lives below the national poverty line, "and the average rural poverty rate is 35 percent, much higher than the Phnom Penh rate of 1 percent and the 'other urban' rate of 22 percent" (MoP 2010).

Cambodia's poverty line

It is important to recognise that Cambodia's official poverty line (see Table 2) is set at a level that is extremely low – only about half a US dollar a day. The sensitivity of poverty rates to the method of analysis can be seen by a simple shift in poverty line. For example, using the same statistics from the 2007 census as in the table, an adjustment in the poverty line to 4000 Riel (about US$1/day) would increase the poverty rate (see WB 2009b on Poverty Profile and Trend in Cambodia).

There is much debate about which poverty line should be applied in Cambodia. Despite progressive improvement in poverty reduction over recent decades, compared with other countries in the region, a great majority of Cambodians still survive on low incomes – and they are poor or close to being poor. With the kinds of shocks and crises predicted with climate change, this analysis is important for illustrating how vulnerable many people might be.

Table 2: National poverty lines by domain (2004 and 2007), in current riel per capita per day

Domain		2004	2007
Phnom Penh	Food	1,782	2,445
	Non-food	569	647
	Total	2,351	3,092
Other Urban	Food	1,568	2,274
	Non-food	384	430
	Total	1,952	2,704
Rural	Food	1,398	1,965
	Non-food	364	402
	Total	1,826	2,367
National	Food	1,442	2,042
	Non-food	384	428
	Total	1,825	2,471

Source: CSES 2007, National figures derived from domains using CSES population estimates for 2007

Human Development Index analysis

The above poverty analyses based on income and consumption provide an important foundation for discussion, but the ways in which people are poor or at risk of becoming poor are more diverse and complex. Approaches based on a broader understanding of poverty and human development apply a composite index of income and non-income indicators.

For the last 20 years, the global Human Development Index (HDI), produced by UNDP, has sought to provide an additional perspective by including three key variables to assess human well-being:

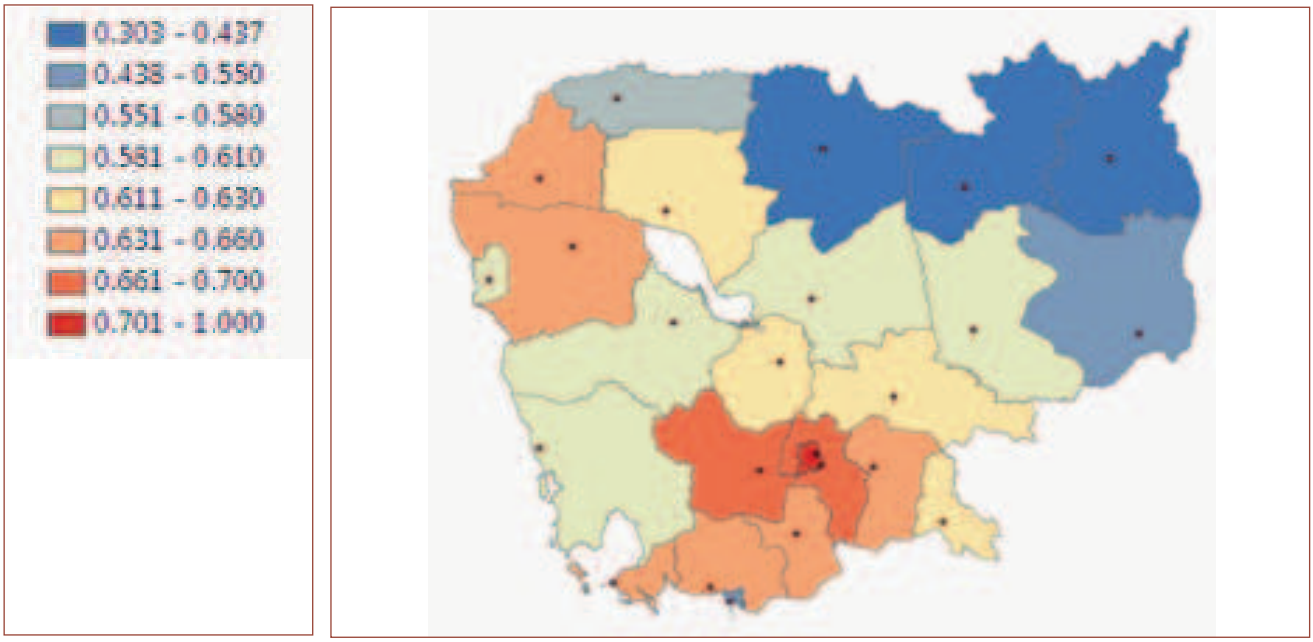
- Living a long and healthy life
- Being educated
- Having a decent standard of living

The latest HDI for Cambodia (see Annex for further details) draws on statistics from the Commune Database (CDB) and provides a picture of relative performance across the country in improving well-being according to health, education and income/consumption.[13]

By using the CDB, it is possible to generate an analysis of HDI disaggregated at provincial levels. Building on the global HDI framework, the indicators for the Cambodia Human Development Index are:

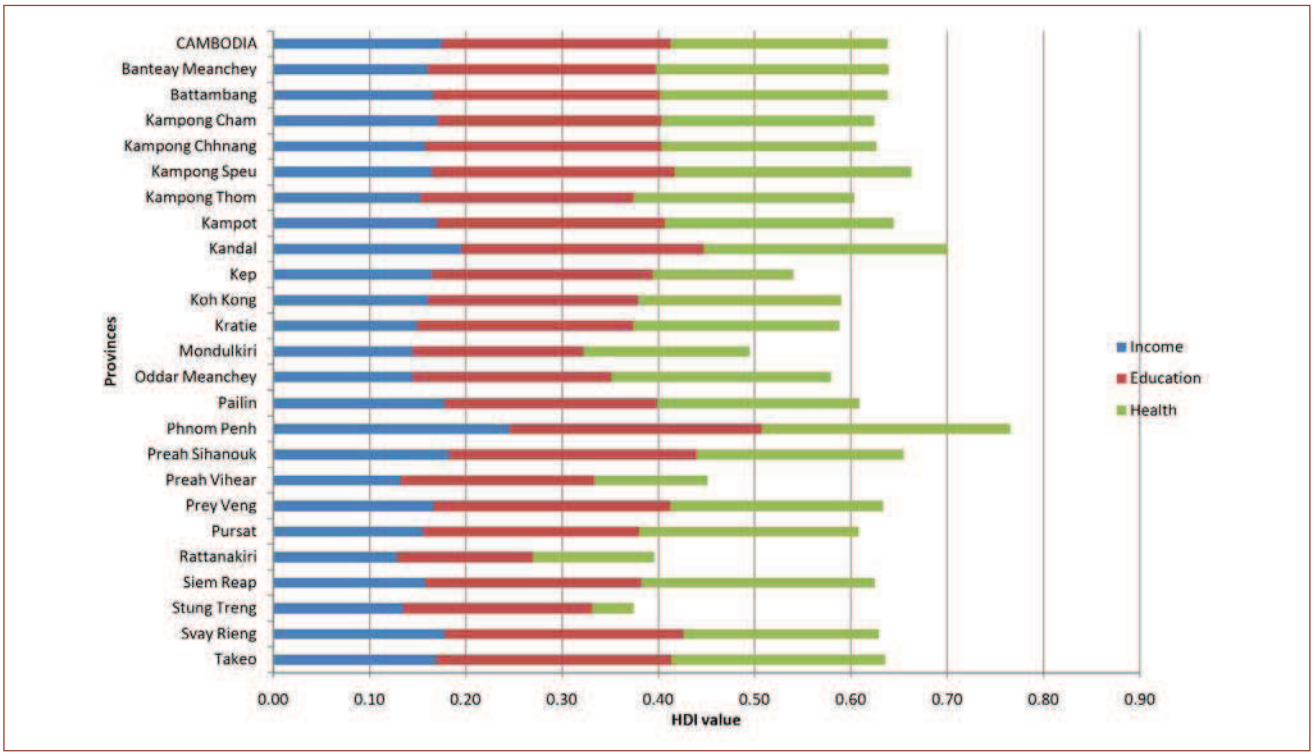
- Living a long and healthy life – based on child survival rate beyond age 5

Map 1: HDI performance across the country



Source: Computed by the HDI analysis team (NCDD)

Figure 9: Cambodia Human Development Index 2010

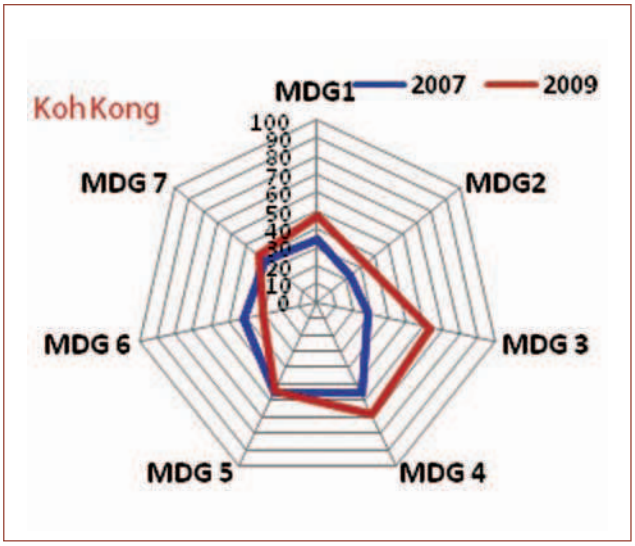


Source: Computed by the HDI analysis team (NCDD) 2010

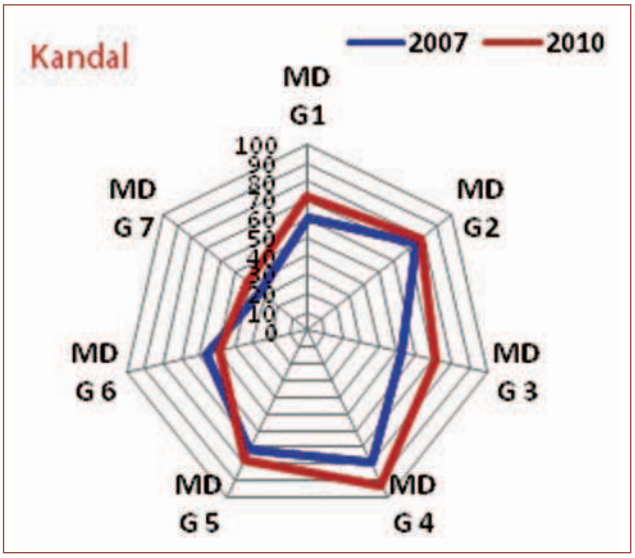
Figure 10: Provincial CMDG scorecards of Kandal, Koh Kong and Stung Treng (2007 and 2010[14])

Cambodia Millennium Development Goals		Status
	Eradicate Extreme Poverty and Hunger	Off Track
	Achieve Universal Nine Year Basic Education	Needs Attention
	Promote Gender Equality and Empower Women	Needs Attention
	Reduce Child Mortality	On track
	Improve Maternal Health	Off Track
	Combat HIV/AIDS, Malaria and other diseases	On track
	Ensuring Environmental Sustainability	Off Track
	Develop a global partner-ship for development	
	De-mining, ERW and Victim Assistance	Moderately Off Track

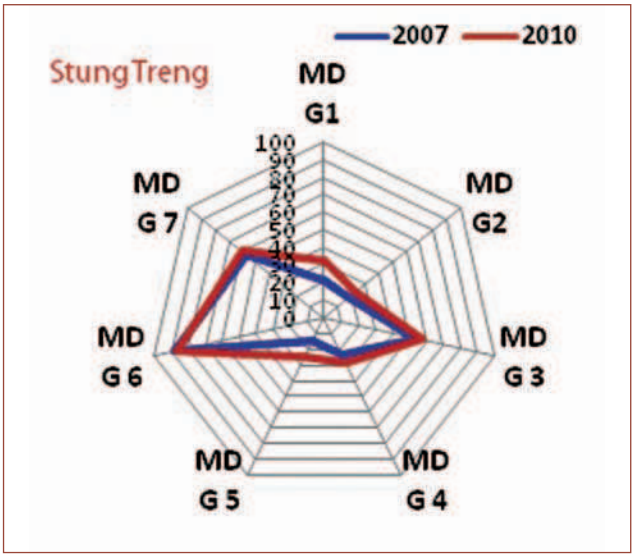
CMDC scorecard in Koh Kong



CDMG scorecard in Kandal province



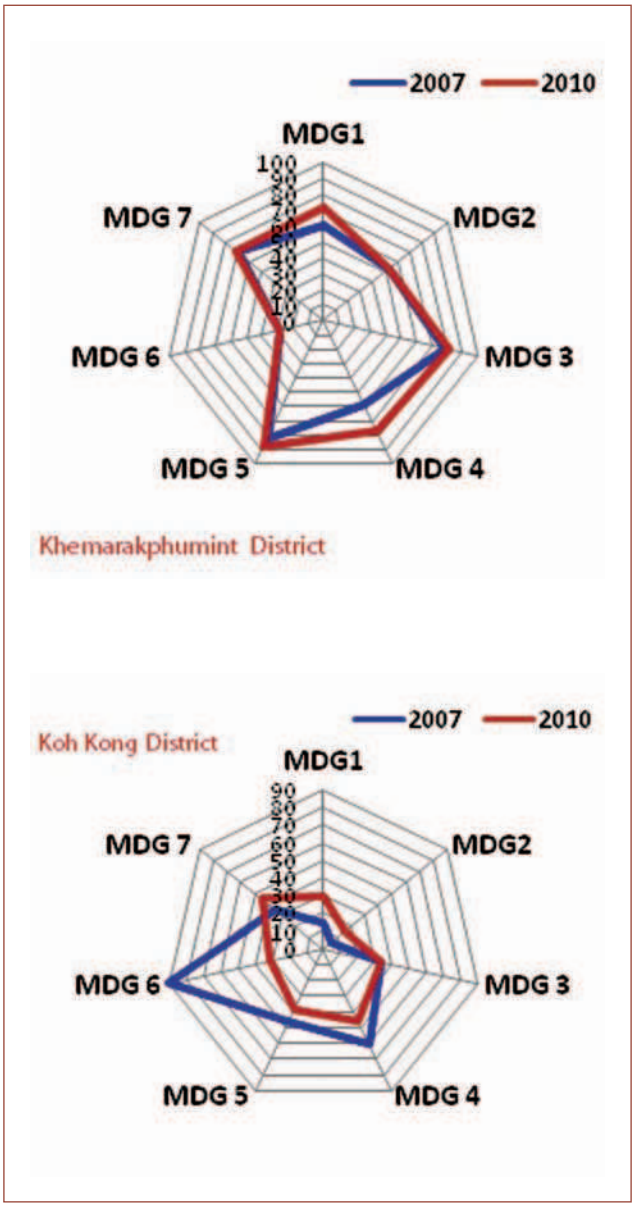
CMDG scorecard in Stung Treng



- Being educated – based on literacy rates of people aged 18-60, combined with school attendance rates for children aged 6-14
- Having a decent standard of living – based on consumption and expenditure expressed in Riel per day

The geographical distribution of HDI scores is presented in Map 1. It illustrates clusters of provinces with weaker HDI scores, as well as the relatively small number of higher-performing provinces in the south-east plains and Phnom Penh.

Figure 11: Comparative CMDG of two districts in Koh Kong Province



Source: MoP 2010

The performance of each province is determined by the combination of all three variables. Figure 9 demonstrates that human development in Cambodia does not always correspond directly with income. For example, some provinces, such as Pailin, have a relatively high score in terms of income, but their overall human development performance is lower than provinces with a lower income score. The analysis illustrates that education and health have major roles to play in improving human development and the quality of life of Cambodian people.

The variance in inter-provincial development performances becomes even clearer when we consider progress in reaching Millennium Development Goal (MDG) targets at sub-national level. In Figure 10 are found CMDG scores of Kandal, Koh Kong and Stung Treng, which lie in different ecological zones and respectively demonstrate high, medium and low HDI performances. At district level within the same province, differences in development performances are even starker.

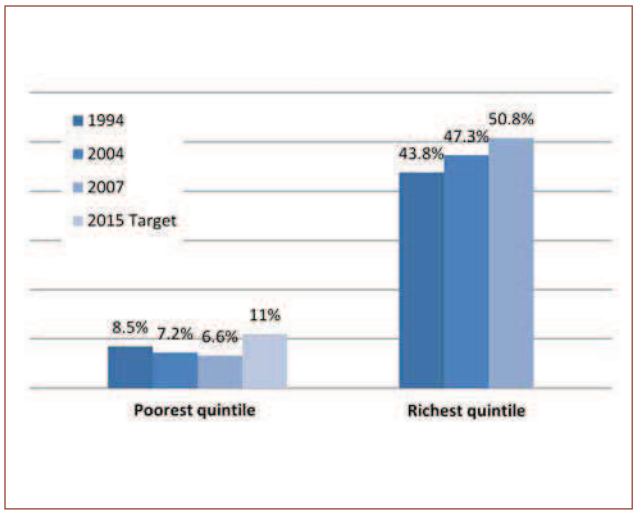
A separate, local CMDG analysis also illustrates the relatively low performance across the country in some key areas. Some provinces have made important inroads in meeting targets for child mortality (such as Kep), maternal health (notably, Phnom Penh) and HIV/AIDS and malaria (Mondulkiri, Preah Vihear, Rattanakiri, Oddar Meanchey, Stung Treng). Other provinces' rate of progress is very slow, with Kep standing out with regard to child mortality and Pailin on maternal health. Significantly, a 2010 CMDG gap analysis (MoP) points to three provinces as being behind schedule for meeting targets for reducing poverty and hunger (Pursat, Preah Vihear, Mondulkiri). But it is also striking that nearly all provinces score poorly in meeting MDG environmental targets. As is discussed in greater detail below, all of these targets are closely associated with climate change vulnerability. Slow rates of progress under current circumstances thus should be a cause for concern with the added threat of climate change.

Variations in performance become all the more clear when we look at the performance of districts within the same province. Figure 11 shows samples of CMDG performance in different districts of one of the three provinces mentioned above (example from Koh Kong).

In all, both the HDI and CMDG analyses reveal that:

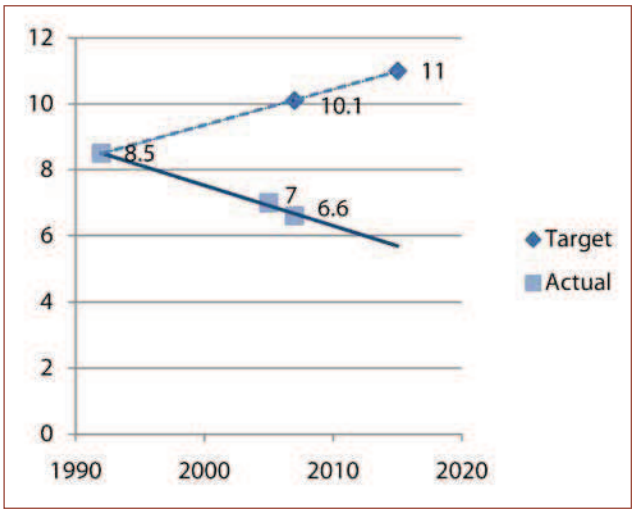
- Performance in human development is not solely determined by income. Some provinces with high income performance have low overall human development scores.

Figure 12: Evolution of share of national consumption of lowest and highest quintiles (2004-2007)



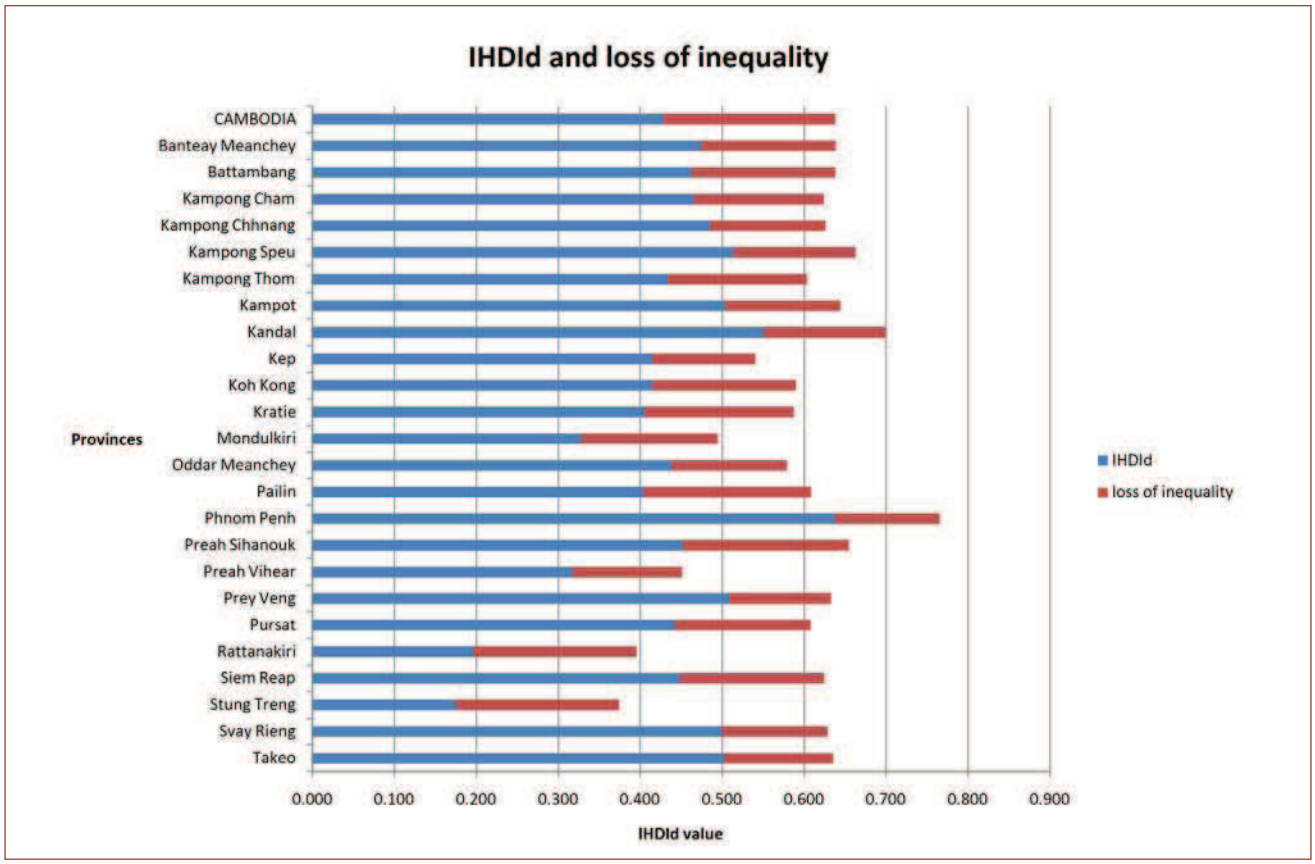
Source: CSES 2007 (WB 2009)

Figure 13: Planned and actual shares of the poorest quintile in national consumption



Source: CSES 2007, cited by CMDG Report 2010

Figure 14: Inequality-adjusted HDI- 2010 and loss in HDI at national and provincial levels



Source: Computed by the HDI analysis team (NCDD) 2010

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Where communities have been given viable natural resources to manage, evidence suggests that important economic benefits can be created.

- Development performance varies from province to province, and even among districts of the same province, in terms of the pace and areas of improvement. The performance of some districts demonstrates a long way to go in meeting several key MDG targets.

Inequality: Understanding trends

Cambodia faces a long-term issue of inequality, given that the period of economic growth and reduced poverty rates corresponds with a period of increased inequality, both between and within provinces. This issue of inequality is a key concern with regard to climate change. Inequality indicates the level of people's entitlements, or their ability to transfer assets into positive outcomes. Planned climate change adaptation strategies, as with other planned interventions, are likely to favour certain people over others, exacerbating existing discrepancies in wealth, voice and power. According to Roberts and Parks (2007), quoted in UNDP (2007/08, p. 80), **"countries with high levels of income inequality experience the effects of climate disasters more profoundly than more equal societies".**

In Cambodia, the share of national wealth, comparing the richest and poorest 20 percent of the population, displays a distinctly skewed distribution, as shown in Figures 12 and 13. The share of the lowest quintile in national consumption has fallen from 8.5 percent in 1993 to 6.6 percent in 2007 (WB 2009a); moreover, the performance in reducing inequality has slipped below RGC targets.

Figure 14 indicates that, when taking inequality across people and sectors into consideration, HDI scores decline in all provinces – but again, to different degrees. In a perfect world with no inequality, normal HDI scores and inequality, adjusted HDI scores would be the same (see Annex for the technical note on HDI computation used for this report).

Figure 15: GDP growth by sector before and during the global financial crisis

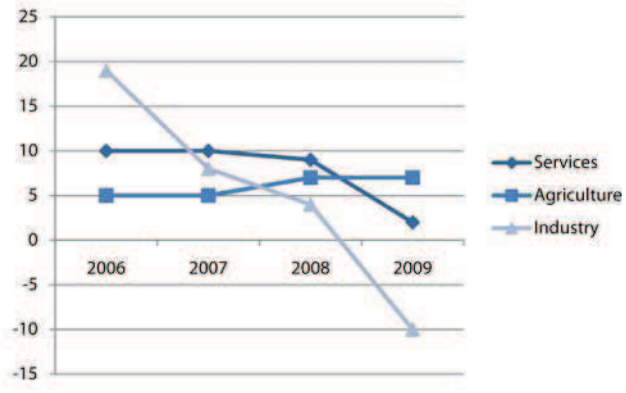
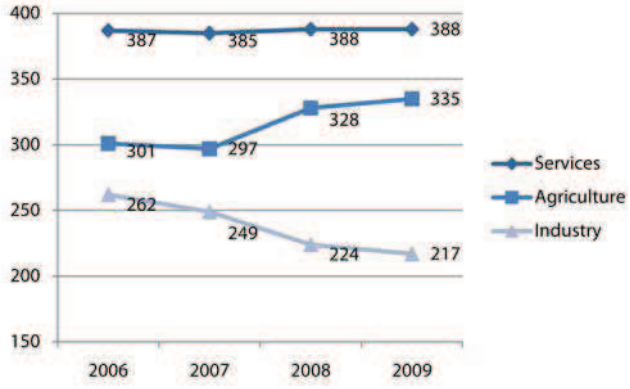


Figure 16: Contributions of sectors to GDP before and during crisis (% of total GDP)



Source: MEF, Mid-Term Macroeconomic Framework, March 2010 Update

Social equality is itself a goal and indicator of development. Unless inequality is reduced as part of national development, coping with inequality – and the disproportionate vulnerability of poorer people – will require transfers such as social protection measures that will require sufficient budgets and responsive institutions. This all has implications for national development. Social equality is also a matter of rights and voice – of being able to participate meaningfully and influence how decisions are made, of having access to information, and of rights to justice.

Rural livelihoods in Cambodia

To better understand the dynamics of poverty and vulnerability for rural people, it is important to understand rural livelihoods in Cambodia. Typically, rural livelihoods are characterised as being largely agricultural. While this description is true, it nonetheless masks the diversity of what rural people do and how people, households and communities manage their assets, opportunities, risks and challenges. The depiction of agricultural rural livelihoods also misses the dramatic social and demographic changes taking place across the country and the emerging linkages between rural and urban economies and markets, as well as the growing importance of off-farm employment for many farming households.

Yet agriculture continues to have a central place in rural livelihoods, accounting for at least a third of GDP (MEF 2010), and with around 9.5 million people (out of a total population of 14 million) involved in agriculture to some degree (FAO/MoP 2010). Rice farming continues to play a critical role in rural livelihoods and in the cultural imaginations of rural people. Even so, the relative contribution of agriculture to GDP has declined overall during the last 20 years as the industrial and services sectors have grown. However, during the last five years, in which Cambodia has faced economic, food and fuel crises, the agriculture sector has continued to grow, while the industry and services sectors have declined. Agriculture's contribution to GDP has also increased slightly in this period (see Figures 15 and 16). As a review of Cambodia's economic competitiveness argues, the "only sector which will provide any meaningful cushion as a short-term crisis buffer and a medium-term recovery and growth engine is agriculture" (UNDP Cambodia 2009, p. 5).

People in Cambodia are involved in a whole range of activities as well as farming, often raising livestock as insurance and savings and utilising natural resources,

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Rice farming continues to play a critical role in rural livelihoods and in the cultural imagination of rural people. Even so, the relative contribution of agriculture to GDP has declined overall during the last 20 years as the industrial and service sectors have grown.

particularly capture fisheries and forests. But they also increasingly engage in commercial activities and in selling their labour, either within rural areas or further afield.

The pace of change for rural livelihoods has been dramatic, and in many ways can be considered to be less exclusively rural. Off-farm employment is increasingly important. There are significant labour markets within the agricultural sector, and also in emerging manufacturing, small-scale industry and construction. These labour markets are in rural areas, provincial towns, and of course Phnom Penh, but also in neighbouring countries, most importantly Thailand. Much of this migration is unofficial, leaving migrant workers extremely vulnerable.

Both push and pull factors are at work in migration patterns. Migration can be a means of coping with shocks and crises and is associated with loss of crops, dealing with health shocks, and loss of land and indebtedness. But migration also appears to be a mechanism for diversifying household activities and securing additional sources of income to supplement agricultural activity, with some members of rural households migrating and sending remittances to support relatives at home as a regular feature of rural livelihoods (Pilgrim et al 2009, So 2010). With this kind of movement, the distinctions between rural and urban are becoming blurred and the linkages shifting.

Maintaining this degree of diversity of activities within the household is in many ways the basis for ensuring economic viability, and is itself an adaptive strategy for dealing with seasonality and external influences such as changing market pressures and opportunities. By necessity, rural livelihoods have always been adaptive – responding to and predicting changing circumstances, and juggling a range of different activities among different members of

Table 3: Landholdings (% of households)

	Landless	< 0.5 ha	0.5-1. ha	1-3 ha	> 3 ha	Total
Plains	24.8	26.3	21.6	20.0	7.2	100
Tonle Sap	19.2	17.3	20.5	29.7	13.3	100
Plateau	11.1	20.6	27.4	31.3	9.5	100
Coastal	22.8	34.1	22.0	17.9	3.3	100
Total	21.1	23.4	22.1	24.4	9.1	100

Source: Sophal 2008, based on national survey of 2,235 households in June 2008.

the household. This degree of adaptive capacity inherent in Cambodian rural livelihood strategies indicates the range of skills and capabilities that rural people possess, but also provides a sense of the considerable constraints and obstacles faced on a regular basis.

Climate change puts rural livelihoods once again under the spotlight, begging the question of both how rural people will be affected by climate change, and also for what kind of a future Cambodia should strive.

Access to and control over productive resources

Access to productive resources – land, water, forests or fisheries – is a critical component of rural livelihood security (Markussen 2008), ensuring people's agricultural production is economically viable, and giving them the security to make long-term investments.

Evidence across Cambodia suggests that access to these productive natural resources is seriously constrained. Indeed, the history of such access in post-conflict Cambodia has been fraught with tension and remains highly contentious. There exists widespread concern that access to these resources is determined by wealth, position and power, and that the most productive resources have been degraded, privatised and enclosed to the disadvantage of most rural people (CARD 2010).

Land

Secure access to land is fundamental for agriculture. Massive social upheavals during the Khmer Rouge regime and decades of armed conflict have severely weakened traditional customs regulating land use, and modern institutions for handling land disputes remain weak (Markussen 2008). This issue has become critical in Cambodia, where problems of tenure insecurity and land conflict are widespread and the situation has been described as 'anarchic" (NSDP 2010, p. 10). As a result, land conflict is a persistent feature of rural Cambodia (MoP/UNDP 2007).

As Table 3 illustrates, rates of landlessness in Cambodia are high. The national average indicates 21 percent of households are landless and another 45 percent land-poor, owning less than one hectare (Sophal 2008). This limits their productive capacity. In most circumstances, such small landholdings barely allow farmers to meet household subsistence needs, and act as the major constraint to farmers working to improve production and economic returns. With more than 60 percent of farmers living off less than one hectare (and even higher rates in the plains and coastal areas), access to land is a pressing issue across the country.

Significant progress has been made since 2003 in issuing land titles, which are key to helping resolve land disputes "By the end of 2009, 1,675,363 land titles had been issued, of which three-quarters were for rural land and one-quarter was for urban land. This represents about 24 percent of the total land plots to be registered" (MoP 2010).

Progress particularly accelerated in 2009, by doubling to more than 400,000 land titles issued. Although this remained below the projected 2009 target, if land titling continues at such a rate, it can reach 58 percent by 2015, slightly short of that year's target (see details from MoP 2010 on achieving CMDGs).

Forests and fisheries

Rural livelihoods in Cambodia also depend on harvesting forest and fishery resources. However, analyses differ with regard to access to these productive natural resources.

On one level, there has been a clear policy shift toward recognising the importance of common property resources in rural livelihoods, as well as their importance in contributing to poverty reduction. For

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Over the last decade, important improvements have occurred in Cambodia's health indicators, but as with other indicators, the national improvements are starting from a low baseline; the quality of health services may require further strengthening.

example, this has included policies on Community Forests (CFs), Community Fisheries (CFis) and Community Protected Areas (CPAs), and registration of communal land by indigenous peoples. Where communities have been given viable natural resources to manage, evidence suggests that important economic benefits can be created – and if management regimes are sufficiently transparent and accountable, benefits can indeed accrue to poorer people (Blomley et al 2010).

At the same time, the costs of losing access to common forest lands and resources can be dramatic. Often the people that depend on these resources subsist with very little buffer against shocks and crises. As people in the Sesan River basin explain the situation, "We are caught between the tiger and the crocodile": unable to access the forests because of concessions, and unable to derive benefits from fishing because of rapid declines in natural productivity (ADB 2010).

Welfare: Health, education and nutrition

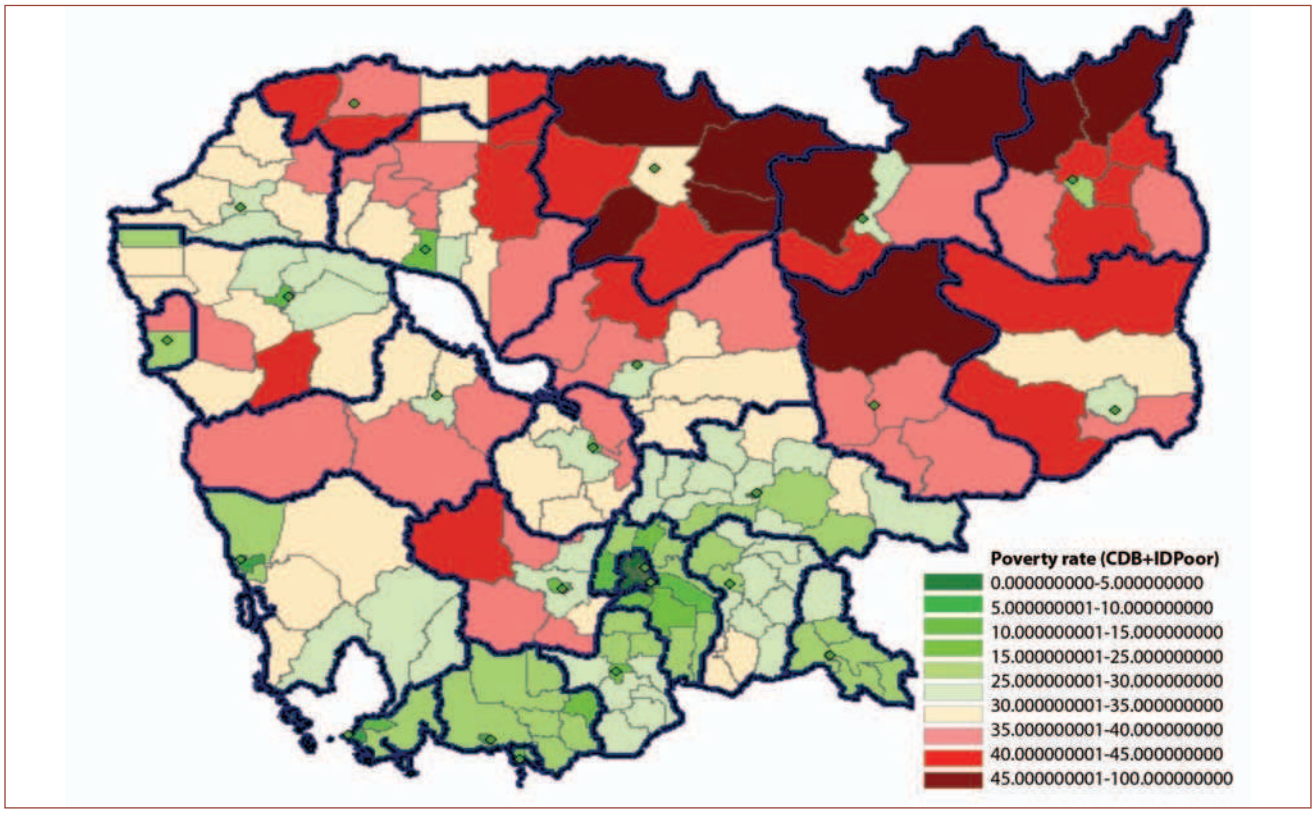
Health, food security and education are key determinants of human development and well-being, yet it is also in these areas that Cambodia has historically faced many constraints (So 2010).

Table 4: Access to improved drinking water in rural areas

Indicator	2006	2007	2008	2010
Access to improved drinking water as % of rural population	42.6	45.5	40.49	43.49
Access to sanitation as % of rural population	16.5	16.7	23.24	25.0

Source: RGC (2009), NSDP 2009-2013

Map 2: Map showing food deficit in Cambodia



Source: Boret et al 2009, The Commune Database, Ministry of Planning Map by NCDD PST M&E Unit, 2009

Health

Ill-health is consistently identified as one of the main factors in people becoming poor and destitute.

Over the last decade important improvements have occurred in Cambodia's health indictors, but as with other indicators, the national improvements are starting from a low baseline; the quality of health services may require further strengthening.

Improvements in access to health service provision through health care centres and hospitals are acknowledged across all recent studies (CAS 2008). The government along with development partners has established a Health Equity Fund (HEF) to exempt the poor from user fees, with 1.3 million people exempted in 2007 (Naron 2009). However, in many cases poorer people remain less able to access such services and "the benefits of health care are eluding the poor" (Naron 2009, p. 403). More than a quarter of patients have to borrow money or sell property to cover health care costs.

The quality of health services is extremely variable across the country and for different people. Although the number of doctors, other health personnel and medical beds available in public hospitals has increased since 1990, the number of people per doctor remains very high and was stagnant from 1997 to 2005 (Naron 2009). Significantly, these services remain less

Table 5: Male and female illiteracy rates

Age group	Male illiteracy rates %	Female illiteracy rates %
15-24 years	16	23
25-44 years	22	40

Source: RGC 2009

accessible in times of crisis, with physical access at certain times of the year undermined by flooding (Naron 2009).

Even so, Cambodia has made significant progress in reducing the prevalence of major diseases, and has been internationally recognised for its efforts in response to HIV/AIDS (MoP 2010) while making steady progress in reducing fatality rates from both malaria and dengue.

However, when compared with other countries of South-East Asia, Cambodia still has a high incidence of malaria, tuberculosis and HIV/AIDS (UNDP Cambodia 2009). This level of ill health also has an impact on national economic performance, with Cambodia being ranked well below other South-East Asian countries (UNDP Cambodia 2009).

Food- and water-borne diseases remain critical factors in the prevalence of illness. There are many reasons for this (MoH 2010). Despite improvements, the percentage of rural people who have access to safe water and sanitation is still very limited. Access to water has only improved slightly since 2006, and more than half of rural people still do not have access to improved drinking water (see Table 4). Villagers often only have a single water source for drinking (including ponds, streams or rivers), which can be easily contaminated. Access to sanitation for rural people is also extremely low (see also Table 4). Even if there is access to toilets, education regarding their appropriate use is often lacking. Water and sanitation programmes may not reach very remote parts of the country, and infrastructure may not be accessed or maintained. The combined costs of poor access to sanitation in Cambodia (medical costs, loss of labour and productivity, etc.) are estimated at US$448 million, equivalent to 7.2 percent of GDP (World Bank 2008a).

It is estimated that only 30 to 40 percent of people in Cambodia boil or treat water from potentially contaminated sources. Childhood mortality due to diarrhoea remains high, with 16 percent of deaths among children under 5 years attributable to diarrhoeal disease (MoH and WHO 2010).

While maternal health has improved, maternal mortality rates remain high. There is an urgent need to reduce the high Maternal Mortality Ratio, which stands at 461 deaths per 100,000 live births and is among the highest in the region, making it unlikely that Cambodia can reach its CMDG target of 250 by 2015 (MoP 2010).

Moreover, child mortality is identified as one of the CMDG targets for which there has been the most progress. Yet child mortality is still high, and Cambodia is ranked lowest among eight countries in the Association of Southeast Asian Nations (ASEAN) in terms of infant mortality, as well as life expectancy and education (UNDP 2009a).

Health also represents a major factor in people becoming poor. In Cambodia, people's resilience to health-related shocks is limited. If the intensity and frequency of these shocks were to increase, it would bring additional pressures that could become unmanageable (CARD 2011).

Table 6: Disasters experienced 2004-2007, by consumption quintile (%)

	Per capita consumption quintile					
Survey year	Poorest	Next- poorest	Middle	Next-richest	Richest	Cambodia (national)
2007	85.6	82.2	82.2	72.0	40.9	72.5
2004	90.0	90.1	88.0	83.7	64.7	83.4
Difference	-4.4%	-7.7%	-5.8%	-11.7%	-23.8%	-10.9%

Source: Compiled from CSES 2007 Tables 18 and 29

Box 6: Dealing with shocks and crises: Examples from the economic downturn

The overall picture for Cambodia emerging from HDI analysis suggests that the impacts of the global financial crisis have not been as severe as anticipated, and were buffered to a large degree by a period of improved agricultural productivity. However, more detailed household-level research indicates the level of hardship felt by many people (Tong 2009). Studies of the effects of the economic downturn, based on extensive research among rural households in March 2008 and May 2009, indicate that household consumption fell dramatically, by 30 percent and 23 percent respectively, and was accompanied by significant sales of assets, including livestock. While the strategies that rural people adopt are in themselves not unusual, it is striking that people have largely been left to their own devices to respond to these kinds of shocks. This indicates a gap in terms of the State's role in providing a means of social protection.

Food security and nutrition

Food security and nutrition are key determinants in human health and well-being, and at the heart of achieving development objectives. It is also in the areas of food production systems and distribution that some of the greatest threats associated with climate change exist for Cambodia. Different aspects of food security need to be considered.

Despite achieving a surplus in rice production, many people in different areas of the country face food insecurity. Food poverty has only fallen from 24 percent to 18 percent (MoP 2010).

Food, in turn, is an important component of child health in particular. Cambodia records extremely high rates of stunting. In 2007, 51 percent of children under 5 were moderately stunted, while 28 percent were severely stunted (WB 2007). This means that a total of 79 percent of under-5 children – nearly 4 in 5 – were stunted to some degree. The CMDG Report 2010 also suggests that the percentage of children suffering from wasting increased from 8.4 percent in 2005 to 8.9 percent in 2008. Child mortality likewise is closely associated with food security and nutrition. According to MoH, malnutrition is a factor in 54 percent of deaths of under-5 children (MoH 2010).

These extremely high rates have profound implications for the physical and mental development of Cambodia's next generation, and thus its potential contribution to national development.

Education

Knowledge is intimately linked to human development and key variables of poverty.

In general, important improvements have occurred in the availability of and access to schooling across the country.

More schools and their increased physical accessibility means that overall school enrolment has improved. In addition, improvements have been found in the highest grade that students have achieved, even among poorer households (WB 2007). At the same time, a persistent disparity in education levels between women and men is clear from comparing basic education statistics (see Table 5).

However, for younger people gender disparities in primary and lower secondary education have largely been eliminated (MoP 2010).

Critically, the quality of education remains a serious issue. Qualifications of teachers in rural areas limit the effectiveness of education provision, with fewer than a quarter of teachers having completed upper secondary education (Naron 2009). The relevance of education in terms of building a skilled workforce and of people's

ability to participate as active citizens also remains questionable.

Clear linkages also exist between education and health. For example, rates of stunting and wasting among households in which women have completed secondary school education or higher are significantly lower than those with no formal education. According to UNICEF (2009):

Among children born to mothers having no education, the rate of stunting was 45.8 percent and of being underweight 43.5 percent, while for children of mothers with secondary education or higher, the rates were 22.2 percent and 25.1 percent, respectively.

These concerns with regard to education performance become all the more important as Cambodia tries to absorb a growing youth labour force. With 300,000 young people entering the labour force each year, improving human capital will be a necessary feature of long-term development.

Natural disasters, shocks and crises

Poverty is a key determinant to people's vulnerability to natural disasters and their ability to recover. But natural disasters also cause people to become poor or, in some cases, destitute.

Disasters affect a significant proportion of all Cambodians, irrespective of wealth. However, the poorer the household is, the more significant the implications are. The comparison of two years' data in Table 6 also illustrates that despite a general reduction in the percentage of people affected by disasters, the rate of improvement is much lower for poor and middle-income groups. Dealing with disasters thus remains a problem that is intimately linked with poverty.

Living under pressure and fear of destitution

For many poor people in Cambodia, making ends meet is a daily struggle that involves countless difficult decisions about managing limited resources and limited labour. Illness or death of a family member, followed by natural disasters and crop losses, stand out as the main shocks and crises that rural households experience (So 2010). The threats of destitution, ill health and death of family members pose a source of constant worry.

The experiences of the recent global financial and food crises are still being assessed, but available analysis provides some important insights (see Box 6). The role of agriculture appears to have been extremely important in reducing the extent of the negative impacts among the rural population in Cambodia and suggests the need to pay greater attention to the agriculture sector (Jalilian et al 2010). At the same time, this experience also highlights the vulnerabilities of key groups – the elderly, women, children and people with disabilities.

As diverse as people are, there is remarkable similarity in the ways in which they try to cope with shocks and pressures. These include a combination of:

- Relying on less expensive food
- Purchasing food on credit
- Reducing food eaten during the day
- Reducing adult food consumption so that children can eat
- Reduced overall consumption
- Reducing expenditures on health care, and therefore having to tolerate chronic illness and, in some cases, death
- Borrowing, often adding to already high levels of debt
- Migration
- Sale of assets

Each of these coping strategies has implications for future livelihoods development. A question that

lingers for the discussion of potential climate change impacts is the degree to which people are able to respond to shocks and crises, particularly if these are to be more frequent and more intense. It is encouraging that recent external shocks indicate a reasonable degree of resilience. However, it remains to be seen how resilient people will continue to be from this weakened base – and what form of strategic support will be needed from the State.

Children and youth

Climate change remains an issue for the future, and as such, for future generations who will bear the costs of actions for which they have no responsibility. Responding to climate change is thus very much about how we prepare a world for our children and future generations.

The story of children and climate change is all the more important given the relatively young population of Cambodia and the many challenges that it faces under current circumstances. More than 65 percent of the people are younger than age 30, with 41 percent under 18 (NIS 2008) and more than 10 percent younger than 5 (NIS 2008).

Estimates suggest that a large number of children are living in poverty, with figures from 2004 indicating a number of about 1.7 million (MoP 2010). Many factors influence child poverty, including household size, ethnicity and health dimensions. As noted in the discussion above, nutrition levels for children in Cambodia stand out as key areas of concern.

Many children in rural Cambodian households also work. In 2001 more than 1.5 million children aged 5 to 14 were involved in some form of work. Now, however, Government targets to eliminate the worst forms of child labour and reduce the number of children working to 125,000 by 2015 appear on track (MoP 2010). Research suggests that of all children who are working, 80 percent work in the agriculture sector, but so far there have been no specific child

Climate change remains an issue for the future, and as such, for future generations who will bear the costs of actions for which they have no responsibility.

Box 7: Women: Key drivers of Cambodia's development

A total of 52 percent of Cambodia's agriculture workforce – in farming, fisheries and forestry – are women (FAO/MOP 2010). They are increasingly playing a lead role in private sector development and economic growth by establishing microenterprises and actively accessing credit. Their special role in ensuring the health and food security of family members is also well recognised. They could potentially be highly instrumental in addressing climate change challenges in rural Cambodia. However, women still lag behind men in terms of educational attainment, and data show that more girls than boys drop out of school to contribute to household incomes. Women also have less access to information and new knowledge, or to decision-making at all levels. Special attention is needed in order to realize women's potential in leading action to respond to climate change.

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Women comprise the majority of Cambodia's farming workforce.

labour policy measures addressed to this sector (MoLVT/ILO 2008). While working is often a necessary feature of farming households' coping strategies, this can impinge on children's rights to education, which also has implications for national human development. Greater pressure on rural households from climate change is likely to draw more children into agricultural work.

Gender

Poverty in Cambodia has a clear gender dimension. Women, and particularly female-headed households, tend to be poorer, with less social capital and less ability to access public services and to influence local decision-making. This includes access to resources, even within community-based initiatives (MoWA 2008).

According to MoP 2010, "Cambodia is on track to eliminate gender disparities in agriculture and industry". This report also shows that 75 percent of women's wage labour derives from agriculture while the percentage from industry remains very low. "Economic opportunities for women are still largely constrained, with most credit, training, extension and support programmes not sufficiently tailored to their needs".

The Ministry of Women's Affairs has developed specific activities related to climate change in their five-year plan, Neary Rattanak III. Cooperation through the line

Box 8: What does human development mean for different people?

Women: *Vulnerable to health impacts, critical role in ensuring food security for the family.*

Most working women in Cambodia are in the agricultural workforce. Despite important improvements, women tend to lag behind in education and access to public services, and tend to be underrepresented in community decision-making.

Youth: *Majority of the population.*

Vibrant future generation to move the country forward, but still lack needed skills and capacity.

Children and elderly: *Most vulnerable in times of natural disasters.*

Their health conditions impact livelihoods of the poor. Women are often responsible for caring for them.

Indigenous people: *Heavily dependent on natural resources and forest ecosystems.*

Already marginalised and impoverished.

ministries' Gender Mainstreaming Group, especially with MAFF and MOE, ensures that gender is taken into consideration in climate change-related responses and challenges. MoWA also works to promote gender responsive poverty reduction, agricultural and rural development policies and services, including mainstreaming gender considerations in national climate change adaptation and mitigation, policies, strategies, and dialogue.

Women have different roles in the household, and many areas of household vulnerability, such as collecting water, are areas that tend to be the responsibility of women and children. This can mean that women have to spend a large part of their day in trying to access safe water and are therefore less able to engage in other, more productive activities. This also suggests that impacts of vulnerability are currently felt harder by women, and that this will intensify with climate change (Fitzgerald and So 2007).

Poorer households are more likely to be headed by a woman, and there is widespread evidence across the country that divorce or abandonment by husbands or fathers contributes to their vulnerability (So 2010). This may also be related to patterns of migration, in which men leave the family ostensibly to seek employment and income. In many cases, however, the men do not return or send remittances to their families.

Summary

This analysis of poverty illustrates that Cambodia's performance in poverty reduction continues to improve in many respects. Nevertheless, a closer look at the sub-national level, looking in particular at CMDG performance, and at different dimensions of poverty, gives a different impression.

It is clear that a great many people in Cambodia remain poor or live in such precarious circumstances that they are at risk of shocks and crises. People's asset base is extremely weak. Despite progress, access to viable landholdings and productive natural resources remains a central concern. Equally, access to basic welfare services remains at very low levels, despite significant progress.

Performance is also mixed across the country, with some areas standing out as continuing to be poor according to a range of indicators and achieving slower rates of progress in meeting development targets. There are also important differences in vulnerability among people – according to gender, age and ethnicity.

This varied performance indicates the locally specific nature of vulnerability and the need to tailor responses to local circumstances, which can differ even within a relatively small locality. In all, this suggests the importance of local planning and implementation with regard to climate change adaptation.

CHAPTER 4

Impacts and implications of climate change

Introduction

This chapter draws on the predictions of climate change (Chapter 2) and the analysis of human development (Chapter 3) to consider the likely implications of climate change for rural livelihoods. The chapter is organised around key sectors – water, agriculture, forestry, fisheries, health and natural disasters. These are the sectors that are not only most likely to be affected by climate change, but also most closely associated with rural livelihoods in Cambodia. The chapter also tries to consider how different regions of the country and different people might be affected.

Climate change is only one of many drivers of change in Cambodia, and therefore needs to be analysed in context (TKK & SEA START RC 2009). Cambodia's vulnerability to climate change, as noted earlier, is largely a function of existing vulnerabilities related to human development and poverty, and limitations of its adaptive capacity. In order to better understand the extent of vulnerability according to each of these sectors, the vulnerability context for each sector and region is also discussed.

Water resources

The central importance of water for meeting social and economic development objectives and the anticipated impacts of climate change are such that the World Bank observes in its 2010 global assessment (p. 137), "People will feel many of the effects of climate change through water." This is especially true for Cambodia (cf. Johnston et al 2010, UNEP 2009).

Water is fundamental for all aspects of economic and social development and human well-being, cutting across agriculture, fisheries, forestry, health and disasters. Water management has played a pivotal role in Cambodia's social and economic history, beginning with the days of the Angkor civilization, when advanced water management systems enabled unprecedented economic and political expansion (Higham 2001). The value of water is thus deeply embedded in Cambodian culture. From the past through to the present, religion, social institutions and water management have been closely intertwined in the country.

Almost 86 percent of Cambodia's territory lies within the Mekong River basin, including the Tonle Sap basin (with 12 tributary sub-basins), the '3S' basin (Sekong, Sesan and Srepok Rivers) of the northeast, and the Cambodian Mekong delta. Water resources are highly dependent on this complex river system, which stretches across six countries, and on the natural 'flood pulse.' In addition, a number of smaller river systems drain from the high-rainfall Cardamom and Elephant Mountains in the south-west into the Gulf of Thailand.

Estimates of surface water availability suggest figures of around 75,000 million cubic metres, excluding water in the coastal zone, and groundwater resources of around 17,600 million cubic meters. These represent 100 times more than the current water used in the country. The Mekong River alone carries water at a rate of 475,000 million cubic metres per year through Cambodia to the South China Sea.

Although Cambodia is endowed with an abundance of water resources, the main challenge is one of smoothing its availability and distribution throughout

seasons, across regions and between users. The seasonal variation in Cambodia is dramatic, with high water levels and flooding in the rainy season, contrasted with parched soils and water shortages in the dry season (Öjendal 2000). Yet these natural processes of flood and recession – the flood pulse – drive the natural productivity of agriculture and fisheries.

Water resources bring together interests from many sectors. Various Ministries and institutions have responsibilities for different aspects of water in Cambodia, sometimes with unclear roles. Since 1999, water resources as a specific area of responsibility have been given greater profile with the establishment of the Ministry of Water Resources and Meteorology (MoWRAM), which has a mandate to coordinate and manage water-related activities in the country. This includes water infrastructure rehabilitation, construction of new schemes, including flood control, and polders (an irrigation scheme specific to the coastal zone) aiming to protect agricultural land and public property. The foundation of the water policy is a commitment to Integrated Water Resource Management (IWRM), enshrined in the Water Law of 2007.

Despite development of the legal framework, current water resource planning tends to follow sectoral interests of particular Government agencies rather than the hoped-for integrated approach (JICA 2007, Clausen 2009). Coordination and collaboration across these agencies remains weak (Clausen 2009, Hirsch and CDRI 2008), and so far progress has been limited in putting in place the necessary institutional arrangements, either at national or river-basin levels (Clausen 2009, Roux 2005).

Policy priorities: Irrigation and hydropower

The main national policy interests concerning water resources relate to expansion of water infrastructure for irrigation and hydropower. With a widely held perception that water is underutilised in Cambodia, both irrigation and hydropower are considered to have great potential for economic growth.

Given that the vast proportion of agriculture is dependent on rainfall, the development of irrigation is seen as the main mechanism for reducing vulnerabilities to vagaries of the seasons and for increasing agricultural production. Much of the irrigation infrastructure is seriously debilitated after the long military conflict. Rehabilitating and expanding irrigation systems thus have become cornerstones of agricultural policy since 2000, although this policy priority does not always translate into spending priorities (PER 2009).

Establishment of reliable energy sources is seen as a national development priority. The price of electricity in Cambodia is one of the highest in the world and seen as a major impediment to both industrial development and development of the rural economy. The seeming abundance of water resources for hydropower appears to have enormous potential in Cambodia, with the Ministry of Industry, Mines and Energy (MIME) estimating the total achievable hydropower potential at about 8,000 MW (Clausen 2009).

Irrigation and hydropower development both require water resources and viable catchments and, to varying degrees, alter natural hydrological patterns that are themselves subject to impacts from climate change. Understanding these interactions is therefore essential for effective planning to ensure the sustainability of water resources and minimise negative impacts. So far, planning mechanisms for assessing water resource options under a changing climate, and the potential impacts and tradeoffs, are not in place. The risks associated with such development in Cambodia and across the Mekong basin, particularly for inland capture fisheries and food security, are extremely high.

Limited technical capacity and the lack of reliable data related to water resources further constrain attempts for more coordinated, long-term strategic planning. The lack of hydro-meteorological stations, and the long periods of conflict during which no data

were gathered, mean that assessing the national water balance between supply and demand is not possible (MoE 2010, TWGAW 2010). A lack of human, technical and institutional capacity for water resource management also exists at all levels.

Because of Cambodia's central location in the Mekong River system, the country has a trans-boundary dimension to water resource management. The actions of Cambodia's upstream neighbours in developing water resource infrastructure, primarily large hydropower dams, also have an enormous influence within the country. Upstream hydropower development will alter hydrological flows in Cambodia, affecting water quantity, quality and sedimentation, with serious implications for fisheries and agriculture (TKK and START RC 2009, Clausen 2009, Eastham et al 2008, and ICEM 2010). Cambodia's own actions likewise will have national consequences as well as downstream consequences for the Mekong delta and coastal zone of Viet Nam.

Climate change impacts on water and their implications

The Mekong basin has been highlighted in global assessments as one of the river basins that will feel the effects of climate change most severely (UNEP 2009). Climate change will affect the water cycle, bringing shifts in the timing, duration and intensity of rainfall patterns and seasons, changing the hydrology of major rivers and tributaries as well as groundwater recharge, and consequently altering the quantity, quality, availability and distribution of water (ICEM/MRC 2010, TKK and SEA START RC 2009, Bates et al 2008, Eastham et al 2008). All of these anticipated changes will have implications for agriculture and food production (Fraiture et al 2007) as well as human health and well-being (TKK and SEA START RC 2009, UNDP 2006, UNDP 2007).

The most recent studies predict various climate change impacts for water resources in Cambodia (TKK and SEA START RC 2009). These include:

- Likely significant alterations in the Mekong River hydrological regime, upon which inland fisheries and agriculture depend (MRC 2009)
- Changes in seasonal distribution of rainfall, with drier and longer dry seasons, and shorter, more intense wet seasons (MoE 2010)
- Increased volume and intensity of wet-season rainfall, leading to increased floods and a marginal decrease in dry-season rainfall (Clausen 2009)
- Reduced flow of the Mekong and its tributaries in the dry season and increased flow in the rainy season (TKK and SEA START RC 2009)
- Higher drought risks in most of Cambodia's agricultural areas as a result of future climate change (2025 to 2050) (MoE 2010)
- Increased temperatures, with corresponding increases in evapo-transpiration (Fraiture et al 2007)
- Increased frequency and intensity of extreme events, such as floods and droughts (Eastham et al 2008)

Effects of these changes will be felt differently in different parts of the country. For example, for the Tonle Sap the predictions are for changes to the natural flood pulse, higher water levels and longer flood duration. The most immediate and dramatic effects would be felt in fisheries: changes to the natural hydrology would alter the flood pulse (the reverse flow into the Tonle Sap from the Mekong), which drives natural productivity. Such changes would also affect the key fishery habitats of flooded forests. This impact on fisheries has wide implications for local economies, nutrition and health, given that fish are the main source of protein in the local diet.

For the Mekong delta, the impacts are likely to include extension of the area flooded and changes in the onset of the flood season, with the risk of increased water scarcity during the dry season (TKK and SEA START RC 2009).

Main implications from the impact of climate change on the water sector are potentially exacerbated by the current condition of watersheds, catchments and floodplains that affect the runoff and recharge of

groundwater, as well as by water resource development plans. Further degradation of catchments, watersheds and floodplains will thus lead to additional pressures on the ecosystems.

Without improved management, changes in water availability could lead to reduced water quality and greater water scarcity, particularly in the dry season – in turn leading to increased competition between sectors and among different users. These effects will be felt most acutely by small-scale farmers and fishers.

Reduced water quality and availability for domestic use would have enormous impacts on human health, with most rural people still dependent on natural water bodies for drinking water.

In addition, collecting water from farther afield would be more demanding on labour and time, and most likely felt most acutely by women and children. In some cases, water would need to be purchased.

Agriculture

Agriculture is the foundation of rural livelihoods, and for Cambodia remains dominated by rice production. It is hugely important for national economic development, where it is seen as the sector with the greatest potential for medium-term contributions (UNDP Cambodia 2009). Clearly, any impacts on the rice sector would have profound implications for Cambodia.

Agricultural production in Cambodia is closely related to climatic conditions. Many factors contribute to production levels and limited economic returns. Soil fertility is generally extremely low, with much of the country characterised by sandy soils (Johnston et al 2009). Access to irrigation is limited, and questions persist with regard to the viability of irrigation for such soil conditions.

Farmers' access to productive assets, primarily land, is also extremely limited, as discussed earlier. Farmers do not have secure tenure over their land, and land-holdings are typically less than 1 hectare. Weak access to support services and agricultural inputs for small-holders, as well as limited in-country agricultural processing and weak access to markets, further limit the realisation of economic benefits and present substantial constraints to future development. Reliable market and crop information and weather forecasting are not available.

Livestock rearing is a key part of rural livelihoods, providing a means for savings in the case of larger livestock and sources of income and food with regard to pigs and poultry (Tong 2009). Production remains largely small-scale, and its contribution to total agricultural production has remained largely static, providing only 15.3 percent of total agricultural production in 2009 (MAFF 2010). Livestock production has great potential, but is largely constrained by limited extension and veterinary services as well as weak marketing channels throughout rural areas. Poor livestock health is a major factor in household insecurity (Tong 2009).

Predicted climate change impacts on agriculture

Cambodian agriculture is extremely vulnerable to climate change (Mainuddin et al 2010, CISRO 2008, ACIAR 2009, MoE 2010). The specific threats of climate change for agriculture include:

Increases in temperature. These may include changes in both daytime and nighttime temperatures, plus peaks in temperature and increased numbers of extremely hot days per year. Such increases affect not only evaporation, but also growing and flowering cycles of crops such as some popular rice varieties. This can reduce yields of crops and pastures by preventing pollination and accelerating dehydration (Johnston et al 2009). Studies conducted in Thailand, Viet Nam and Indonesia (Peng et al 2004), as well as a more recent study in Cambodia (Kala, Boret and

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Kurukulasuriya 2011) suggest that, on average, the rice yield can be expected to decrease by 10 percent for every 1°C increase in growing season minimum temperature. This is because higher temperatures at the time of rice flowering could lead to floret sterility, limiting the grain yield. Impact on rice yield is predicted to be significant. MoE (2010) shows rice yields will decrease under both high and low emission scenarios, and will continue to decrease within a range of 70-20 percent to of current production based on different seasons and scenarios.

Changes in rainfall patterns. Predictions suggest that wet seasons will be shorter, but with higher levels of rainfall, while the dry season will be longer and drier. This will result in shifts in the distribution of rainfall between areas. The changes to the length of seasons, combined with the delayed onset of the wet season after a longer dry season, will affect traditional cropping practices.

Flood and droughts are major influences on rice production in Cambodia. The regular seasonal pattern of flooding and drought is central to traditional agricultural practice, ensuring fertility and productivity. Traditionally farmers have been able to plant different rice varieties according to what they expect from the upcoming seasons. Yet climate change will not only result in more floods and droughts – more intense and more frequent – but will also make the onset of seasons less predictable. This has a large impact on productivity, especially for rice, which is very sensitive to timing of first rains. Climate change is also associated with 'mini-droughts' (i.e. short droughts that occur in the wet season) and unexpected rains during the dry season, all of which further affect productivity and the livelihoods of farmers.

MoE (2010) records areas of rice crop that have been affected by flood and drought in various years (see below). Such events happen with some regularity, and floods and droughts can occur in the same year

(for example, 1996 and 2002). The period 2000-2002 also saw three consecutive years of significant flooding.

Increased incidence of pests and disease. Changes in temperature, rainfall, seasonal patterns and changing length of the growing season (and ecological systems) have the potential to increase the threat to agriculture of pests and disease (FAO 2003, IOM 2009). Warmer temperatures in otherwise cool seasons may result in decreased winter mortality of insect populations. Temperature increases may speed up growth rates of crop pathogens and increase reproductive generations per crop cycles, making the crop more

Table 7: Historical record of flood and drought damaging rice crops (ha)

Flood		Drought	
Year	Area (ha)	Year	Area (ha)
1984	400,000	1991	200,000
1995	150,000	1994	250,000
1996	450,000	1996	400,000
2000	400,000	1997	430,000
2001	200,000	2002	150,000
2002	100,000	2004	300,000

Box 9: Chemical use and health effects

Treatment is often difficult when patients have little knowledge of the chemicals used.

Cambodian farmers readily take on board new technologies in response to declining yields. While such yield declines might occur with climate change, farmers' responses might not always be most appropriate.

Kin Hean, 19, was studying at Grade 8 when he took up a job of pesticide spraying in local paddy fields to earn some cash. However, with no protection his health was badly affected by the pesticides. All the instructions were written in Vietnamese, and Cambodian farmers often use the pesticides without understanding the full safety measures required. They often only wash with soap after such usage; some think eating sweets or mango will help with ill effects. Kim's eyes became affected as a result of the spraying. He stopped going to school and stays in bed. His parents sold off their surplus rice for his health care, but without understanding what sort of chemicals farmers are using, doctors are often helpless to advise appropriate treatment.

Ministry of Agriculture, Forestry and Fisheries (MAFF) extension workers try to explain to local farmers about the risks of chemical pesticides and encourage them to use organic pesticides, but the raw materials for the organic inputs are not readily available.

Based on field visit to Prey Veng, November 2010
Photos © UNDP/Arantxa Cedillo

vulnerable. Increased CO_2 levels could enhance the competitiveness of some weed species.

The appearance in Cambodia of different types of insects (e.g. brown plant hopper) that traditional varieties of rice are not able to resist, and for which farmers do not have management methods, have already been identified (So 2010, Plan International 2010, IOM 2009). Responding to these pests might encourage farmers to increase their use of pesticides (IOM 2009, Johnston et al 2009). In addition to increasing the cost of inputs, this also raises issues for health and ecological impacts such as loss of aquatic animals in rice field systems.

Already there is evidence of growing use of pesticides, often without full understanding of the safety requirements and the risks. Most pesticides are imported, with instructions on their use not available in the Khmer language. Most farmers are thus unaware of or unable to follow the safety requirements for pesticide use, and often apply a combination of several kinds of pesticides. When people become sick as a result of exposure to pesticides, they are largely left to their own devices.

Meanwhile, loss of livelihood is a common issue for farmers during the dry season because of the increased incidence of livestock disease, associated with lack of water and grazing land and the long distance to water sources for livestock (see Box 10).

Because larger livestock are an important investment and means of savings for farmers, livelihood impacts can have serious consequences. They push people into debt and reduce their financial safety nets, which exposes them to an inability to access cash when faced with other crises (cf. Tong 2010).

Implications of climate change for agriculture

Given the central importance of agriculture, particularly rice, for rural livelihoods in Cambodia and national economic development, any impacts on production will have far-reaching implications, most notably for the poor. Even with rising levels of production and rice exports (RGC 2010), the number of people considered food-insecure remains high (see also Chapter 3).

The variability of weather events caused by climate change, such as increased uncertainty of seasonal patterns and increased range of extremes, also means farmers are less able to rely on traditional practices and need more accurate climate information, lest

Box 10: Livestock loss due to extreme weather

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A study by Plan International (2010) in Siem Reap and Kampong Cham shows many villagers have reported livestock deaths as a result of changing weather patterns.

In 2009, villagers in Kouk Prech (Siem Reap Province) reported that 48 cows died because of extreme heat and poor water quality. In the neighbouring village of Sanday, villagers reported 17 cows and hundreds of chickens had died in one month (January 2010). Similar experiences have been reported in Taream village (Dambae in Kampong Cham), with a prolonged dry season reducing grazing land. As a result, some farmers had to sell their remaining livestock. The heat was also associated with the prevalence of disease among pigs.

Source: Plan International (2010)

Box 11: Implications of water scarcity

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Kim Ne, 40, examines a pump at his paddy field. His water source is underground, and so he has dug a well and pumps from it to irrigate dry-season rice.

Farmers in some parts of Cambodia are already facing water scarcity but the ways in which they are adapting to these challenges can lead to inequitable and unsustainable outcomes.

In Thnort Commune (Svay Rieng), water shortages during the dry season can be very serious. In 2008 some villagers had to buy water from Viet Nam to irrigate 200-300 ha of rice; for this, they had to pay 2,500 Vietnamese Dong per hour per farmer, for about 100 hours, for one to two months.

In Por Village (Thlork Commune, Svay Rieng), farmers have installed private tube wells to access groundwater. As a result, water scarcity has become a problem during the dry season. With all farmers pumping water at the same time during the day, there is not enough water generated from underground. This forces some farmers to pump water during the night as well.

Similarly, under the Sdau Koang pumping irrigation scheme in Prey Veng, farmers took to guarding their paddies at night when they needed additional water to stabilise their crops during a prolonged shortage, in efforts to ensure the water pumped from the station was not diverted by others before it entered their paddies.

Based on field visits to Svay Rieng, February 2010, and Prey Veng, 2008

they suffer decreased production efficiency, and consequently, reduced yield.

Critically, a recent economic analysis suggests that with a 1°C rise in temperature, annual mean net revenue falls by around 10 percent, which essentially indicates that for an average farm, climate change may render cropping agriculture an unprofitable activity (Kala, Boret and Kurukulasuriya 2011, Peng et al 2004).

Yet agricultural impacts of climate change may not be felt evenly across the country. Increased wet-season precipitation in drier areas can be beneficial, especially if this coincides with a reduction in frequency and duration of droughts in the wet season (Eastham et al 2008). In wetter areas of the country, however, potential increases in flooding may make rice cropping unviable in low-lying areas if they are too frequently inundated; in turn, this may require a more transformational change to production systems, such as through shifting rice cropping into the dry season through irrigation (ACIAR 2009).

It is important to recognise that farmers in Cambodia are highly adaptive and regularly build on existing agricultural practices to overcome challenges. Farmers frequently make complex decisions about cropping to manage all sorts of risks. However, as the examples below illustrate, some actions by individual farmers in response to water scarcity may not be in the public interest and may not be sustainable.

If farmers' ability to make decisions were strengthened – with appropriate technological, skills and information support – they would be better placed to deal with the challenges of climate change.

While the global food crisis is argued to have provided a 'warning against the historical neglect of the agriculture sector' (Jalilian 2010), as discussed in the following chapter, the threat of climate change may require a review of current policies and practices regarding land use and crop productivity; water demand and management; extension practices; issues surrounding access to land; natural resource management; access to finance, technology and markets; and efforts to increase the planting index[15] (MoE 2010).

Fisheries

The freshwater capture fisheries of Cambodia are among the most productive in the world (Baran et al 2006, MRC 2010). Fishing has been central to rural livelihoods in Cambodia at least since the times of Angkor; along with rice farming, it holds a central place in rural livelihood strategies and cultural practices, involving 2 million to 4 million rural people (Baran et al 2006, MRC 2010). Fish and other living aquatic resources are enormously important for food security and nutrition, as noted earlier, contributing up to three-fourths of animal protein in rural diets (Hortle et al 2007). In 2009, fisheries contributed 25.2 percent to agricultural sector activities and therefore are a significant economic activity.

Inland capture fisheries dominate national fisheries production. While it is known that natural production varies from year to year and is strongly influenced by hydrological patterns, determining estimates of production is very difficult (Coates 2002). Generally production is estimated using catch records and is stated as being between 280,000 tonnes and 400,000

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tonnes per year of fish, with additional production of around 60,000 tonnes per year of 'other aquatic animals'[16] (OAA) (MRC 2004). This ranks Cambodia as the fourth-largest inland fisheries producer in the world (MRC 2004).

These figures may well be underestimates, often overlooking the small rice-field and floodplain fisheries that could alone be in the region of producing 285,000 tonnes (Hortle 2007). Estimates based on people's consumption patterns, and which are therefore more likely to be inclusive of all fishery types, suggest that total production levels are in the region of 524,000 to 616,000 tonnes per year (Hortle 2007). The natural production of aquatic animals in rice fields is estimated as worth at least US$100 per hectare (Hortle 2007), compared with the value of rice production at US$150 per hectare.

Cambodia's vulnerability to climate change in the fisheries sector is therefore likely to be felt at the micro level of households and communities, as well as at the level of the national economy. A recent global study of the vulnerability of national economies to the impact of climate change on fisheries ranks Cambodia as 30th most vulnerable in the world (Allison et al 2009).

The productivity of the natural capture fisheries of Cambodia is closely related to natural hydrological patterns and the integrity of fish habitats. This is not simply a matter of volume of water equalling volume of production. The onset of the flood season acts as a trigger for migration, with fish moving along the main stems of the rivers or between the rivers and floodplains, where they migrate to breed, spawn and feed and then retreat as waters recede. While the amount of water in any given year is a contributory factor, the timing of the flood, combined with the number of peaks during the flood season and the area of land inundated, are also important factors. The area of land flooded provides important habitats for feeding, breeding and spawning, while the quality of the vegetation, such as flooded forests and wetlands, and the interconnectivity of the floodplain ecosystems also represent important factors in fishery production (Baran 2007).

Inland fisheries productivity is strongly influenced by actions from other sectors. Fisheries constitute the main sector that is vulnerable to development of water resource infrastructure, with hydropower development, both within Cambodia and in upstream countries, considered to constitute the greatest threat to natural production and rural livelihoods (ICEM/MRC 2010, Allen et al 2008). At local level, land use change – such as conversion of flooded forests along the Tonle Sap for agriculture – and unplanned development of rural roads also have significant impacts on natural fisheries (Baran, Starr and Kura 2007).

Despite their economic importance, the concerns of fisheries are rarely addressed in planning processes for other sectors. In particular, hydropower projects have failed to identify costs and implications of impacts or to identify specific mitigation measures for fisheries impacts (Friend et al 2009).

Recognising the importance of fisheries for rural livelihoods, Cambodia has supported the establishment of Community Fisheries and is turning over commercial fishing lots to local communities (FiA 2009). This process began in 2001 as a response to conflicts between commercial and small-scale fishers, but performance to date has been mixed. In some areas of the country, the number of Community Fisheries (CFis) established has been high, but in other areas progress has been limited. Slow progress has been attributed in some cases to complex bureaucratic procedures and the need for official approval at key stages. In many areas, privatisation of public water bodies, as a result of land concessions, has denied public access. There also exists competition from large-scale commercial fishing, which often uses efficient yet destructive gear and is often illegal.

Table 8: Summary table of predicted impacts on Cambodia's fisheries

Climate changes	Impacts on fisheries
Delayed onset of flood season	Change the trigger effect of flood season – unknown response to fish migrations
Longer, drier dry seasons	Some species are able to survive for the dry season, as long as there are some viable fish refuges. It is not known how well they will be able to survive for longer, drier and potentially hotter periods Reduction of key habitats – for example, flooded forests Dry-season brood stock more exposed to fishing effort
Shorter, wetter rainy seasons	Migration triggers affected Reduced season for breeding and spawning, as well as feeding – reduced opportunity for juveniles to reach suitable size and maturity to continue migration and life cycle
Sea level rise (SLR)	Even a modest SLR of 20 cm would cause contour lines of water level in the Mekong delta to shift 25 km inland during the flood season and saltwater to move further upstream during the dry season Alter the fish species composition of fisheries, but may not be detrimental of overall fisheries yield (ADB 2009)

Sources: ADB 2009, Allison et al 2009, MoE 2010, FiA 2009

Predictions of impacts and their implications

Various studies thus suggest possible climate change impacts on fisheries, as summarised below.

The most serious implications of declines in natural fisheries productivity are in terms of food security and nutrition, particularly considering both the rising population and the growing demand for food resources. Given the high levels of persistent food insecurity and malnutrition in many regions of rural Cambodia, as well as the high reliance on fish protein in the diet, any impact on the availability of that protein is significant. There are currently no viable alternatives to this source of protein, and while developing livestock and aquaculture may provide potential, this would require enormous, sustained investments in extension, training and provision of inputs – with no guarantee that this could be successful or economically viable.

Further degradation of capture fisheries will most likely lead to intensified competition over fish resources, driven by scarcity and rising market value. Based on experience of weak governance in fisheries and other resources, in these cases it is reasonable to assume that poorer and vulnerable people, including women and children, will be most likely to be affected.

The Tonle Sap fishery will be especially vulnerable, but so too the people dependent on fisheries of the Upper Mekong and 3S tributaries in Stung Treng, Kratie, Rattanakiri and Mondulkiri.

Forests

Forestry profile

Forests generate important livelihoods benefits in Cambodia. More than 80 percent of Cambodians rely on fuelwood and around 8 percent on charcoal for cooking (NIS 2009). The Forest Administration (2010) estimates that nearly 4 million rural people – more than 30 percent of the population – live within 5 km of the forest, with forest resources accounting for an average of 10 to 20 percent of household consumption and income sources. For example, resin harvest by Phnong people in Mondulkiri generates an average household income of US$340 per year –

equivalent to the annual cost of purchasing rice to support a family of five (Evans et al 2003). Traditionally, forest resources have provided important safety nets for rural people in times of crisis. The total annual income generated from non-timber forest products is considered to be extremely high – with the trade to Viet Nam from five provinces calculated in the region of US$5-8 million (Tola 2009).

Cambodia remains rich in forest resources, particularly in comparison with other countries in Asia. Forests of the country are dominated by moist lowland evergreen forest, semi-evergreen forest and deciduous forest. A unique flooded forest is found along the shores of the Tonle Sap Lake and upper part of the Mekong River. Mangroves are found along the coast.

Forest resources have, however, been seriously degraded. From the 1980s to 1990s, the rate of deforestation was estimated at around 2 percent (200,000 ha/year), declining to 0.8 percent from 2002 to 2006 (75,000 ha/year).

In 2008 forest cover was reported at 59 percent, but this fell significantly in just one year, to 57.59 percent in 2010 (FA 2010). The RCG has now set a policy target of maintaining 60 percent forest cover, which would mean that Cambodia would have one of the highest such percentages in the world. However, establishing accurate figures for forest cover, as well as the type and quality of the forest, is highly difficult.

For many years, Cambodian forests have been under pressure. Despite a moratorium declared in 2002, illegal tree cutting has continued, in some cases encroaching upon protected areas. For instance, a biodiversity survey of the Cardamom Mountains, considered the richest region in the country in terms of biodiversity, indicated that logging was taking place inside protected areas (MoE 2008).

Particularly for areas previously under logging concessions, the granting of economic land concessions for agro-industries was introduced under the Sub-decree on Economic Land Concession 2005. By early 2009, MAFF reported that 65 economic land concessions, totalling about 1 million ha – almost 10 percent of forest lands – had been granted for agro-industrial development and permanent mono-cropping of rubber plantations.[17] Yet the granting of economic land concessions without broad consultation with local people and in-depth studies of land suitability has the potential to create serious social and environmental threats; this has already been identified as one of the main causes of social conflict in rural areas (WWF 2010). As the RGC observes, *"The anarchy in illegal land possession, illegal claim of State land and protected areas as privately owned, and unlawful logging are still taking place"* (NSDP 2010, p. 10).

Important policy initiatives have attempted to address these threats and ensure benefits to local people by handing over forest management rights to local communities through CFs (under MAFF) and Community Protected Areas (under MoE). CFs, introduced in Cambodia in 1992, were formalised with the passing of a sub-decree in 2003 that recognised their contribution to sustainable forest management within production forests. Under the Forest Law, the recognition of the rights of local communities and the importance of decentralized management of natural resources are clearly highlighted. However, the process of legal recognition remains a challenge for local communities living inside and close to forest areas; only a limited number of CFs have been formally established. While 430 CFs (380,976 ha) are still in the formal process of registration, 107 have reached agreement with MAFF, but only four have reached the final stage of approval and have a signed management plan (FA 2010). Similarly, while 84 Community Protected Areas (covering about 93,000 ha) are going through the formal process of registration with MoE, only two have reached the final stage of the process. Included in the newly adopted 20 year National Forest Programme is a Government commitment to allocate 2 million ha to community management (MoP 2010).

In some cases, the forests over which communities have been granted management rights are seriously degraded, providing limited opportunity for economic benefits. Moreover, rights to these forests are limited to only 15 years – a time period considered too short to allow communities to reap significant yields from their own investment in management and forest rehabilitation.

Such insecure access rights and constrained potential for economic returns undermine the principles on which the CF effort is founded – to deliver benefits to local communities. CFs are also often located in areas in which there exist intense conflicts over forest resources, particularly from outside commercial interests, and these interests frequently take precedence over local claims to CF status (Blomley et al 2010, Baginski and Wollengerg 2010).

Predictions of climate change impacts for forests

Climate change predictions suggest that forests will be affected by changes in temperature, precipitation and shifts in seasons. Such changes directly affect the existence and vitality of species and ecosystems, and will increase the risks associated with pests.

RGC predictions of climate change impacts on forestry show exposing forests to a longer dry period might reduce forest productivity and increase the risk of fire. If forests are being logged, there is a risk that it will take longer for them to regenerate. With increased risk of fire, forests are at risk of turning into shrub or unproductive lands (MoE 2010).

In addition to temperature changes discussed in the SNC, rainfall changes will also adversely affect forests. Changes in rainfall patterns will affect survival of seedlings, cropping calendars and crop varieties, with risks of increased soil erosion and degradation of watersheds as a result of intermittent drought and flooding.

Implications of climate change for forestry

Given the importance of forests to rural livelihoods, any loss of productive forests, as well as of biodiversity, will lead to loss of income or livelihood options for forest-dependent communities. This can also lead to atypical insect growth cycles that can further affect agriculture and forests.

A commonly held belief is that forests attract rainfall and keep things cool. The loss of forest cover will definitely affect local microclimates as well as increase the risk of soil erosion and landslides.

Overall, however, it is in the area of forestry that some of the greatest opportunities deriving from climate change exist. With such a large proportion of Cambodia under forest cover, there exists enormous potential for conservation and sustainable forest management to become opportunities for generating tangible economic benefits, particularly through REDD+ mechanisms.

Natural disasters: Floods, droughts, sea level rise

Natural disasters are key factors in rural people becoming poor and destitute in Cambodia (see also Chapter 3) and in the persistence of poverty. Climate change will alter the type, intensity and frequency of disasters with severe implications for countries that already face hazard risks. Cambodia's monsoon climate is predicted to exhibit more frequent and more intense disaster risks as a result of climate change.

Cambodia has significant experience with natural disasters, with about a third of all communes identified as vulnerable (NCDM/WFP 2003). Communities are often pressed to the verge of their coping capacity, and as a result, there is often a fine line between a 'natural' regular flood or drought, and one that becomes a full-blown disaster. Within communities

and households the impacts can also vary, being influenced by existing vulnerabilities and capabilities. There is also a clear gender dimension, with global reviews indicating that women are often more negatively affected during and after natural disasters, but that where gender equality is stronger, there is also greater resilience to such disasters (Foa 2009).

Floods

Although floods are usually disastrous for humans, they may have beneficial effects too, including improving soil moisture and fertility for agriculture, ground- and surface water recharge, and ecological benefit for fisheries. Different types of floods are noted in the chart below.

Nonetheless, one of the worst floods in Cambodia's recent history occurred in 2000. The National Committee for Disaster Management (NCDM) estimated that 750,618 families, representing 3,448,624 people, were affected. Among these, 85,000 families (387,000 people) were temporarily evacuated from their homes and villages, with 347 deaths (80 percent of which were children). Damage to infrastructure alone, not including lost production and other secondary-impact costs, was estimated at US$150 million (NCDM and MoP 2008).

Socioeconomic development and natural resource management have directly affected human vulnerabilities to flooding. Unplanned patterns of human settlement and land use have resulted in dramatic increases in the population living in the Mekong floodplains. Depletion of forest cover has resulted in increased siltation of major water bodies and soil erosion. The construction of roads can also intensify flooding patterns, particularly in floodplains, by blocking natural drainage, so that some areas around roads are flooded while others are not affected (NCDM and WB 2010).

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Drought occurs at different scales. Localised drought is also becoming increasingly apparent throughout many areas of the country, including areas that are also flood affected.

	Seasonal Floods	Severe Floods	Flash Floods
Explanation	Caused by heavy rain in upper catchments throughout rainy season Slow but steady rise in water levels, lasting for several days	Occur when heavy rains coincide with arrival of tropical depressions and storms	Caused by rapid onset of rain in mountainous areas, which leads to rivers bursting their banks Sudden rise in water, lasting only few days, but associated with severe damage
Vulnerable provinces/areas	Tonle Sap and lower floodplains	Mekong River	Mekong River, 3S and Tonle Sap basins

NCDM is the main national coordinating body, bringing together representatives of all Ministries and chaired by the Prime Minister. NCDM has links to the local level, through provincial- to commune-level Disaster Management Committees (NCDM 2010).

But where preparedness and early warning systems or relief efforts are ineffective, the impacts of hazards can be all the more severe. Flood preparedness is constrained in Cambodia by poor coordination among concerned agencies at national level, exacerbated by a lack of systematic flood preparedness planning at provincial, district and commune levels (MRC 2009). Lack of hydrometric data and monitoring also constrains capacity to respond to and prepare for disasters (cf. MRC 2009). Affected people may not be reached at all, or only affected local elites, with more marginalised people often excluded (So 2010). Global experience suggests that where people's voice and influence have been strengthened and civil society organisations (CSOs) are active, the performance of relief efforts has been dramatically improved (Foa 2010, Foti 2008).

Drought

Like floods, a period of the year in which water is scarce is a natural phenomenon. A drought is considered as a period of abnormal dry weather that causes serious hydrological imbalance. Two types of drought affect Cambodia, as noted below.

Drought occurs at different scales. Localised drought is also becoming increasingly apparent throughout many areas of the country, including areas that are also flood-affected. Consecutive droughts occurred in several parts of the country in 2001, 2002 and 2003. An important impact has been in intensifying water stress on agricultural crop production, especially rice and vegetable production, with 80 percent of agricultural fields lying idle in most areas for six months. To a lesser extent, other impacts have been felt in terms of increased rates of water-related disease mortality and morbidity. Again, both losses in agricultural productivity and ill-health, as are associated with droughts, are factors in people being poor.

Sea level rise

Predictions of sea level rise (SLR) remain extremely uncertain. According to Cambodia's draft SNC, sea levels are predicted to rise by 1 metre, leading to the permanent inundation of some 25,000 ha of coastal zone by 2060. Of this area, 47 percent (11,832 ha) is mangrove and 42 percent (10,509 ha) wetland.[18] Low-lying areas, including settlements and commercial areas, beach resorts, seaports and coastal fisheries, could also be submerged or affected by high tides, with significant socioeconomic implications (MoE 2010).

- A hydrological drought occurs when water levels in rivers and streams fall below a minimum level. This can affect water supplies, forcing people to take water from sources that are contaminated, such as those shared with livestock.
- A mini-drought occurs when there is a period of no rain in the wet season. This type of drought is most closely associated with impacts on agriculture, livestock and health.

For agriculture, there are four characteristics of drought in the country:

- Unpredictable delays in rainfall onset in the early wet season
- Erratic variations in wet-season rainfall onset, amount and duration across different areas
- Early ending of rains during the wet season
- Common occurrence of mini-droughts of three weeks or more during the wet season, which can damage or destroy rice crops in unirrigated fields

Even these predictions may well underestimate the full impact of SLR. Saltwater intrusion and localised sea surge flooding are already being observed (see Box 12), and with continued future climate change, these issues are expected to intensify. Areas affected by increased salinity are expected to be far greater than the total area of land inundated by SLR. During the dry season, rising sea levels and low river flows will mean that saltwater will extend further into river systems for longer periods, thereby reducing the availability of freshwater along the coast (MoE 2002, 2005).

A 2009 study by the Royal University of Phnom Penh and MoE in Smach Touch village (Sihanoukville) suggests that the village will face rainfall increases of 0.88 percent by 2050, along with temperature increases of between 1.4-1.5°C. For this village alone, the study predicts:

- 14 ha of land loss to SLR (more losses expected by 2050)
- Increased saltwater intrusion, which had already affected 98.83 ha in 2009, to 135.97 ha by 2050. Economic losses from US$800-1,600 in 2009 to US$40,000-800,000 by 2050
- 13 wells will be inundated by saltwater from SLR

The reduced availability of freshwater will have important implications for coastal communities, with villagers driven to find alternative freshwater sources, spending more time and energy to find these sources, and spending money to buy water in the dry season.

Predictions of climate change impacts and their implications

Cambodia has experienced natural disasters regularly: floods, droughts, storms and some degree of SLR. Climate change is unlikely to unleash a new round of natural disasters, but these are likely to occur more frequently and more intensively. The impacts have already been felt and linger long beyond the disaster itself. Floods and droughts have consistently been contributing factors in agricultural production failures and in pushing people into poverty. The ability of rural people to withstand these kinds of disasters is already stretched. Any additional pressure is likely to have implications for people who are already poor and vulnerable. But even for those who have been able to absorb the shocks so far, more frequent and intense disasters are also likely to have dramatic impacts.

Implications of the changing disaster risk profile for Cambodia are found not only at the level of impact on affected people, but more broadly, at the level of national and local economic costs. Between 1987 and 2007 alone, the total cost of floods has been estimated at US$327.1 million, with US$138 million in damages caused by drought. Significantly, drought

Box 12: Water seller

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Access to safe drinking water is already limited across rural Cambodia. With salination of water supplies the financial costs of accessing safe water can be a heavy burden.

In the coastal region, sea water also goes into drinking wells. People in the coastal area often have to buy water from water sellers when they do not have access to clean freshwater. One barrel (30 litres) costs 500-1000 Riel, which represents a notable additional expenditure, especially for the poor.

Interview with water seller, 2 February 2010, Prey Nup, Preah Sihanouk

periods increasingly are being followed by destructive floods.

In the case of Typhoon Ketsana, even though the impact was extremely serious, it could easily have been considerably worse had it not been for the level of relief effort. However, this relief came at significant financial cost, mostly provided by the Cambodian Red Cross, development agencies, non-governmental organisations (NGOs) and private contributions.

The impacts of natural hazards live on long after the hazard itself has passed. For many people, suffering the impacts of one major hazard can have devastating impacts. More frequent and more intense hazards increase the risk of long-term destitution for greater numbers of people.

Health

Health underpins human well-being. Ill health remains a key factor in people becoming poor and constitutes one of the main obstacles to achieving MDG targets in Cambodia (see also Chapter 3).

Climate change will affect the fundamental determinants of health. Globally, WHO (2002) estimates climate change causes more than 150,000 deaths and the loss of 5.5 million disability-adjusted life-years from climate-sensitive health outcomes (i.e. diarrhoeal disease, malnutrition, malaria, etc.). Close associations between health and climate variables have been identified for such diseases as malaria, dengue, diarrhoea and cholera (ADB 2009). Global studies particularly suggest that by 2030, South-East Asia faces significant health risks associated with increased malnutrition as a result of climate change (McMichael et al 2003).

Cambodia's vulnerability to the health-related impacts of climate change is shaped by the current poor health condition of many people and the significance of poor health as a factor in people becoming poor (MoH and WHO 2010). The high incidence of malnutrition, water-borne diseases, and poor maternal and infant health status all stand out as critical human development challenges for the country. Current health status in Cambodia is also associated with poor health service delivery, given the limited number of health centres, as well as the limited numbers and capacities of health professionals. But there also exists a demand-side aspect to this, with inequitable access to quality health care often determined by wealth (Fitzgerald and So 2007).

Predictions of climate change impacts on health

The main areas of health concern with regard to climate change in Cambodia are related to:

- Vector-borne diseases, particularly malaria and dengue
- Water- and food-borne diseases, such as diarrhoea and cholera

Table 9: Natural disasters in Cambodia, 1987-2007

	No. of events	Killed	Injured	Homeless	Population affected	Damage in $US (in millions)
Flood	12	1,125	53	275,805	9,514,614	327,100
Avg. per event		94	4	22,984	792,885	27,258
Drought	5	0	0	0	6,550,000	138,000
Avg. per event		0	0	0	1,310,000	27,600
Epidemic	8	788	0	0	413,570	0
Avg. per event		99	0	0	51,696	0

Source: Adapted from NCDM, Strategic National Acton Plan for Disaster Risk Reduction 2008.

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Given the current health status in Cambodia and the identification of poor health as a major cause for people becoming poor, the potential implications of climate change are thus extremely serious, exposing more individuals and households to the burdens of ill health, putting greater pressure on already-strained health service delivery mechanism, and placing greater demands on limited State health budgets.

- Food security and malnutrition
- Health consequences of extreme weather events (Vulnerability and Adaptation Health Technical Report 2010)

It is predicted that incidence rates, distribution and patterns of disease will shift, with the risk that there will be outbreaks of both malaria and dengue in some parts of the country.

A major cause for concern has been the emergence of drug-tolerant falciparum species – the species most closely associated with high mortality rates from malaria. This has occurred largely along Cambodia's border with Thailand.

Dengue is also endemic in Cambodia, with its incidence related to precipitation, humidity and temperature. While dengue can be contracted at any time during the year, the peak season is generally in June and July. The incidence of dengue varies from year to year, and there have been epidemics, with the most recent in 2007 (MoH and WHO 2010).

As discussed in the analysis of human development (see also Chapter 3), food security is closely associated with health. It is in this area of food security and malnutrition that Cambodia has performed most poorly in terms of human development. In brief, climate change will affect all four dimensions of food security: food availability, access to food, stability of food supplies, and food utilisation. Given the current nutritional and health situation in the country, additional pressure as a result of climate change is likely to be serious.

The extreme weather events noted in the sub-section above clearly have had significant health implications. Other potential health impacts of extreme weather events identified by MoH and WHO 2010 include:

- Increased morbidity and mortality from heat waves, floods and droughts

- Food shortages as a result of crop destruction, leading to poor nutrition and malnutrition
- Effects on water supplies, sanitation and drainage, resulting in various health impacts, particularly via the spread of infectious diseases
- Mental health impacts from the loss of family, home, livelihood, income and/or community
- Substantial burden on health services

Given the current health status in Cambodia and the identification of ill health as a major cause for people becoming poor, the potential implications of climate change are thus extremely serious, exposing more individuals and households to the burdens of ill health, putting greater pressure on already-strained health service delivery mechanisms, and placing greater demands on limited State health budgets. Ill health also has consequences for national economic development by reducing the human resources of the country.

Recently the consequences of ill health on Cambodia's economic development and business competitiveness were assessed in comparison with other countries in ASEAN (UNDP 2009a, p. 6). However, Cambodia's poor

Women

There are clear gender dimensions to poverty and vulnerability in rural Cambodia. Women tend to have lower education levels, less access to assets and information, and a high level of responsibility within the household. Women tend to suffer the impacts of ill health more – either directly or due to having to take on responsibility for caring for sick members of the family.

With men and younger people often migrating in search of employment, women and older people tend to be left in the villages. Despite women's critical role within households and communities, they tend to have less voice in how decisions that affect their lives are made.

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There are clear gender dimensions to poverty and vulnerability in Cambodia. Women tend to have lower education levels, less access to services, less access to assets and information, and a high level of responsibility within the household.

Box 13: Children's work in response to Typhoon Ketsana

Children have a basic right to education. But many families pull their children out of school in response to various shocks and crises – as they cannot afford the associated costs, and need additional labour for household survival.

In Por Tret, students aged 13-14 are working after school taking care of cattle. Their earnings are low, only 10,000 Riel (US$2.50) per month per cow. Most of the students only eat one meal a day. Sometimes they leave school to go to work without having had lunch, instead taking care of the cows in the fields and forest. Other students have gone to another commune to work picking mung beans. Here they can earn 10,000 Riel per day and also be provided with one meal – making such employment opportunities more attractive than continuing with school.

performance in this analysis is not solely related to the incidence of ill health, but again is linked to the weakness of health services, diagnosis and treatment.

Health implications

Dealing with the predicted impacts of climate change will put greater burdens on health service delivery, with clear financial implications. It is also worth noting that the current level of performance against health indicators, although still extremely weak, has come at a considerable cost and with high levels of financial and technical support from the international community; health initiatives represent 30 percent of total ODA to the country (UNDP 2010b). Financial contributions from different sources can be summarised as follows:

RGC	• 12 percent of national budget (equivalent to 1 percent of GDP) • US$6 per capita/year
International donors	• Total annual contribution in 2007 = US$103 million • US$6 per capita/year
Direct patient payment	• US$25 per capita/year • 66 percent of all health expenditures

Source: Adapted from Naron 2009

Climate-related health impacts thus are likely to have very significant additional financial implications for a critical sector that is still under-resourced and struggling to meet development objectives in many areas.

Impacts on different people: Women, children and indigenous peoples

As already noted, evidence from research in Cambodia suggests that women and children will feel much of the effects of climate change.

Across the country, when households are confronted with shocks and crises – similar to the kinds of impacts associated with climate change – children are pulled out of school and put to work. Often this involves supporting adult household members in agricultural work. But it also may involve sending children further afield to find employment and contribute to household income (see Box 13).

This obviously raises serious concerns for the health and well-being of children often engaged in dangerous employment. But there also exist long-term implications for children being forced into work and denied education. Given the shortage of skilled labour in the country and the importance of improving access to quality education, ensuring that children are able to attend school also depends to a large extent on the economic security of their households.

Indigenous peoples

Poverty rates among indigenous people tend to be higher than for other people. Indigenous peoples are heavily dependent on natural resources and agriculture.

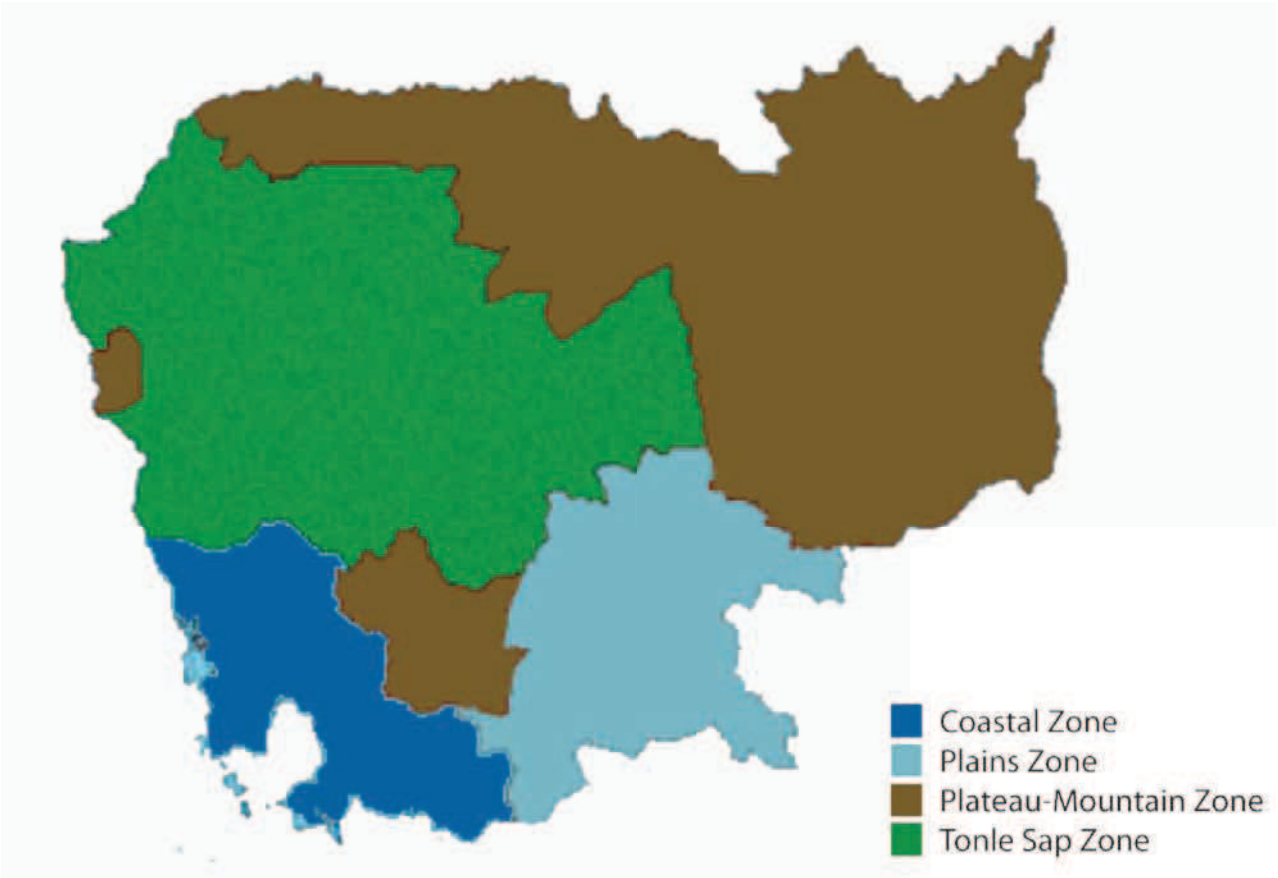
Box 14: Multiple changes felt by the Phnong people

Floods, droughts and insect infestations have been annual seasonal events, which the Phnong people in Mondulkiri have learned to predict, expect and prepare for. But since the 1990s, they have observed more frequent occurrences and increased intensity of these events, negatively affecting their upland crops.

Sometimes insects destroy the entire harvest of one village, which was rarely seen earlier. Some people attribute this to longer spells of drought and changes in weather (more heat and rain), while others blame increased commercial activities in the province, which have led to land clearing/deforestation, changes in water regime, loss of habitat, and increased use of pesticides in some areas. Changes in the patterns of rains and droughts lead not only to crop failure, but also competition between household water use and agriculture. Livestock and humans alike, especially children, fall ill during extreme temperature changes.

If these changes continue, the centuries-old traditional knowledge of the Phnong and other forest dwellers may someday be lost. The Phnong already feel that the climate is increasingly unpredictable. In turn, this will disrupt their traditional farming and cultural practices, which have long been dependent upon predictable rainfall patterns and amounts.

Map 3: Map showing four major agro-ecological zones in Cambodia



Historically indigenous peoples have managed these resources sustainably and equitably, based on traditional rules and regulations, and intimate knowledge of their environment. However, access to these resources, particularly forests and land, is under pressure with encroachment, privatisation and increased degradation. Access to education and health services is limited, and indigenous peoples tend to be under-represented in national and sub-national decision-making with less access to information, redress and remedy. The loss of forest – that also has deep spiritual value – has already had profound consequences.

Climate impacts in different regions of Cambodia

As discussed in Chapter 2, the predicted impacts of climate change vary according to different parts of country. The degree of temperature increase is expected to be different between low-altitude and high-altitude areas. The projection of changes in rainfall intensity in different areas is also highly mixed, as it depends largely on the course of GHG emission scenarios and on differing predictions arising from different time periods. Vulnerability to climate change impacts are determined not only by the degree of changes in temperature or rainfall, but also by specific local conditions, including environmental, social and economic conditions, as well as key economic sectors and development priorities of a particular area.

The country can be divided into four different ecological zones, as presented in the map 3. These zones represent different agricultural activities and population and livelihood systems.

Possible implications of projected impact of climate change, based on agro-ecological zones in Cambodia

- **Tonle Sap zone** Given the central importance of agriculture, particularly rice, for rural livelihoods in Cambodia and national economic development, it is implied that any impacts on production will have far-reaching implications, most notably for the poor. Even with rising levels of production and rice exports (RGC 2010), the number of people considered food-insecure remains high. With a large concentration of poor people and heavy dependence on agriculture and fisheries production, the Tonle Sap zone stands out as being particularly vulnerable to climate change.
- **Plains zone (the Mekong delta).** This area stretches from Phnom Penh down to the Viet Nam border, which includes the Mekong and Bassac floodplains. It has an estimated population of 4,326,825, including 2,251,752 women involved in agriculture. It is one of the main agricultural production areas, already susceptible to floods, droughts and siltation, all causing agricultural losses and soil degradation. While poverty levels are not as high as in other parts of the country, the relatively high population density means that there are many people who are vulnerable to climate stress within this zone.
- **Coastal zone.** This zone includes areas of four provinces (Koh Kong, Preah Sihanoukville, Kampot and Kep) and is projected to be vulnerable to SLR and increased salinisation, with impacts for agriculture, fisheries and access to safe drinking water. Mangrove ecosystems and coastal erosion are especially vulnerable, and their degradation can intensify climate change vulnerability. Poverty levels within the coastal zone are high, with few alternative employment options. Coastal resources are coming under greater pressure, particularly from tourism development, industrialisation and urban expansion.
- **Plateau/mountain zone.** This zone covers the upper stretches of the Mekong River and its tributaries (the Sekong, Sesan and Srepok in the northeast) as well as other upland areas, such as the Cardamom Mountains. These forested uplands contain a diverse range of relatively undisturbed old-growth rainforest and support globally significant biodiversity. The zone consists of sparsely populated areas of semi-subsistence shifting cultivation, but recent rapid land use change has given rise to

increasing pressure from encroachment on agricultural land for plantations, grazing, deforestation and mining. More pressure is occurring with regard to livelihoods dependent on natural hydrological systems and productivity of natural forests. The zone includes some of the poorest areas in the country and already faces numerous development constraints.

Summary

Climate change is one of many drivers of change. How it will manifest in Cambodia, and its implications, are clearly very much influenced by current circumstances, as this analysis repeatedly shows. Cambodia is going through a period of rapid change in both the national and rural economy, in developing policies and institutions, and in the ecological landscape.

Rural livelihoods and people's well-being in Cambodia depend on a range of resources cutting across different sectors – water, agriculture, fisheries and forestry. Many of the key factors in people being poor – such as health and natural hazards – are also closely linked to climate change.

Cambodian people have already demonstrated their resilience to crises, having come through a period of enormous upheaval. But their ability to improve their lives, and those of their children, is already undermined by persistent poverty, and the added threats that climate change poses.

While this chapter has presented impacts according to specific sectors, the full consequences of climate change will be felt across all sets of resources and areas of livelihood activity, with each influencing the other. Moreover, actions of climate change adaptation in each sector will also influence the vulnerability of other sectors, potentially exacerbating these vulnerabilities.

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Part III
RESPONSES TO CLIMATE CHANGE

BUILDING RESILIENCE BASED ON CORE PRINCIPLES, SECTORAL APPROACHES AND LOCAL ACTION

Much of the action required to deal with climate change will happen at local level, involving the State, communities, civil society and the private sector.

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CHAPTER 5

Building climate-resilient rural livelihoods

Cambodia's vulnerability to climate change is a product of:

- Weak assets and entitlements of rural people – health, landholdings and land productivity, empowerment and voice
- Limited adaptive capacity – insufficient technical, financial and human capacity, institutional constraints, and weak governance/decision-making processes

Building long-term climate-resilient rural livelihoods depends on addressing these dimensions of vulnerability. This requires:

- Reducing current vulnerabilities – especially to floods and droughts, but also health shocks and other hazards; and
- Forging a climate-resilient, and long-term, low-carbon development pathway

For each of the areas that are so closely associated with rural livelihoods, there will be a need to:

- Promote low-carbon, climate-resilient technologies, techniques and practices
- Support more strategic, integrated approaches to decision-making, planning, and management – particularly for water and land resources

Much of the action that will be needed will be at local level and must involve the State, communities and citizens, civil society, and the private sector. The governance reforms already occurring put Cambodia in an opportune position to take concrete and lasting action on climate change.

Introduction

This section turns attention to addressing the potential impacts of climate change and taking advantage of existing opportunities to build climate-resilient rural livelihoods.

While Cambodia is identified as one of the countries in South-East Asia as vulnerable to climate change because of its weak adaptive capacity (Yusuf and Francisco 2009), in many ways the country could be well placed to take on these challenges. Many of the legal and institutional frameworks that would address climate change specifically, as well as broader development dimensions, are being put in place. The RGC has prepared long-term strategic approaches to development and governance reforms, in the form of the Rectangular Strategy and the National Strategic Development Programme (NSDP). These provide the development framework within which strategies and priorities for responding to climate change can be integrated, with implementation via sectoral strategies under the responsibility of specific Ministries and Government agencies.

Much of the action required to deal with climate change will happen at local level, involving the State, communities, civil society and the private sector.

Significantly, the Public Administration Reforms under the Organic Law (2008) set in place a major overhaul of Government systems, founded on principles of transparency, accountability and representation as well as handing over authority for planning and management of development to citizens through a series of local councils. The principles underpinning these reforms and the shift toward a more territorial, integrated approach fit well with principles of climate change action. Thus, they provide an important opportunity for partnerships and collaboration between actors.

However, how these reforms specifically address climate change remains unclear, and to date discussion has only been in terms of 'mainstreaming' climate change. What this mainstreaming will mean in practice is also not clear.

At the same time, Cambodia is well positioned to access emerging sources of climate change finance – including through REDD and the CDM – that could support innovations in key areas, notably forest management and energy services. This finance promotes low carbon-emission development options to reduce the global emission of GHGs and ultimately limit climate change impacts. The international commitments of financial flows to assist in transferring technology and developing capacity also open up opportunities for Cambodia to invest in low-carbon development and climate change resilience.

Cambodia and other LDCs have argued that at least 70 percent of future climate change fund allocation should be directed to LDCs for building adaptive capacity and facilitating adaptation – including the current commitment of US$30 billion through 2012, and the future commitment of US$100 billion per year by 2020.

As the previous discussions have revealed, overall major impediments to continued development become even more severe with the threat of climate change. These are related to concerns with regard to persistent poverty in many areas, as well as fears that many people who have moved out of poverty in recent years could slip back into destitution. Weaknesses in governance, coupled with limited institutional, human, technical and financial capacity and strained information systems, must be addressed as part of the overall response to climate change – and to further economic and social development.

This is why 'business as usual' is no longer an option. Building resilient rural livelihoods requires a new form of strategic planning and action, with greater roles for and innovative partnerships between the State, communities, civil society and the private sector, as well as new forums for decision-making that can allow for the inclusive, accountable and representative deliberation that heightened risk and uncertainty call for. With so much at stake, and so many diverse interests involved, there is an even greater need to ensure that climate change is in the public domain, and that there is space for public deliberation.

Building resilience: Key concepts

As discussed in Chapter 2, the concept of **resilience** is founded on the need to strengthen the capacity of social and ecological systems to withstand perturbations, disturbances, shocks and crises.

Building resilience has become a central concept in responding to climate change, as it brings together the need for **adaptation** (responding to unavoidable effects of climate change) as well as mitigation (ensuring actions that reduce further climate change impacts).

From a people-focused development perspective with a grounding in reducing poverty and improving human well-being, building resilience must also combine the ability to cope with disturbances and the imperative to generate lasting human development

improvements – in poverty reduction, well-being and equity. Human development is also about empowerment and ensuring meaningful participation in how decisions are made.

Options for building resilient rural livelihoods can be considered on two inter-related levels:

1. The technology, techniques and practice of climate change adaptation and mitigation
2. The strategic decision-making, planning and implementation arrangements between the State, citizens, and development actors

A clear need exists to improve the technology, techniques and practices associated with all development – whether in agriculture, health care or water management. Now, there exists a growing body of experience, within Cambodia and across the world, in the kinds of technologies and techniques that can be taken up and the kinds of benefits that can be generated.

The very nature of climate change – with its high degree of uncertainty and risk – and the local variations in its impacts and implications make it all the more important that mechanisms that allow for more strategic institutional and decision-making arrangements underlie these technologies and techniques. Moreover, different people will be affected in different ways, with poorer, more marginal people being at greater risk. It is therefore important that there is meaningful participation of citizens in decision-making processes.

The discussion below on building low-carbon, climate-resilient rural livelihoods emphasises these broader challenges. It is here that the need for long-term sustained effort is all the greater, and that support for more sustainable actions in line with needs and circumstances of rural people will be achieved. At the same time, the discussion is based on the emerging experience of practices from which broader lessons can be drawn.

Building resilience: Key principles

Key principles can help shape consideration of different options for building resilience – and for considering how these options can be identified and their potential realised.[19]

These are:

- Informed strategic, participatory planning and decision-making
- Rights-based approaches
- Putting ecological considerations at the heart of development
- Integrated, area-based approaches
- Adaptive, flexible and learning-oriented institutions
- 'No regrets' options

Principle 1: Informed strategic, participatory planning and decision-making

Climate change concerns are multi-faceted, bringing in many technical disciplines – social sciences, economics, biology, management and policy analysis. Different future scenarios need to be assessed and potential consequences of different actions evaluated. Generating such information places considerable strains on data gathering systems as well as research and analytical capacities, with serious financial and institutional implications.

Ultimately, climate change predictions need to be interpreted. This requires a new approach to decision-making and implementation that is more inclusive and deliberative, draws on wide sources of knowledge and experience, and is able to develop a vision for the long-term future.

Much of the action required for effective climate change response is beyond the sole capacity of the State. To ensure legitimacy and compliance, a high degree of public participation is needed. Moreover,

meeting objectives of social justice requires an active and engaged civil society. As previously discussed, it is not possible to only 'predict and act'.

Principle 2: Rights-based approaches to protect the poor and vulnerable

For the concept of resilience to fit with the principles of human development, it must be balanced by commitments to rights and equity (Roberts and Parks 2007, ICHRP 2008, Article 19 2009, Steni 2010). Without considering how benefits and costs are distributed among people, it might be possible to maintain overall social resilience to climate change – but at the cost of disproportionate impacts on certain groups. Equally, it is important to ensure that poor and vulnerable people also have access to the technologies and information needed for building climate resilience. All this includes specific commitments to protect the rights of women, children, the elderly and indigenous peoples, who are more likely to face negative impacts of climate change, just as they have been less likely to derive benefits from economic growth and development. It is essential that both the 'winners' and 'losers' from climate change participate meaningfully in the many complex decisions that will affect their lives. Such principles should be applied at the international, national and local levels.

Thus, it is essential that the rights of all people in Cambodia are strengthened and secured, so as to ensure that climate change actions are just, socially acceptable and generate better human development outcomes.

The linkages between rights and climate change have been clearly articulated:

When considering the human rights impact of climate change, it is important to recall that all human rights are indivisible, interdependent and interrelated. The principle applies to all human rights, whether they are civil and political rights, such as the right to life, equality before the law and freedom of expression; economic,

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Much of the action required for effective climate change response is beyond the sole capacity of the State. To ensure legitimacy and compliance, a high degree of public participation is required.

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It is important to ensure that poor and vulnerable people also have access to the technologies and information needed for building climate resilience. This includes specific commitments to protect the rights of women, children, the elderly and indigenous peoples.

social and cultural rights, such as the rights to work, social security, health and education; or collective rights, such as the right to development. The improvement of one right contributes to the advancement of the others. Likewise, the deprivation of one right adversely affects the others. In tackling climate change, governments worldwide must bear in mind that they have not only moral but legal obligations to protect and promote basic human rights enshrined in the Universal Declaration of Human Rights and inter-national human rights law.

OHCHR 2007

Cambodia itself has recognised this principle by its signing of the Rio Declaration on Environment and Development, an historic 1992 milestone in the global community's commitment to protecting the environment and securing sustainable development.

A core part of the Rio Declaration, Principle 10, is based on the conviction that addressing environmental challenges requires effective access to information, access to public participation in decision-making, and access to redress and remedy.

As Principle 10 states:

Environmental issues are best handled with the participation of all concerned citizens, at the relevant level. At the national level, each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making processes. States shall facilitate and encourage public awareness and participation by making information widely available. Effective access to judicial and administrative proceedings, including redress and remedy, shall be provided.

Informed public decision-making depends on information being both accessible and acceptable to the public, and on stakeholders having the knowledge,

awareness and capacity to make use of this information. This requires a combination of dissemination and social learning – making information available in ways that are understandable to the people who need it, but also building on current knowledge and practice so that those most vulnerable to climate change can become actively involved in identifying appropriate adaptation strategies.

In addition, information needs to be publicly accessible and acceptable in order to ensure accountability and transparency of decisions and actions. Effective, transparent and accountable governance depends on access to information. Often those most at risk have least access to information. Thus, information must be available to the public – particularly information on weather, rainfall, market prices, hazards and extreme events – but equally information on policies, plans and actions that have potential impacts, whether with regard to environmental pollution, infrastructure projects or policy changes. In all, reviews of global experience clearly demonstrate that when information is in the public domain and people's rights of access are guaranteed, abuses of the environment and associated social impacts are reduced (cf. Foti et al 2008).

The right to meaningful participation in how decisions are made is also at the core of democratic, deliberative and accountable governance. This basic principle is clearly guaranteed in the national Constitution as well as supported by various international commitments. In particular, the right to Free Prior and Informed Consent (FPIC) has become accepted as a necessary condition in ensuring fair and equitable decisions – and is increasingly being taken up by the private sector for investments that have social and environmental impacts. Rights to public resources and a clean and safe environment, again enshrined in the Constitution, must also be supported by specific measures and guidelines for how these rights will be put into practice (Article 19 2009, Steni 2010).

Crucially, underpinning rights overall is the fundamental right to justice – and to redress and remedy should there be any infringements or abuses. As discussed, rural Cambodia has faced a high degree of conflict over rights of access to and control over land, forest and fishery resources. The mechanisms for resolving such conflicts with just and acceptable outcomes have been criticised (NSDP 2010, p. 25); climate change impacts risk exacerbating these tensions, intensifying competition over increasingly scarce and valuable resources. While there is a clear constitutional and legal basis for rights to redress and remedy, it is essential that effective mechanisms are in place to guarantee people's rights to justice and to hold the State, elected officials and others accountable for their actions.

Principle 3: Putting ecological considerations at the heart of development

It can be argued that climate change puts ecological considerations – the natural processes that drive the climate – back at the heart of development. Again, this reminds us that the most fundamental resources on which we depend, are finite, and that the Earth's capacity to absorb the impacts of economic development is limited too. Restoring and conserving ecological systems and the goods and services that they provide can help to maintain freshwater supplies and improve agricultural sustainability and productivity, while also reducing risks from natural hazards (TEEB 2009).

The Ecosystem Approach is a key principle underpinning the Convention on Biological Diversity (CBD). It is an approach that brings people and their ecosystems together, recognising that ecosystem management is a matter of societal choice, and that management should be decentralised to the lowest appropriate level. The Ecosystem Approach highlights the value of different sources of knowledge, scientific and indigenous, and promotes effective participation of different stakeholders, particularly local people.

This kind of approach is also being applied to climate change adaptation, with the concept of Ecosystem Based Adaptation – an integrated, multi-sectoral

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Ecosystem based approaches are also being taken up by specific sectors. For example, fisheries management has increasingly advocated for the need to manage fisheries at different scales – both at community and local levels, but also at the broader river basin and landscape levels.

approach based on specific areas or landscapes, enshrined in the IPCC:

Ecosystem-based adaptation aims to increase the resilience and reduce the vulnerability of people to climate change through the conservation, restoration and management of ecosystems. When integrated into an overall adaptation strategy, it can deliver a cost-effective contribution to adaptation and generate social benefits.

WB 2010, p. 129

This approach is based on the definition of ecosystem boundaries. The application of the Ecosystem Based Approach is most clear in management of river basins, watersheds and coastal zones. However, one of the greatest challenges in applying the Ecosystem Approach is that ecological boundaries often do not correspond with administrative boundaries.

At the same time, ecosystem-based approaches are also being taken up by specific sectors. For example, fisheries management has increasingly advocated for the need to manage fisheries at different scales – both

Box 15: The Territorial Approach

The Territorial Approach defines territories according to their circumstances and potentialities, and comparative advantages for economic development have emerged as new strategic directions in much of the economic development literature. This is an approach first applied to regional development strategies within countries and federations and is increasingly found applicable to climate change.

Reference: UNDP/UNEP undated

at community and local levels, but also at the broader river basin and landscape levels. Because drivers of fisheries productivity are largely related to ecosystem processes (e.g. hydrological flows and floodplain connectivity), management of fisheries requires special attention to maintaining these ecosystem functions. Inevitably, this draws fisheries management closer to land use, watershed protection and infrastructure development.

Management at the ecosystem scale thus moves away from focusing on specific pockets of resources, such as an area of forest, toward considering the broader landscape in which these resources are situated. This approach has been taken up as **landscape management** and is incorporated into the Cambodian Law on Protected Areas (2008).

Ecological considerations have further entered the debate on agricultural development with recognition of the potential for the use of chemical inputs, as well as the long-term ecological and human risks to water and soil quality. This has led to renewed interest in **'conservation agriculture'**.

A key mechanism for ensuring environmental considerations in development planning is the process of impact assessment. Legislation in Cambodia endorses the need for environmental impact assessments (EIA) and for a process in which findings are deliberated in public (MoE 1995). However, the practice tends to fall short of legal requirements and public expectations. Equally it is important to consider social impacts of projects – including environmental projects. Strengthening these assessment procedures is essential to address heightened climate change risks, suggesting the need for more regular, sustained and public environmental monitoring of water and air quality, and of ensuring that environmental standards are maintained.

A fundamental principle of environmental governance established in the 1992 Rio Declaration and within the UNFCCC is that those responsible for pollution should bear responsibility for the costs of such pollution. Known as the 'polluter pays principle', it has been applied in global negotiations around climate change and also underpins efforts around impact assessment and monitoring. The polluter pays principle has also influenced the development of 'payment for ecosystem services' (PES) whereby those responsible for maintaining ecosystem services that generate benefits that accrue to others, are rewarded financially for doing so. Both these principles have influenced how financial support to developing countries is provided from developed industrial countries who share the responsibility for much of global GHG emissions. This PES approach has been endorsed in national policy around hydropower development in Viet Nam (Socialist Republic of Vietnam 2008, Winrock International 2008). Under this approach, communities are provided financial incentives to maintain watersheds around hydropower reservoirs in order to protect the slopes from erosion that would otherwise accelerate siltation in the dam reservoirs, that would in turn reduce the dam's lifespan. The PES approach has also been piloted in Cambodia to provide financial incentives to communities utilising agricultural practices that create wider environmental benefits.

Putting ecological considerations at the heart of development is also brought together under the concept of **low-carbon development** – a way of reframing development objectives and practices by emphasising developmental priorities around human well-being, equity and environmental sustainability. This includes addressing unsustainable consumption patterns, particularly of wealthy countries, but also of elites in developing countries. Low-carbon development is most clearly associated with identifying development pathways that address the key drivers of climate change – energy production, land use, agriculture, transport and industrialisation. As technologies improve, and international finance mechanisms are put in place, countries such as Cambodia may be better placed to adopt low-carbon technologies at relatively early stages of their national economic development.

Principle 4: Integrated, area-based approaches

While sectoral approaches are necessary for addressing the multi-faceted aspects of climate change and for promoting the appropriate technologies, techniques and practices of good adaptation, effective action to promote low-carbon, climate-resilient rural livelihoods ultimately will require more integrated approaches for managing land, water and ecosystems. These will have to acknowledge the multi-functionality of agro-eco-systems in supporting ecosystem resilience, and take cross-sectoral approaches based on specific territories and ecosystems (McGray and Bradley 2007, Fisher et al 2008, Johnston et al 2010).

There is growing interest in focusing on specific areas rather than sectors, from the spheres of economic development and natural resource management, which are also being applied to climate change resilience. The Territorial Approach is increasingly gaining, with a focus on the specific circumstances, needs and potentials of specific regions within a country (see below).

The ecosystem-based approach discussed under Principle 3 provides a clear framework for how such integration might be applied (Falkenmark et al 2007), but obstacles exist. Most important is the lack of harmony between administrative boundaries – of province, district, commune and village – through which development planning and implementation processes normally operate, and the ecosystem boundaries. While some smaller ecosystem units, such as small watersheds, can be addressed within existing administrative boundaries, moving toward an ecosystem-based approach requires action at a scale that crosses several administrative units. A need to move in this direction is most clear in terms of water resource management so as to establish effective management institutions such as watershed committees and river basin organisations.

As the discussion on human development and climate change impacts and implications has suggested, responses to climate change will need to be tailored to particular needs and circumstances at local or sub-national levels. Interest is therefore growing in the role that territories – sub-national units – can play in climate change responses, taking into account their comparative advantages for economic development.

This kind of approach fits well with the current reforms of public administration and good governance under the Organic Law (2008) and the Promotion of Decentralization and Deconcentration (D&D). The discussion that follows considers how the emerging framework of D&D could also take on board the principles of good climate change responses.

Principle 5: Adaptive, flexible and learning-oriented institutions

Much of the literature on the institutional dimensions of climate change responses argues for institutions to become more adaptive, altering their strategies and actions in the face of fluid and unpredicted circumstances (Agrawal 2009).

This means that institutions will need to be more flexible, in the ways that plans are made and implemented, that monitoring, evaluation and reporting are conducted, and that finances are allocated and managed. Ensuring that institutions can be both adaptive and flexible, but still maintain needed standards and ensure the best possible outcomes also requires them to become more 'learning-oriented,' able to review and reflect critically on experience and to take on innovative suggestions. This itself requires institutions to be transparent and self-critical, and institutional processes to be sufficiently open and responsive to demands from citizens and a broad range of 'winners' and 'losers'.

There are obvious challenges to applying this principle. In many ways, the foundation of good governance and

accountability is the inherent stability in institutional systems, with actions based on agreed rules and procedures. Similarly, bureaucratic procedures are by definition fixed, with only limited space for flexibility. While most institutions would argue that monitoring and evaluation mechanisms are purposely designed to encourage institutional learning, experience suggests that most institutions find it difficult to take on board lessons learned and are slow and inefficient in initiating change.

For institutions to move in the direction of becoming more adaptive, flexible and learning-oriented also depends on the degree of influence of citizens and other actors, as well as mechanisms for ensuring accountability. Again, this takes the discussion back to the principle of ensuring a rights-based approach, particularly to protect poor and vulnerable groups.

Principle 6: 'No regrets' options

With climate change bringing so many threats, and such a high degree of uncertainty, it is important to be able to prioritise actions. It is difficult to justify allocating scarce resources to actions that might or might not be needed, and indeed, to actions that might or might not actually prove effective. These are very practical considerations for decision makers at all levels, from rural households making plans about agricultural practices, to sub-national and national Government agencies, and from NGOs to the private sector.

A key factor in prioritising will be to identify those actions that make sense more or less irrespective of climate change outcomes. These are often termed 'no regrets' options – actions that provide clear benefits, with manageable incremental costs and risks. Identifying such 'no regrets' options is also linked to applying the key principles of building climate-resilient rural livelihoods. From a human development perspective, 'no regrets' actions for building climate change resilience prioritise the need to address existing areas of vulnerability and poverty.

Another way of thinking of 'no regrets' options is through the concept of 'safe to fail' (cf. NCVST 2009). Many decisions made today will not be possible to reverse, even if circumstances change. This is most clearly the case for large infrastructure projects that have known social and environmental impacts and costs, or that generate irreversible ecological change. Such projects may be deemed viable as long as these impacts can be managed and mitigated, but changed circumstances may heighten impacts even further.

Projects show that many of these schemes, touted as 'failsafe' – or allegedly unable to fail – do indeed fall short, often in the face of unanticipated circumstances. However, it is possible to determine that should a scheme fail, the impacts would remain manageable. In other words, rather than hoping that nothing will go wrong in the unpredictable future, it is better to consider whether the impact would be dangerous or unmanageable if something went awry. The scheme thus would be 'safe to fail' – rather than 'failsafe'.

In infrastructure development, this approach also leads to thinking about the combined and cumulative benefits that might be derived from many small projects rather than one mega-project. Social and environmental risks associated with such large projects tend to be more difficult to manage. This approach thus encourages moving away from the 'grand plan', with all its associated costs and risks, to thinking of the 'many 10 percent solutions', for which the combined risks might be less – and the benefits greater (NCVST 2009).

Summary

The principles for building low-carbon, climate-resilient rural livelihoods can be seen to reinforce each other, providing a framework for discussing options for Cambodia. In many ways these principles are both a framework and a goal to which practices should aspire. The following chapters are based on putting these principles into practice.

CHAPTER 6

Building resilience: Improving health, safety nets and Disaster Risk Reduction

- Key factors in people becoming poor are related to health, and to the impacts of disasters, such as floods and droughts on vulnerable people
- Supporting people to overcome such shocks and crises enables them to contribute to long-term development and to building long-term solutions to climate change
- These represent high-priority, 'no regrets' actions that can reduce current vulnerabilities while also contributing to building resilient rural livelihoods for long-term development

Introduction

Applying the principle of 'no regrets' based on what is already known about human development in Cambodia draws attention to key inter-related factors in people being poor and vulnerable to becoming poor. As the discussion on human development (Chapter 3) has illustrated, shocks and crises related to health and natural disasters (floods, droughts and storms) are key factors that contribute to people becoming poor.

Strengthening people's capacity to cope with and overcome these kinds of shocks stands out as an urgent priority for meeting human development objectives (MoP 2010). At the same time, improving human health while putting in place social protection, social safety nets and Disaster Risk Reduction mechanisms can be seen as high priorities from the perspective of climate change.

Health

As discussed previously, ill health is a major factor in people becoming poor – and constrains people from taking advantage of other economic potentials that would allow for greater resilience. Indeed, improvements in health can have more significant impacts on overall human development than improvements in income. Nonetheless, Cambodia faces major challenges in the area of health with regard to achieving the MDGs.

Yet despite the clear health dimensions to climate change, the sector has so far been relatively poorly represented in State planning efforts around climate change adaptation, with limited input into the Initial National Communication to the UNFCCC and other key documents (MoH/WHO 2010).

Much of what is required in improving health depends on effective coordination and integration with other sectors – for example, with agriculture, to ensure improved food security and nutrition; with water resources, to ensure improved access to safe water sources; and with environment, to ensure that health impacts of environmental degradation are considered and addressed.

With extremely low levels of access to safe drinking water for rural people, the quality and quantity of these sources will be increasingly under threat as a result of climate change. This pressure on water sources will be most acute at certain times of the year – and will have disproportionate impacts on people who are already poor, the elderly, children and women, as well as those who suffer from ill health.

Box 16: The ailing family of the Tonle Sap

Fisherman Prum Kean is a father of six who lives in Moat Kla floating village in Tonle Sap Lake. His is one among 250 fishing families in the village.

As a result of illness, Prum Kean's weight plummeted by 10 kg in 10 months (October 2009-July 2010). His 1-year-old is also ill and has already suffered from dengue twice and typhoid once, as well as several bouts of diarrhoea and vomiting.

Kun Phy, Prum Kean's wife, worries about the frequent illness of her husband and son and the effects this has had on family income, which is already very low.

"He has been sick too often", she says of her husband. "He is the breadwinner of the family. When he is sick, he can't go fishing. And when my son is sick, I can't go out fishing either".

Interview, July 2010

Diversifying sources of water will be essential; many measures can be taken in addition to putting in water supply infrastructure such as wells.

For example, the use of simple water filters has proved highly effective in allowing people to access traditional natural water sources, but also improving the water quality so that it is safe for consumption, by ensuring that the water passes through the filters.

Furthermore, it will be important to monitor access to safe water so as to be able to ensure emergency provisions can be delivered to vulnerable people when most needed. Ensuring rapid response will require maintaining strong linkages and communication with commune and village groups.

Building resilience in terms of health likewise will require specific actions within the health sector itself. These include promoting more effective and responsive planning and service delivery processes, putting in place health insurance safety nets, and improving monitoring and surveillance of disease.

There are clear gender dimensions to health. As noted, women tend to both suffer the consequences of ill health while also having to take on responsibilities for caring for family members. Targeting women in health

Box 17: Ceramic water purifiers: Improving access to safe drinking water

Provision of ceramic water purifiers (CWPs) is a cost-effective and efficient way of improving rural people's access to drinking water, and thereby improving health, freeing up household labour and reducing household costs.

Under a UNDP GEF/Small Grants Project, implemented in early 2008 in partnership with local NGOs, community-based organisations and local authorities, more than 10,000 CWPs were provided to 17,048 families comprising 80,286 beneficiaries; these families live in 233 villages, 72 communes and 28 districts in 14 provinces. More than 700 CWPs were also distributed to community centres, temples and commune health posts.

The provision of CWPs to individual households is not free, with villagers buying them from established women's savings groups at a cost of US$5-7 per unit. Sale of the purifiers was used to support a revolving fund for the savings group. In addition, savings on fuelwood formerly used to boil drinking water were calculated at more than US$90,000.

interventions has clear advantages – ensuring efforts reach those in need, and also freeing up women's labour and time that can be applied in other productive areas.

At the policy level, the formulation process of the Health Strategic Plan 2008-2015 identified a number of key challenges for the health sector: increasing utilisation of cost-effective health services; improving the quality of care in both the public and private health sectors; improving distribution of staff, particularly midwives; and improving reproductive and adolescent health services. A new challenge has become evident too: prevention and treatment of non-communicable diseases and injuries. Critically, the burden of environment-based diseases is also an increasing concern for the country. These are mainly related to unsafe drinking water and lack of adequate sanitation structures, indoor and outdoor air pollution, and occupational health risks. All of this requires multi-sectoral collaboration and cooperation among relevant actors, including health, environment and agriculture institutions.

Health protection and insurance

The financial burden of seeking out health services is overwhelming for many poorer people – the same people who are often most in need of health care. By providing mechanisms for protection and insurance, the costs of health care can be more easily covered and made more accessible. In Cambodia the two main mechanisms for health protection are Health Equity Funds (HEF) and Community Based Health Initiatives (CBHI).

CBHI targets the near-poor, who can afford to pay a minimal amount for premium contributions in exchange for a defined health care benefit package. In 2008, 12 schemes were operated by local and international NGOs, covering nearly 80,000 members. The HEF, meanwhile, is a mechanism to reimburse health facilities for treating patients classified as too poor to pay. The aim is to provide poor people with access to appropriate health services and protect them against health-related impoverishment. HEFs were introduced in the health sector from 2004 and are incorporated into a second health support project from 2009 to 2013.

A key area of interest is in the provision of health insurance, which can provide a bridge between health service providers and prospective patients, ensuring improved access. While there is no State-level system of such insurance, experience from the NGO sector in supporting CBHI schemes provides insight into the potential of relevant mechanisms.

Under the SKY initiative (based on the Khmer acronym for 'insurance for our families' – see Box 18), health insurance schemes allow poorer people to cover the costs of treatment for a small premium. With the added confidence of having the insurance in place, people who become sick are more willing and able to seek treatment. The package also demonstrates the potential of generating cost recovery funds by providing a guaranteed source of income to health service providers.

Improving access to health service delivery: The Floating Clinic

While access to health centres has improved significantly, they often remain far away and difficult to reach for many rural people.

Yet as the experience of the Floating Clinic on the Tonle Sap illustrates, innovative approaches based on providing services that fit with specific needs and circumstances of rural people hold great potential. Accessing health care from many of the villages on the Tonle Sap is impossible, with some villages more than 100 km from the nearest facility and many people earning incomes too low to be able to afford transport. Making matters even more difficult, more

Box 18: SKY Insurance package

Insurance packages provide a range of benefits:

- Free and unlimited access to all contracted health centres for primary health care or emergencies
- Free and unlimited access to contracted referral hospitals for both inpatient and outpatient care, when referred by health centres
- Free and unlimited access to contracted provincial hospitals for both inpatient and outpatient care, if referred by health centres or referral hospitals
- Free transportation from health centres to hospitals in emergencies
- Funeral grants and traditional music for funerals
- Limited exclusions such as long-term treatment of chronic diseases

than 80 percent of the lake's residents live with a complex web of debt. For the past three years, The Lake Clinic-Cambodia (TLC) has brought health care and health education by boat to seven villages on the lake – three in Siem Reap province and four in Kompong Thom province – through its 'floating clinic.' It is not easy: during the rainy season, storms threaten and delay travel, while during the dry season low water levels impede boats. Yet at the same time, this experience also attests to the importance of incorporating such innovative service delivery mechanisms into sub-national health care institutions and making them sustainable.

Monitoring and surveillance: The case of drug-resistant malaria

Lastly, recent experience from tackling drug-resistant malaria along the Thai-Cambodia border near Pailin provides some important lessons for future actions with regard to climate-resilient health. This part of the country received international attention as the first place in the world where chloroquine-resistant Plasmodium falciparum malaria was detected. From Pailin, this potentially lethal strain of drug-resistant malaria spread around the globe. Alarmingly, early resistance to the drug artemisinin has been detected in recent years (Samarasekera 2009). With the high incidence of Plasmodium falciparum malaria and the area's historical role in the spread of chloroquine resistance, preventing the development and spread of resistance to artemisinin is a major priority when considering climate change.

A new initiative has focused on a process of ensuring rapid diagnosis, isolation and treatment of cases before they can spread. This involves a network of

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Accessing health care from many of the villages on the Tonle Sap Lake is impossible with some villages more than 100 km from the nearest facility and many people earning incomes too low to be able to afford transport.

village volunteers, of which 3,000 are now spread across the country, to take blood samples from people suspected of malaria infection. Taxis are used to get blood samples to laboratories in Phnom Penh, and state-of-the-art laboratory technology identifies cases of drug resistance so that patients can be isolated and treated quickly. Of the 2,782 people screened in Pailin under this scheme in 2010, only two cases of Plasmodium falciparum malaria were detected – a dramatic improvement from the previous year, when the area had the highest incidence of Plasmodium falciparum malaria.

Ensuring that vulnerable people have access to early diagnosis and treatment depends on having these health services available and accessible in remote areas. In addition, such services must be responsive and linked effectively with national-level services, which depends on the network of village health volunteers – or decentralization of a key health service to village level.

Responding effectively also requires appropriate technical support. Currently these efforts are funded as part of an international collaboration between Thailand and Cambodia, involving MoH, WHO and British universities funded by the Bill and Melinda Gates Foundation at a cost of US$22.5 million.

Shocks and crises: Social protection, safety nets and Disaster Risk Reduction

Cambodia's recent history is a testament to the strength of Cambodian people in the face of terrible adversity. Growing out of this history is well-grounded experience of providing relief and support to those most in need, albeit with the support of the international community.

Rural people in Cambodia consistently make difficult choices, adapting household livelihood strategies according to changing environmental and economic circumstances. In times of floods and droughts, community members help each other protect and repair damaged property and public infrastructure, as well as provide loans of food and cash (WB PDNA 2010, ADI 2007). However, the ways in which rural people are compelled to deal with shock and crisis – selling land, removing children from school, borrowing at high rates of interest – can further exacerbate their vulnerability, as the previous discussion has noted.

Recent evidence indicates that some degree of autonomous adaptation by rural people to climate

Box 19: Migration in response to Typhoon Ketsana

Migration is an increasingly common strategy in the life of rural people in Cambodia, and an important strategy for dealing with livelihood crises.

Many people have been forced to migrate as a way of coping with natural hazards.

Following their crops' destruction by Typhoon Ketsana in 2009, villagers living around the Stung Chinit irrigation scheme in Kompong Thom headed upstream to cut wood and take non-timber forest products to sell, while others went down to the Tonle Sap Lake to begin fishing.

Many villagers from Por Tret, Chi Sampov, Prek and Chamchrum villages were also reported to have gone over the border to Thailand as seasonal migrant workers. In Por Tret, only 10 out of 42 families stayed back, while the rest migrated in search of jobs.

Based on interviews with local authorities in Kompong Thom, November 2009

change is already occurring (MoE/BBC Trust 2011). Yet crucially, concerns about the capacity of community institutions to provide support have emerged, with suggestions that degradation of and growing pressure on natural resources have intensified strains on traditional, informal mechanisms of mutual support (CARD 2010). Nonetheless, analyses of poverty point to the importance of having such mechanisms in place, whether through family and kin or through other social networks. Experience suggests that ultimately this level of social capital is critical, as there is only so much that individuals, households and communities can do for themselves (ADI 2007).

However, the experiences of the global financial and food crises also provide insights into the limitations of such informal mechanisms for social support. Both these crises affected a large proportion of the Cambodian population simultaneously. This meant, in effect, that most people were in need of assistance and that very few were in a position to provide support to others. This kind of analysis has implications for considering responses to climate change.

Resilience at household and community levels in Cambodia does not always receive the level of State support that is needed (Snidvongs 2006). For the State, provision of social protection has focused on public employees, with development partners and NGOs taking up other areas. Overall, the reach and geographical coverage of existing welfare services and safety net initiatives is limited (CARD 2010). Despite good experience on the ground, NGOs have not always been able to fill this gap at an adequate scale across the country, with access to quality health and education services often remaining beyond the reach of poorer people.

Again, the importance of this kind of State-led support has been reinforced by the experience of the global financial crisis. With many people in Cambodia, particularly those working in manufacturing and textiles, losing their jobs, and with greater pressure on rural areas, the Government, development partners and NGOs were obliged to review the need to provide social safety nets. This led to the development of the National Social Protection Strategy for the Poor and

Box 20: "I wonder and wonder, but I have to continue farming."

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Nouv Nuan, 48, lost her crops after Typhoon Ketsana swept through in 2009. She recalled: "Our wet-season farming got flooded, and now we have to do the dry-season farming or else we will starve. It was as if we were drowning in a deep well, and we couldn't swim or climb up".

In mid-February 2010, she had just harvested one portion of her paddy field from a small piece of land (0.6 ha) borrowed from a relative. "We now manage to have food, but we owe people money for petrol, rent and other things", she said.

"I wonder why there was such a big flood (the typhoon), as for the past 18 years I have never seen such heavy flooding. I wonder and wonder, but I have to continue farming. I need strength to bike to the field. My children need money for schooling, and my ailing mother-in-law needs our help too".

Interview in Kompong Thom, 18 February 2010

Table 10: Approach to social protection and climate change adaptation

Approach to social protection	Benefits for climate change adaptation
Provision	Protects those most vulnerable to climate risks, who have low levels of adaptive capacity
Prevention	Prevents damaging coping strategies as a result of risks to weather-dependent livelihoods
Promotion	Promotes resilience through livelihood consolidation and/or diversification and security to withstand climate change-related shocks Promotes opportunities arising from climate change
Transformation	Transforms social relations to help address underlying social and political vulnerability

Adapted from Davies et al 2007

Vulnerable, which is still being deliberated. Critically, the process of devising this strategy has been built on consultations with a range of stakeholders representing not only Government agencies with social protection-related responsibilities, but also NGOs, international agencies and donors, and the private sector.

In addition to support for health protection, the strategy makes a number of key recommendations:

- **Education:** Harmonising and expanding coverage of programmes promoting education and child development; targeting child labour, through implementation of in-kind transfers, including school feeding, take-home rations and cash scholarships
- **Cash transfers:** Piloting transfer programmes to alleviate chronic poverty and promote human development; cash transfers to give people access to key social welfare services; overcoming demand constraints of nutrition
- **Public works:** Improving the effectiveness of public works to respond to food insecurity, crises and natural disasters; designing such public works interventions according to climate change adaptation priorities

Meanwhile, targeting women in social protection measures offers clear advantages. Women stand out as a disadvantaged group in Cambodia. By targeting women – for example, in cash transfer and public work schemes – the existing burdens that women face can be reduced by providing the needed financial support and infrastructure. There is also a multiplier effect, for doing so also enables women to invest in household health and education, and to take up opportunities in education and training (Foa 2010). However, this also requires gender-sensitive planning and effective participation of women.

Moving from shocks and crises towards more long-term development can be seen as a shift from dealing with emergencies to encouraging systemic change. In the language of social protection literature, this is referred to as moving from provision and prevention toward more transformative change associated with promotion and transformation. In many ways, this is similar to moving from emergency relief to more long-term, structural change and development.

The area of public works offers particular potential for supporting long-term transformative actions required for climate resilience. So far, public works schemes in Cambodia have tended to focus on basic infrastructure such as roads and bridges. Yet while a need still exists to improve rural infrastructure across the country, there is an additional need to ensure that such infrastructure is climate proof – for example, that roads are designed to withstand higher flood levels while also allowing for effective drainage.

There also exist more long-term potentials for cash transfers and public works schemes. For example, by providing employment and food to vulnerable

groups, public works can reduce their vulnerability in times of crisis. As noted most Cambodian public works interventions have provided labour opportunities for poor people in the construction of key infrastructure – roads, bridges and irrigation canals. As the infrastructure requirements of climate change adaptation shift, however, the types of public works that could be undertaken may address not only flood protection, but can also move toward investments in ecosystem restoration and climate proofing of existing and planned infrastructure. The labour requirements of such a broad-based approach to infrastructure investments thus provide an opportunity both to ease vulnerabilities of the poor, while also constructing needed infrastructure.

Disaster Risk Reduction

Climate change will alter the natural disaster and hazard profile for the country, and without adequate support to reduce exposure and impacts, and to deal with the consequences, many more people will be at risk of becoming poor. Disaster Risk Management (DRM)[20] cuts across many sectors to ensure effective planning, land use, protection of key resources and effective early warning systems and emergency response.

Under the framework of the Strategic National Action Plan for Disaster Risk Reduction 2008-2015, Cambodia has an institutional mechanism for responding to disasters in the National Committee for Disaster Management (NCDM), an inter-Ministerial coordination body with provincial-, district- and commune-level committees for local action. The overall aim of the Action Plan is to reduce the vulnerability of the poor who are affected by natural, environmental and human-induced disasters. The Plan prioritises integrating DRR in national and sub-national planning, improving early warning systems, monitoring and assessing relevant risks, and strengthening disaster preparedness.

The major national focus of dealing with natural hazards has been on mobilising emergency relief in

As the infrastructure requirements of climate change adaptation shift, the types of public works that would be undertaken may address not only flood protection, but can also move toward investments in ecosystem restoration and climate proofing of existing and planned infrastructure.

response to specific disasters. In general, emergency responses have succeeded in reducing mortality and disease rates associated with disasters, by providing food, relief, medicine and temporary shelter. However, this has come at considerable financial cost, often borne by the donor community. Moreover, the effectiveness of these efforts in preventing people from slipping into poverty as a result of disasters is less clear, given the short-term nature of the actions, with little follow-up. However, recent evidence also suggests that the effectiveness of State emergency relief efforts can be improved when appropriate checks and balances are in place, and civic institutions and local voice are strengthened (WB and NCDM 2010). Effectiveness of relief efforts is also closely associated with gender equity and empowerment, with women playing important roles in ensuring equitable outcomes of disaster relief (Foa 2010).

Despite the experience of emergency relief, there has been less effort on disaster prevention and preparedness in the country. Nonetheless, this area is increasingly being targeted, with particular emphasis on strengthening sub-national planning across sectors and providing adequate financial resources. This is seen as a means of ensuring that key sectors, such as agriculture, health, water and sanitation, education, land use planning, and natural resource management and infrastructure, incorporate disaster preparedness within their sectoral planning. As such, DRR, much like climate change, is crosscutting and cross-sectoral, with much of disaster preparedness focused on strengthening livelihood security.

Addressing natural hazards and disasters faces major institutional challenges that have important lessons for climate change adaptation. Coordination among different agencies at different scales is always difficult, and remains a key constraint that will require improvement to ensure both effective emergency response and disaster prevention and preparedness.

Turning to early warning systems, their performance so far in Cambodia has been mixed. For example, early warning systems for flood preparedness along the Mekong have been supported under regional collaboration through the Mekong River Commission (MRC), with popular media disseminating warnings to affected villages and several NGOs and international organisations involved. These have targeted highly vulnerable areas, such as the provinces of Kratie, Takeo, Kandal, Prey Veng and Svay Rieng. However, early warning systems for other vulnerable areas, such as the coasts or sea fishing vessels, are less well established (FiA 2010).

Research also suggests that while many more people are experiencing climate-related extreme events, information is not reaching them in time. For example, 90 percent of respondents in a recent study reported such an experience in the previous year (MoE/BBC Trust 2011). But more than a third (36 percent) had not received any information about the event, and alarmingly, 72 percent of those who did receive information did so after or during the event. Of those experiencing an extreme climate event, only 8 percent received information from the State. Significantly, more men (66 percent) received information about the event than women (60 percent), although there was little difference in the timing of the information men and women received.

All this suggests an urgent need to improve early warning systems in Cambodia and to ensure that those most at risk have access to the information that they need. Critically, it will be important to target systems to identify who is likely to be vulnerable, and in which areas, and to disburse support quickly. Currently this draws on the Identification of Poor Households Programme (ID Poor). But climate change can hit even the non-poor, and risks of exclusion in Cambodia are high.

Opportunities exist for simple innovations based on accessible technology. For example, mobile phone use and access is growing rapidly across the country, even in rural areas, with 60 percent of respondents in one recent study owning mobile phones; 91 percent

have access to a phone (MoE/BBC Trust 2011). A total of 45 percent of the mobile phone owners also send and receive text messages. The study recommends that possibilities for mobile communications within national disaster preparedness strategies be explored. Popular media such as TV and radio can also play important roles in providing appropriate information for preparing for and coping with extreme weather conditions.

Clear overlaps exist between national strategies for social protection and DRR that become even more prominent in the context of climate change. In particular, DRR and climate change adaptation share much in common in preventing harmful impacts from extreme events, and in aiming to make livelihoods more resilient in advance of such events. Yet so far, development of DRR and social protection strategies appear to be separate efforts, focused on social safety nets and emergency relief rather than long-term development, and with little linkage. This inevitably raises concerns about effective coordination and collaboration for long-term climate change adaptation.

Summary

Disaster Risk Reduction, social protection and climate change adaptation can be seen as overlapping, cross-sectoral approaches (Davies et al 2009). Each aims to strengthen assets and institutions, while also promoting improved knowledge and information systems and more inclusive decision-making.

Climate change adaptation requires a more long-term perspective than the traditional addressing of specific types of emergencies or crises, and necessitates tackling the root causes of poverty and vulnerability. As such, this inevitably draws attention to issues of health as well, given the strong linkages to both DRR and social protection.

In turn, the effectiveness of crosscutting DRR and social protection interventions for building resilience to climate change will be determined by the extent to which the ways of thinking and types of actions that each aims to promote can be incorporated in policies and practices of different agencies at national and sub-national levels. While the development of policy in Cambodia in each of these areas has progressed in recent years, the outstanding challenge will be to ensure that these approaches are built into overall strategies aiming to address the kinds of uncertainties and risks that climate change will bring.

Drawing on the perspectives of social protection and DRR, the following sections will consider how these approaches can be incorporated into regular planning and action of other relevant sectors and into sub-national and community-based actions.

CHAPTER 7

Sectoral approaches

- Across all sectors, there exists a need to put in place the planning, implementation and decision-making institutions and processes that allow for a more integrated approach to sectoral responses. These will need to address the degradation of key natural assets as well as the limited access and entitlements of poor people.
- For all sectors, it will be necessary to address constraints to poor people's access to productive resources, as well as limited access to extension support, market opportunities, and information and technology.
- Some examples of technology and practice that are appropriate for poor people, and that fit with principles of climate change-resilient rural livelihoods are highlighted in each sector.

Introduction

This chapter considers the requirements and opportunities for building climate-resilient rural livelihoods.

Two inter-related aspects to building low-carbon climate-resilient livelihoods are examined:

- Promotion of technologies, techniques and practices
- More strategic, integrated approaches to planning and management

The discussion is based on applying the principles for climate resilience outlined in Chapter 3, presented through five key areas:

- Water resources
- Agriculture
- Forests
- Fisheries
- Rural energy

Water resources

It is through water that human well-being, environment and biodiversity come together, and through water that many of the impacts of climate change will be felt. It is thus through actions on the management of water resources that the building of resilient rural livelihoods will depend.

Water is central to two of the pillars of national economic development – the energy sector, through the promotion of hydropower, and agricultural development, through the expansion of irrigation. But water is also fundamental to the basics of human well-being and health.

The core challenge of water resource management in Cambodia is of access and distribution. As presented in the discussion of predicted impacts of climate change (Chapter 2), scenarios for water resources suggest that availability will shift according to seasons, leading to decline of the resources themselves and increased competition among different users – whether sectors, regions or individuals – as well as to stresses between the seasons. With many of the watersheds in Cambodia already degraded, and in combination with weak governance arrangements and limited capacity, this presents serious challenges.

Management of water resources requires looking at both supply- and demand-side issues and placing greater concern on balancing water sustainability, efficiency and equity. Underpinning this is the need to establish the institutions to manage water resources more sustainably and equitably among different uses (Brown et al 2007). This marks an important shift from looking mainly at the infrastructure and technology of water resources management (dams,

reservoirs, canals, pipes and pumps) toward the inclusion of political, social, economic and institutional dimensions of access and distribution.

Integrated Water Resource Management

The central strategy for water management, enshrined in international agreements such as the World Summit on Sustainable Development (WSSD) and advocated by the IPCC, is Integrated Water Resources Management (IWRM).

IWRM is an integrated approach to balance water availability and water demand, so that access to water resources among different uses and users can be equitable and fair and economically efficient, but also to ensure that water use is sustainable, taking into consideration ecosystem requirements for water (see Box 21).

Experience from around the world testifies to the technical, legal, institutional and management challenges of putting IWRM into practice.

In many ways, Cambodia is well positioned to move forward with IWRM. The country has made progress on establishing a policy framework for water resources in line with global commitments under the WSSD Johannesburg Plan of Implementation 2002. The Law on Water Resources Management was approved in 2007, building on the National Policy on Water Resources Management and the Strategic Plan on Water Resources Management and Development (2005-2008). The Water Law is set within the framework of IWRM, recognising the different sectoral interests in water while calling for greater coordination and the need to balance social and environmental considerations. As such, the Water Law includes several articles that deal directly with rights, organisation and participation of water users.

However, the experience of putting these IWRM principles into action is limited and highlights the kinds of challenges that will need to be addressed (Clausen 2009). Around the world, water resource management cuts across many sectors, involving numerous Government agencies with different objectives and responsibilities. Coordination has been a consistent challenge. Vested institutional interests need to be overcome, particularly those related to land use changes in watersheds and catchments, and demands for water from key sectors such as mining, hydropower, agri-

Box 21: IWRM and climate change

IWRM is defined as a process that promotes the coordinated development and management of water, land and related resources to maximise the resultant economic and social welfare in an equitable manner, without compromising the sustainability of vital ecosystems.

Based on the WSSD Plan of Implementation Article 26, IWRM strategies should:

- Cover institutional, financial and technological change and promote action at all levels
- Use the river (or water) basin as the basic unit for integrating management
- Give priority to meeting basic human needs and take extra care to ensure access for the poor
- Address the challenge of balancing the need to restore and protect ecosystems with the needs of other water users
- Support stakeholder participation, capacity building, monitoring performance and improving accountability of public institutions and private companies
- Respect and be adapted to local conditions

Source: UNDP, "Catalyzing Change: A Handbook for Developing Integrated Water Resources Management (IWRM) and Water Efficiency Strategies", GWP Technical Committee Background Paper No. 5 (DESA/DSD/2005/5)

culture and irrigation persistently compete. Cambodia has attempted to strengthen such coordination with the formation of the Ministry of Water Resources and Meteorology (MoWRAM) in 1999, bringing most of the responsibilities for water resource management under one Government agency.

River basin institutions and processes

The formation of river basin organisations is a key element of IWRM. So far, however, progress has been limited in establishing such organisations in Cambodia. The Tonle Sap Authority (TSA, see Box 22) is the only river basin organisation established to date, under a Royal Decree in September 2007. Under the auspices of MoWRAM, the TSA brings together 36 local and provincial representatives from the six provinces around the Tonle Sap river basin, along with line Ministries with a remit related to water. It also aims to bring together international organisations and NGOs (RGC 2007, Tonle Sap Authority 2010).

Attempts have also been made to establish an organisation at a more manageable, but still complex, scale, focusing on four tributaries of the Srepok River. The approach in this basin – a catchment in Kratie known colloquially as 'the 4Ps' – has been to work with local stakeholders in building objectives and mechanisms of a multi-stakeholder basin authority (Watt 2009, GWP/CNMC 2007). While the organisation has not been fully established, the process, with its focus on local consultation, provides an important lesson for future development of river basin organisations in Cambodia.

Experience from the setting up of river basin organisations in the Mekong region likewise is highly informative. The approach adopted has been one of the State establishing large-scale organisations with a mandate to manage a series of smaller basins, catchments and watersheds. The experience from Thailand and Viet Nam suggests that this has not been successful, however, with river basins being organisations in name only, not in practice (Molle and Hoanh 2008). Alternative approaches appear to be more promising, highlighting the need to build up river basin organisations from smaller constituent elements and thereby ensuring effective local participation involving diverse resource users. The existence of local-level institutions within the D&D framework, as well as institutions with responsibility for resource management (such as Community Fisheries and Community Forestry committees), offer other potential building blocks of river basin institutions (Clausen 2009).

As critical as public participation is, there is also a need to ensure that such organisations have the authority and budget to allow them to operate. Again, experience suggests that these remain impediments to effective functioning of river basin organisations. It is therefore essential to ensure that adequate levels of authority are transferred to these organisations, and that they receive the necessary financial, technical and human resources to fulfil their responsibilities.

Box 22: The Tonle Sap Authority

The TSA has been able to address some of the critical issues related to poor planning that threaten the sustainability of the Tonle Sap Lake. It has demarcated areas of each of the provinces within the basin and has begun zoning of critical areas such as the 640,000 hectares of flooded forest that are crucial to fisheries production. In addition, it has undertaken initiatives to maintain water quality. More recently, the TSA has demolished more than 100 smaller scale reservoirs built in the basin on an ad hoc basis without adequate planning, which are considered a threat to the basin's ecosystem, water and fishery resources.

While the TSA is able to apply a river basin perspective for the Tonle Sap, it also faces challenges because of the scale of the basin and the diverse stakeholders involved.

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The existence of local-level institutions within the D&D framework, as well as institutions with responsibility for resource management (such as Community Fisheries and Community Forestry committees), offer potential building blocks of river basin institutions.

Proponents often refer to IWRM as a process. In thinking through how this process can be developed further in Cambodia, attention must be given to the need for developing public platforms where different water users within a catchment or basin can come together (e.g. Clausen 2009). The idea of 'dialogue platforms' has been supported in many parts of the world (Dore et al 2010). They provide a starting point for identifying water resource visions and objectives, as well as possible strategies and institutional arrangements for meeting these. At the very least, they provide a public space to negotiate water allocation issues between upstream and downstream users, and among different sectors.

Perhaps more than any other intervention for climate change resilience, management of water resources depends on actions at the regional scale (TKK and SEA START RC 2009). For Cambodia, this is firmly at the scale of the Mekong basin. The drought of 2010 raised regional water resource development issues in public awareness. Much of the media debate has questioned the extent to which the drought has been caused by hydropower dam development in China and other upstream countries, or is the result of climate change. Popular interpretations are often conflicting, but need to be informed.

The main framework of the MRC brings together the four countries of the Lower Mekong basin (Cambodia, Lao PDR, Thailand and Viet Nam) to promote sustainable sharing of the water resources of the basin. With such a clear transboundary dimension to water resource management for Cambodia, the role of organisations such as the MRC will become increasingly important.

IWRM information needs

Managing water for different needs among stakeholders depends a great deal on availability of reliable information. This area remains weak in Cambodia and across countries of the Mekong.

The responsibility for collecting data on meteorology and hydrology falls within the responsibility of MoWRAM. Although data systems were established in the early 20th Century, many stations are no longer fully functioning. Long data gaps during the period of civil conflict also exist.

Systems for management, processing and quality control of data also remain weak, with recordings still sent manually to province headquarters and Phnom Penh. It is not clear how the data are made available or applied (MoE 2010). In addition, no system exists to integrate climate and weather forecasting with hydrological features, at national, provincial or community levels (Solar 2009). Hydrological flows represent a particularly critical area where significant further data are required.

Maintaining environmental flows at both upstream and downstream levels – in other words, ensuring that ecosystems continue to function and provide economic and social benefits – also stands as a central feature of IWRM, requiring effective coordination between MoWRAM and MoE. However, the legal framework, rules and regulations and institutional mechanisms for such integrated management are not in place.

The importance of data and information becomes exceptionally clear when considering regional development, and the need for individual countries to be able to assess their own situation as well as that of the wider region. As a downstream country highly dependent on the natural flows of the Mekong and its tributaries, Cambodia's ability to plan its own future, and to negotiate fairly with its neighbours on water sharing arrangements, rests heavily on the availability of reliable scientific data and information that is acceptable to all parties.

The lack of effective data and information systems has been identified as a critical impediment to overall development in Cambodia (GWP/CNMC 2007). Donor support is being sought to build and strengthen these systems, but this process will take many years. In the meantime, other sources of data and information will also need to be utilised.

Assessing options and impacts

Ultimately, IWRM is about making choices about how water should be managed and distributed. With so much national and regional interest in developing large-scale water resources infrastructure, the need is urgent to put in place appropriate mechanisms for assessing water resource options and impact assessments.

The controversy surrounding water resource infrastructure – particularly hydropower dams – has encouraged development of such decision-making frameworks. In addition, the importance of such planning approaches has been recognised by many of the leading private hydropower companies around the world, with the International Hydropower Association (IHA) developing its own Sustainability Protocol. Development of this decision-making framework has involved testing in the 3S River Basin, in partnership with the Governments of Cambodia, Lao PDR and Viet Nam, as well as the MRC, ADB and World Wide Fund for Nature (WWF).

The Mekong basin has also seen the application of integrated assessment procedures. Strategic Environmental Assessments (SEAs) have been adopted by the Government of Viet Nam as a framework for planning hydropower development in the context of wider development objectives. Furthermore, the MRC recently commissioned an independent SEA study of the Mekong mainstream dams to consider planned dam development in the context of other economic and environmental trends, and to assess hydropower among other options for meeting development objectives. With more at risk from poorly planned development, there is ever greater need for applying such decision-making tools.

As the subsequent discussions will demonstrate, for Cambodia to deal with climate change across different

sectors, it will also need to address management of water resources and the ecosystems on which water itself depends. The same kinds of multi-scale, integrated, participatory approaches that are ingredients of IWRM will be urgently needed for agriculture, fisheries and forestry. This is a technical challenge requiring capacity and knowledge – but it is also a governance challenge, requiring new ways of working that can allow for effective public participation.

Agriculture

For the vast majority of Cambodians engaged in agriculture, their vulnerability is exacerbated by their weak asset base – limited land holdings and high incidence of landlessness, high rates of debt, low soil fertility, lack of access to agricultural inputs – as well as weak access to social institutional assets – lack of access to credit, weak extension services, and limited access to markets and value-added opportunities. By diversifying crops so as not to be fully dependent on rice, farmers are able to reduce vulnerability to weather and climate variables.

Predictions of climate change suggesting that temperatures will increase and seasons will shift are likely to lead to crop losses and shifting planting schedules alike. Building resilient rural livelihoods suggests the need for farmers to adapt to both these sets of vulnerability factors and to expand areas, improve yield and increase the planting index (MoE 2010).

Land

A fundamental and urgent structural issue arising from the weak asset base of rural people is found with regard to achieving secure access to productive land.

As the discussion on human development has made clear, landholdings in Cambodia are very low and many people are virtually landless. This means that most farmers in Cambodia barely have enough land to meet subsistence needs. Moreover, land title is often murky, allowing for encroachment and seizing of land, adding to people's insecurity.

Recent research demonstrates the importance of resolving these longstanding issues of land access and security as part of the overall approach to climate change resilience. A clear correlation exists between security of landholdings and productivity. A recent assessment again has identified secure landholdings as being a significant factor in agricultural production, with secure land title being associated with higher production levels (Kala, Boret and Kurukulasuriya 2011). If farmers had more secure access to more viable plots, they would be better placed to make the long-term commitments and investments needed for increasing productivity, and hence, adapting to climate change. Conversely, providing secure access and tenure to land resources greatly increases potential for improved productivity as well as meeting food security and income generation needs.

The future of rice

In the 1960s Cambodia was one of the main rice exporters in Asia, but production declined dramatically during the civil war. Cambodia reached rice self-sufficiency in 1995 (Nesbitt 1997), although it has only recently re-entered the world market as a rice exporting nation.

As a result of the impacts of recent crises, and the realisation that agriculture still plays an important role as a social and economic safety net, the sector has received fresh attention from national policies. Moreover, the potential for agriculture, and rice in particular, to contribute to short- to medium-term national economic growth has become more readily accepted (UNDP 2009a). This recognition is most evident in the emerging rice policy (RGC 2010), with the continued dominance of rice production now termed 'white gold' (see Box 23). In turn, enthusiasm has been renewed for the rice sector to grow and become more export-oriented, moving into the

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The potential for agriculture, and rice in particular, to contribute to short- to medium-term economic growth has become more readily accepted. This recognition is most evident in the emerging rice policy, with the continued dominance of rice production now termed 'white gold'.

processing of agricultural products and rice milling. In the wake of the global food crisis of 2008, Cambodia hopes to replicate the successes of Thailand and Viet Nam in exporting rice (USDA 2010, Randey and Bhandari 2009), bringing 'white gold' even more prominently into national development policies.

In so doing, Cambodia is being hugely ambitious. The current rice production goal is 15 million tonnes per year by 2015; of this, 8 million tonnes of paddy rice is targeted for export. Yet this is more than double the 7.1 million tonnes currently forecast for 2010, as well as similar production figures for 2007 and 2008 of 6.76 million tonnes (MAFF 2009).[21] Such an enormous increase in rice production will have important implications for land use and water management. Given agriculture's contribution to national GHG emissions, this also has implications for climate change vulnerability and mitigation. In all, the challenge will be to improve rice productivity while adhering to the principles of low-carbon agricultural development (see Box 24).

Water for agriculture

Irrigation is almost universally identified as the major constraint to improving rice production in Cambodia. The lack of access to irrigation is also widely identified as a major factor in farmers' vulnerability to climate change. All climate change adaptation recommendations for the country refer to the need for expanding the area of land under irrigation. Yet the case for irrigation is not clear-cut.

The efficiency of existing irrigation systems also is questionable. A comprehensive review covering 2,525 irrigation schemes in 13 provinces revealed extremely poor performance (CEDAC 2009). Only 6 percent of irrigation schemes were assessed to be functioning well, while a staggering 62 percent were deemed not functional and a further 32 percent were found to be partially functional. Major factors in this poor performance are related to weak institutional capacity of farmer groups and low incentives for collective action,

Box 23: White gold: Development of rice agriculture

A recent policy paper the on promotion of paddy rice production and export of milled rice prioritises the following:

1. Infrastructure building and enhancement
2. Improved provision of extension services and agricultural inputs
3. Land management reform
4. Finance and marketing
5. Expanded farmer organisations and institution building and coordination

By 2015, the country hopes to achieve a rice surplus of 4 million tonnes, of which 1 million would be exported (RGC 2010).

However, the current policy paper does not specifically address the challenges associated with climate change in Cambodia.

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Box 24: Low-carbon agricultural development: Key ingredients

Low-carbon agriculture refers to agricultural techniques that:

- Promote low-carbon technology in farming for long-term agricultural development
- Conserve and improve soil fertility and reduce the need for tillage
- Give preference to locally available organic inputs over imported chemical inputs
- Promote efficient management and use of water resources
- Reduce energy and fuel demand, for example, for pumping irrigation water and for transport
- Integrate crop and animal farming systems

as well as poor design of the schemes themselves. Ultimately, most irrigation schemes were simply not economically viable. This kind of assessment clearly indicates the kinds of challenges in making irrigation work, particularly for small-scale farmers.

In considering the future development of irrigation, it is therefore important to consider the design of irrigation schemes, ensuring that soils are suitable and that irrigation investments are economically viable. But in addition, irrigation development also must look at institutional issues about management and sharing of water resources, and at ensuring that operation and maintenance requirements can be adequately borne by farmers to underpin sustainability.

Meeting irrigation needs of farmers is perhaps more likely to be realised through smaller-scale systems, developed according to local needs and circumstances (Hoanh et al 2009, Facon 2005). For example, economic returns and farmer mobilisation, financial management, and operation and maintenance are all more efficient and effective at this smaller scale. Because smaller systems tend to be within the boundaries of a single administrative area, they are also more easily managed. From the same review of performance of irrigation schemes in Cambodia, the conclusion was overwhelmingly that systems of less than 1,000 hectares should be prioritised (CEDAC 2009). However, such small- and medium-scale irrigation systems may also face their own limitations,

particularly in regard to the need for collective action of farmers, and economic efficiencies for meeting export-oriented production.

Soil fertility

Agricultural productivity is not solely determined by access to water, but also by soil fertility. Soil fertility is extremely low in Cambodia, and it is questionable whether the soil quality is sufficient in many areas to increase rice production to meet the ambitious new production targets. While the targeted area of land for irrigation is 1.8 million ha (69 percent of current cultivated areas), assessments of soil quality suggest that only 20 percent of soil in Cambodia is actually suitable for agricultural production that would make irrigation investments economically viable (MAFF and MoWRAM 2007). Because rain-fed agriculture will continue to play an important role in the country, this highlights the clear need for improved soil fertility and water retention (Johnston et al 2010).

Sea level rise and saltwater intrusion

Experience from the coastal zone suggests that saltwater intrusion is already a reality for many farmers. Part of the response to saltwater intrusion rests on infrastructure development (see Box 25).

Land access and planning

Management of land resources is the key to both ensuring a territorial approach to local development, as well as ensuring sustainable management of natural resources of forests and fisheries. As the discussion in previous chapters has revealed, however, it is in the area of land that much complexity, confusion and conflict currently occurs in Cambodia.

Expanding new land under irrigation must be done in tandem with ensuring effective land and tenure rights, as well as assessing ecological and equity implications of storing and diverting water resources for agriculture. The need for such land use planning is growing more acute with increasing commercial investment, particularly foreign investment, in agro-industry. Domestic and foreign land concessions are reported to cover 15 percent of the country's arable land (MAFF 2009). Such levels of investment and land use change will have far-reaching implications (Johnston et al 2010).

Box 25: Separating the water

Pon Tith, 53, carries his fishing nets, fish cage and small catfish at the Prek Torn Horn water gate. He has been fishing as well as farming rice since 1979. Construction of the water gate has helped both his livelihoods.

Saltwater intrusion is already very much the reality that coastal farmers live with.

Prek Torn Horn water gate in Kampot Province was renovated in 2008 by MoWRAM to protect the coastal area from seawater. Villagers reported that before the dike and water gate were built, saltwater intrusion used to occur up to 30 km inland, in Touk Meas and Chouk districts.

The saltwater intrusion used to affect not only farming, but also livestock and human livelihoods and health (e.g. drinking water). Since the water gate was built, however, most villagers have started to cultivate double rice crops, in both the wet and dry seasons.

Interview at the Prek Torn Horn water gate, Kampot Province, 2 February 2010

Effective land use planning thus will be essential for climate change adaptation, particularly in areas of high conflict, ambiguous or ineffective land management, or significant ecological importance. These include coastal zones, the Tonle Sap region and the northeast. Much of the responsibility for land use planning is in the process of being devolved to Commune Councils. The requirement for effective participatory planning processes has been enshrined with the rolling out of Commune Land Use Planning (CLUP) under the guidance of the State Land Management Committee (SLMC) at provincial level, and Ministry of Land Management and Urban Planning and Construction (LMUPC). CLUP is designed to guide commune-level planning by providing clarification of status (including titling) of land according to different categories; demarcating forests; planning according to agro-ecological assessments, which provides a framework for planning for climate change; and, perhaps most critically, ensuring effective monitoring and conflict resolution.

However, this local-level planning must also be supported by a comprehensive and transparent approach to land use planning at national level. While this has been identified as a Government priority (NSDP 2010), much remains to be done to ensure such a system is in place.

Experience of low-input agriculture

Several agricultural technologies and practices based on water and land management that fit with principles of climate resilient agricultural development are being tested, developed and promoted in Cambodia. By improving agricultural and water productivity, putting in place small-scale water storage technologies and conserving soil fertility while reducing the need for agricultural inputs, they hold great promise for strengthening climate change adaptation (Johnston et al 2010). These include:

System of Rice Intensification (SRI) is an integrated approach to rice farming that uses organic fertilisers (manure, composting, kitchen waste) for soil fertility improvement. By treating soil fertility, SRI reduces the need for irrigation inputs but requires more efficient water management. Whereas water is needed throughout the growing cycle in conventional rain-fed rice systems, under SRI it is needed primarily to stimulate root growth. Roots of the rice plants grow deeper in the soil and are then able to absorb more nutrients and water. In turn, SRI rice is able to resist drought for up to one month, but requires more efficient water management.

Evidence from across Cambodia indicates that under SRI yields can double, from the current typical rate of 1.5 tonnes/ha to a yield of 3 tonnes/ha. Economic returns also improve significantly, from US$58/ha to $173/ha (CEDAC 2008). Currently, SRI has been taken up by about 100,000 farmers in all agro-ecological zones, and the approach is being actively promoted by Provincial Agriculture Departments with support from NGOs. Under MAFF, the SRI Secretariat is responsible for further expanding coverage.

Despite its potential, however, rates of adoption among farmers remain rather low. Many farmers see SRI as labour-intensive, and for those with limited household labour, this is not always viable. Where there are viable off-farm employment and urban migration opportunities, particularly for areas closer to Phnom Penh, SRI is less likely to be attractive to farming households. SRI absorbs non-premium or residual labour of the household – typically older people and women aged 35 or above – who cannot leave for off-farm or urban-based employment. SRI also remains difficult to adopt at a large scale that is commercially viable; typical plots are less than 2 ha.

Multi-purpose farming, or integrated farming systems, involves cultivation of a variety of crops within the same plots to restore the ecological system in the area, and to produce different agricultural products. On the whole, this provides food sources for household consumption as well as makes important contributions to food security. But in some cases, when well targeted

to markets, multi-purpose farming can generate significant incomes. A typical multi-purpose farm includes a fish pond, vegetable cultivation, fruit trees, a cover crop to help the soils absorb moisture, and rotational crops.

These systems are well developed in lowland areas of Cambodia. While it can be taken up by households with small landholdings, it does require significant investments of capital, technical inputs and seasonal planning to be able to identify the most appropriate crops. The restoration of, or strengthening of, ecosystem functionality in land areas under multi-purpose farming builds resilience of these land areas to climate change impacts and therefore also enhances the resilience of livelihoods drawn from these ecosystems.

In addition, drip irrigation can be a more efficient means of managing water resources for small-scale cash crops, preventing water loss through evaporation. Experience suggests that small-scale drip irrigation can be established with low initial investments (less than US$100 for a 500-square-metre plot), but capable of increasing incomes threefold (IDE 2009).

Climate-resilient varieties. Traditionally Cambodian farmers have been able to draw from around 1,000 varieties of rice that are adapted to specific local agro-ecological zones and climatic conditions. For example, in Tonle Sap and the Mekong floodplains, floating rice that is resilient to high water levels is traditionally grown. However, current farming practices tend to be dominated by use of a much more limited number of varieties, particularly those high-value varieties that have market demand.

Breeding rice varieties that are tolerant to either floods or droughts will have an important role to play in the future. There are encouraging results from trials of drought-tolerant rice varieties in Kampong Cham and Siem Reap that suggest average yields have almost doubled, increasing from 1.9 tonnes/ha to 3.5 tonnes/ha (CURE 2009).

Weather forecasting and insurance. The inherent risks associated with agriculture that will be exacerbated under climate change will need to be addressed. Foremost is the need for improved weather forecasting and for crop insurance. Both are considered necessary to encourage more adaptive cropping strategies. Insurance gives farmers more confidence to make reasonable decisions on planting while reducing risk aversion, even in the face of increasing uncertainties due to climate change. This is particularly useful for the many Cambodian farmers whose farming practices remain non-mechanical, relying heavily on seasonal changes in rain and temperature for crop growth. Resistance by poor farmers to taking increased risks is understandable when the consequences of failure could be catastrophic to their livelihood, with implications for food insecurity and income loss.

Based on rainfall patterns, Cambodia is divided into eight rainfall regions.[22] With impacts of climate change expected to vary significantly depending on local geographical/ecological characteristics, this implies the need for highly localised weather observation and forecasting systems to provide better information on not only immediate weather and climate variability, but also on the prospects for long-term climate change.

Insurance schemes, such as those being introduced in countries such as Philippines[23] and Australia,[24] also require reliable and localised climate information and weather observation systems as prerequisites to determining insurance premiums for particular communities in particular seasons.

Weather forecasting, combined with water management support, can help alleviate issues such as the delayed planting of long-term rice seedlings in mid-2010 because of the late start of rains.[25] For example, a medium-term climate forecast indicating a high probability of delayed wet-season rains might have helped farmers to rapidly decide to plant short-term

Box 26: Farmer Business Advisors: The experience of IDE

Beginning in 2005, International Development Enterprise (IDE) piloted the FBA approach with three entrepreneurs who received training and marketing support. Over a three-year period, the original three FBAs were able to build a client base of 509 small farm households. On average, clients increased their net income by 27 percent, from US$382 to US$480 per year. In late 2008 IDE began to build on this pilot experience by recruiting and training 21 more FBAs. A further 42 were added in late 2009. Together, these 63 FBAs are now servicing a client base of around 5,000 customers. Preliminary surveys indicate that FBA services are helping to generate an annual net additional income of US$150 per client household.

Moreover, surveys conducted during the pilot period indicated that FBA benefits could effectively reach even very poor rural households. About 20 percent of the FBA clients came from the poorest 40 percent of the population. Most FBA client households started with a base income of less than US$1/day, and all earned less than US$2/day prior to receiving FBA services.

Currently IDE is piloting use and communication of available climate data at local level, including temperature and humidity, rainfall, air pressure, evaporation, solar radiation and wind speed. By helping farmers use such information, it aims to help increase the efficiency of agricultural production during times of uncertain weather, maximising food production and income generation during seasons that can accommodate certain crop cultivation better than others.

vegetable crops instead of waiting for the rain to arrive.[26] However, important as such forecasting and insurance might be, they should not be seen as a panacea (Heltberg et al 2008). Indeed, changes in climate and uncertainty about future climate conditions can make insurance more expensive and less appropriate as a means to compensate for losses associated with climate variability and extreme events.

Even while insurance may not be appropriate for very slow-onset climate impacts such as SLR and desertification, it may be considered with regard to soil salinity as a result of seawater intrusion, one of the fastest climate change impacts anticipated. Insurance thus must be considered within an overall risk management and adaptation strategy, where preventing losses will often be more cost-effective than loss-based insurance.

Agricultural extension and the role of the private sector

Limited access to high quality agricultural extension services acts as a serious constraint to farmers across the country. Government agencies struggle to meet farmer demand and face their own limitations in terms of capacity and funding. The private sector already plays an influential role in providing extension services and inputs.

A promising example of private sector activity comes from the growing experience in Cambodia of Farmer Business Advisors (FBAs, see Box 26). These FBAs are essentially micro-entrepreneurs, taking on agricultural extension and marketing responsibilities with greater efficiency and responsiveness to local needs than can be achieved through the Government sector.

FBAs travel within a 6-10 village circuit, assisting farmers to initiate, intensify or expand market-oriented agricultural production. They analyze individual farm enterprises and match any constraints or missed opportunities that they identify with products and services in their 'toolkit', which includes a range of options to reduce risks, improve productivity and increase income. FBAs also provide technical advice at the time of sale and during return visits throughout the growing season.

FBA products include irrigation equipment, good quality seeds, fertiliser, mulch, plastic fencing, and produce collection and marketing services. These products and services are sold at a profit, often on credit with payment due at harvest. In 2010, FBA offerings were expanded beyond horticulture to include products for improved rice production. Products and services related to livestock and fish raising are planned.

Before becoming FBAs, these micro-entrepreneurs typically engage in business activity that already puts them in regular contact with small farmers. Such business activities may include veterinary services, vegetable collection, well drilling, agricultural input supply or agricultural training.

Enterprise Centres (EC) – essentially 'one-stop' agricultural service centres – are a variation of the FBA approach, blending private and public sector participation to facilitate smallholder farming. The EC can be thought of as a combination of farmers' technical schools and centralised contact points for other agricultural value chain actors. Their central purpose is to enable transfer of accessible technology and economic information and financial resources to support sustainable smallholder livelihoods.

An EC can be legally established within farmer organisations, business membership organisations (BMOs), provincial- and district-level departments, public sector service providers, and private sector service providers (including financial institutions) in designated irrigation schemes.

It is expected that ECs will be convenient access points for commercial input suppliers and commercial buyers to either deliver services or make 'quantity enough' and 'quality enough' purchases of smallholders' produce. In this manner, ECs can facilitate the grouping of smallholder farmers into large enough commercially viable aggregates and help them lower their risk profiles by becoming climate change-resilient, while also lowering input costs and increasing agricultural products' selling prices. Accordingly, ECs could become centres for promoting agricultural productivity and growth, and as such, centres of climate change adaptation.

Access to markets

With weak access to markets and transport, most farmers face a large number of constraints. Poor transport links and a lack of storage facilities constrain

Box 27: Farmers' adaptive capacity

The capacity of farmers to adapt to changing weather patterns varies considerably. For example, evidence from recent research in Siem Reap and Kampong Cham provinces by Plan International (2010) illustrates how farmers struggled to cope with the delayed onset of rains in 2010. Many farmers planted their rice seed several times, only for the rice to shrivel and die while waiting for the rains. By the time rains did arrive, several weeks later than usual, many farmers had used up all their supply of rice seed.

However, the situation in Svay Rieng and Kep provinces is remarkably different. In Kep, rice farmers have observed a gradual shift in the timing of the rains. Drawing on weather reports on the public radio, this year they held back from planting their rice because they expected later rains than in previous years. They also applied their own type of fertiliser, accessing waste material from nearby fish sauce processing plants. Using improved access to inputs, information and technology, as well as their comparative advantages with regard to their location near the border with Viet Nam and their larger and more fertile landholdings, by the middle of November 2010 the Kep farmers were successfully harvesting what they considered to be a very good crop.

These two stories have very different outcomes, but it is striking that for both sets of farmers, they were largely left to their own devices to adapt as best they could.

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Market information for farmers remains limited. The gap between suppliers and buyers, as well as the large number of intermediaries, means that most farmers are unaware of consumer preferences and have weak bargaining power in the marketplace.

more commercially oriented farmers, while agricultural products are not diversifying to higher-value crops (ASSDP 2006-2010, pg. 25, and TWGAW 2010-2013, pg. 44). In terms of financial input, little access exists to long-term financing for investment in agricultural products. Most loans are from the informal sector at high rates of interest (preliminary findings from Agribusiness Supply Chain Mission, FAO/EU Food Facility Project).

Market information for farmers also remains limited. The gap between suppliers and buyers, as well as the large number of intermediaries, means that most farmers are unaware of consumer preferences and have weak bargaining power in the marketplace (TWGAW 2010-2013, pp. 44-45).

So far, much of the relevant support has focused on rural infrastructure, including roads and rural electricity, as well as on establishing wholesale markets in border zones to allow Cambodian farmers to connect with regional and global markets. Additional areas of support have focused on producer groups and expansion of rural credit and microfinance. However, relevant policies and regulations for the development of market access are still at a rudimentary level.

Thus, while potential climate change implications for agriculture are extremely serious, there exists considerable potential for responses based on promotion of appropriate technologies and practices. Already, best practices across the country can be scaled up if appropriate support mechanisms are in place.

The resilience of the agriculture sector cannot, however, be separated from some of the more fundamental challenges around access to and sustainable management of productive land as well as more effective management of water resources. These are also areas can be expected to be increasingly associated with conflict and competition. For responses

to meet poverty reduction and food security needs while ensuring environmental sustainability, these critical dimensions of agricultural production will need to be addressed.

Forests

For Cambodia's climate change future, there exist both threats and opportunities associated with forestry. Rates of deforestation and associated land use changes have been the major driving force behind Cambodia becoming a net emitter of GHGs. This has consequences for the global struggle against climate change, as well as direct implications for sustainability of livelihoods dependent on healthy ecosystem goods and services and for more local climate within the country.

It is in the forest sector that some of the greatest opportunities for Cambodia exist. Newly agreed international financing mechanisms, supporting developing countries to protect their forests as a means to reduce climate change impacts, have enormous potential for Cambodia. The REDD+ mechanism could generate significant revenues for both national and local development, with rural communities as forest stewards and primary beneficiaries. Through these finance mechanisms, conservation of forest resources could become economically viable and desirable, rather than a burden. But taking advantage of the opportunities afforded by REDD+ requires addressing underlying vulnerabilities in the forestry sector and meeting the governance requirements established under the REDD+ framework regarding monitoring and evaluation as well as benefit sharing.

The carbon potential of Cambodian forests

By halting deforestation, Cambodia is in a position to reduce GHG emissions and expand the area that can absorb carbon. But in addition, protecting forests – and thereby watersheds and land –can also contribute to ecological protection, water resource management, sustainable land use and agriculture, and human health.

Forests serve as the single most important sink of GHG in the country. According to the 2000 GHG inventory by MoE, while Cambodia emitted a total of 47,000 Gg of GHG that year, its forest cover helped absorb more than half of that amount, at 24,500 Gg. Losing the forest cover means the potential for absorbing GHG will also be seriously compromised.

According to a recent study by Leng et al (2010), 2.96 Gt of carbon is stored in Cambodia's forest ecosystems. One-third of this carbon is estimated to be stored in the country's evergreen forests. The forests in the south-west of the country are found to have particularly high carbon density. In terms of forest carbon storage under different management arrangements, 30 percent of forest carbon stock is estimated to be in the Forestry Concessions (Production Forest, PFR) managed by the Forestry Administration; 26 percent in the Protected Areas managed by MoE; a further 12 percent under Conversion Forests gazetted as economic land concessions owned by the land concessionaires; and 19 percent in other forests (private forests, or plantations) for which management responsibility is unclear.

Land use and forest data

Data on land use and forest cover are much improved since the 1990s. From 2002 to 2006, maps detailing forest cover have been prepared by both the Forest Administration (FA) and Danida.

However, significant gaps in data on forestry and land use remain. No mechanism exists for updating information at provincial level, so that there are concerns about accuracy and reliability of data, and consequently, the distribution and quality of remaining Cambodian forests. In fact, different sets of data have been presented by stakeholders with different positions and agendas on the contentious issue of forest cover

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By halting deforestation, Cambodia is in a position to reduce GHG emissions and expand the area that can absorb carbon. But in addition, protecting forests – and thereby watersheds and land – can also contribute to ecological protection, water resource management, sustainable land use, and human health.

and land use change, including land concessions. Improving such data so that they are acceptable to all parties will be critical, especially considering the strict requirements associated with REDD financing.

Drivers of deforestation

As has been discussed earlier, climate change is not itself the major driver behind the vulnerability of forests in Cambodia. The country has been faced with huge, economically driven pressures on forest resources that have contributed enormously to deforestation rates. The enormous international demand for high quality timber, agricultural products, minerals and livestock products; the lack of a global pricing mechanism reflecting the social and environmental impacts of the loss of forests; and the vast sums of money involved, combined with weak forest governance systems, have come together with a range of vested interests to place considerable pressure on Cambodian forests, despite a moratorium on logging. Such pressure seems to have intensified further since 2004 or 2005.

How these forces have come together has been more clearly articulated in the multi-stakeholder consultation process behind the development of Cambodia's REDD+ Road Map, and there appears to be broad consensus on vulnerability of the forest sector. This can be summarised as:

- Consistently high international demand for forest resources
- Weak legal framework despite clarification of forests as State public property under the Forestry (2002), Protected Area (2008) and Land Laws (2001)
- Weak legal framework regarding land rights and management and control of economic land concessions and social land concessions
- Weak enforcement of the law, and the lack of Government capacity to adequately manage forests

- Poor monitoring on the status and condition of forest resources, and the lack of publicly available information that is acceptable to concerned stakeholders
- Slow rate of progress in establishing Community Forests and Community Protected Areas, as well as the limited rights that such local management regimes are allowed
- Corruption, considered one of the most prominent issues needing to be addressed in the country's efforts to introduce and implement REDD+ effectively and credibly

In addition to these broader pressures on forest resources, rural Cambodia is characterised by an extremely high degree of dependence on forest resources. Forests have traditionally been common property resources, often managed according to traditional rules and regulations (although often not recognised formally by the State). Use of forest resources – for fuelwood, medicines and food – has been a central component of rural livelihoods.

The new National Forest Programme 2010-2029 represents a renewed effort to address the numerous economic and governance challenges to Community Forests and Community Protected Areas in particular. It focuses on five key areas of intervention:

- Demarcation, classification and registration of forest land
- Forest reserve management and conservation
- Forest Law enforcement and governance
- Promotion of forest plantations of up to 2 million ha, which may include current Community Forests and Community Protected Areas as well
- Sustainable financing

Overall, the environment of tension and conflict that surrounds community forest resources clearly points to the enormous governance challenges surrounding land and forest management – and of ensuring that the intended benefits of REDD+ accrue to local communities. The risk is that introducing a system of market-based mechanisms for forest management when property rights and governance mechanisms remain so weak is likely to further disenfranchise those most dependent on forest resources.

Cambodia's preparation towards REDD+ readiness

Recognising the significant potential of forestry resources as a major carbon sink and revenue source, the RGC has recently made major commitments to national implementation of REDD+. This commitment has been clearly supported by the Prime Minister's pledge to place all forests in Cambodia under the anticipated REDD+ framework when it is formalised as part of the international climate change regime.

In 2009 the RGC launched a process of preparing a formal REDD+ Road Map – a national plan to guide how the Government should move ahead with REDD+ readiness. An Inter-Ministerial REDD+ Task Force was established in January 2010 with a mandate to develop the road map, chaired by FA and joined by MoE and the Ministry of Land Management, Urban Planning and Construction. The task force included representatives of civil society as well as development partners that provide funding for the readiness process.

The road to national implementation of REDD+ is a long and complicated process. Following preparation of the road map, implementation of that road map for a 10-year period is necessary, focusing on capacity development and preparation of appropriate policies and legislation.

Implementing REDD+ is as much a governance challenge as a technical challenge. Thus, the need for ensuring safeguards to protect rights, particularly of indigenous peoples, is paramount (see Box 28).

Yet many questions remain unresolved today with regard to REDD+:

- **Finance and benefit sharing.** A guiding principle of REDD+ is that the financial benefits generated will

Box 28: Safeguard principles for REDD

The report *Beyond Carbon* lists the following basic rights as necessary for ensuring the equitable distribution of benefits from REDD:

- The basic right to information
- The procedural right to participate
- Benefit sharing
- The right to forest resources
- Rights over values and customs relating to the forest
- Rights to compensation and environmental restoration
- The right to determine/decline free prior and informed consent (FPIC)
- The right not to be terrorised, and to protection under the law
- The right to a healthy environment

Source: Steni 2010

be shared equitably among various stakeholders, including both national governments and local forest communities.

- **Monitoring, reporting and verification.** For Cambodia to benefit from REDD+, it must put in place a system of monitoring, reporting and verification for both the international community and national stakeholders. This system requires establishing an agreed baseline of the status and condition of forests across the country, as well as a mechanism to monitor the progress of REDD+ according to a range of indicators associated with sustainability, equity and governance.
- **Speed, scale of, and strategy for implementation.** Ultimately, REDD+ needs to be implemented across all forests within a country, rather than at specific sites. The REDD+ mechanism does not allow for a country to protect one area of forest while allowing degradation of other areas. The experience in Cambodia so far has been based around specific projects. While this has been encouraging, the challenge for the future will be to scale up this kind of experience across the whole country. How this should be approached is very much a cause for debate: whether it is better to scale up gradually, or whether it would be better to begin implementation at national level.

Again, underpinning all these debates on REDD+ in Cambodia is the enduring and highly contentious issue of rights of access to and control over land and forest resources. Unless these challenges can be resolved to the satisfaction of all key stakeholders, the promise of REDD+ will not be realised. Moreover,

Box 29: Early lesson from the Oddar Meanchey REDD project

The Oddar Meanchey experience is significant for a number of reasons: It provides a working example of how community-level initiatives, often targeted at small pockets of degraded forests, when pooled together, can take on management responsibilities for forests at such a scale that there are more significant environmental benefits. This suggests the potential for Community Forests to take on management of much larger tracts of forest in the future.

In contrast to the experience of many communities pursuing CF status, in this case the additional incentives of carbon financing, and the partnership between Commune Councils, FA and an NGO, have demonstrated that it is possible to advance the registration and approval process efficiently. With the potential of financial benefits accruing to local communities, CF can be an important driver of livelihoods improvement and economic development.

issues such as unclear ownership also raise a major obstacle to the improvements in land use planning that REDD must bring about.

REDD+ clearly has enormous potential for Cambodia. But there also exists an inherent risk associated with applying market forces to value forests and carbon when property rights to those resources remain weak and such a prominent source of conflict. Unless these underlying issues can be addressed, REDD+ benefits will not accrue to forest-dependent communities.

Initial REDD experience

Cambodia is one of a few countries that has already begun piloting activities in line with REDD.

The experience of Oddar Meanchey presents interesting lessons for the future of REDD in Cambodia. Collaboration between PACT Cambodia and the Forestry Administration has succeeded in accessing Voluntary Carbon Standards through a commercial enterprise, Terra Global Capital. Under a programme called the Mosaic Reduced Emissions From Deforestation and Degradation, several communities have been able to collaborate as one project – allowing them to operate on a scale that gains entry to the international carbon marketplace and to manage forest resources on a much larger geographical scale.

The Oddar Meanchey Community Forest REDD project aggregates 13 community forest groups and aims to protect 67,783 ha of forest, sequestering 7.1 million tonnes of carbon. This is a far larger scale than individual communities could possibly manage, and by accessing these international voluntary carbon markets, it opens up the opportunity for significant economic returns to forest conservation. Again, the governance requirements ensure that the economic benefits accrue to the communities themselves.

REDD+ implementation

Implementation of the REDD+ Road Map over the next 10 years will be critical. During this stage, the country is expected to put in place a number of sophisticated mechanisms, including:

- Development of a national strategy for forest sector mitigation (linked to a country's Low Emissions Development Strategy and covering all major emitting sectors)
- Development of an implementation framework/plan
- Establishment of a reference scenario/reference emission level of deforestation and degradation
- Design and implementation of a credible monitoring, reporting and verification system
- Inclusion of environmental and social impact assessment and monitoring

The REDD+ process basically requires the country to address and effectively remove fundamental drivers of deforestation. This means Cambodia will need to address the complex issues identified above.

A stakeholder consultation process in 2010 stressed the need for awareness raising on REDD+ and the importance of land tenure clarification. The consultation process also led to the need to include the Ministry of Rural Development (MRD), which is responsible for issues of indigenous peoples, in the Inter-Ministerial Task Force. CSO representatives are to be invited as part of technical teams to be established, and the importance of sub-national actors is also recognised. As a result, the renewed task force for the second stage includes MRD, Ministry of Interior (MoI) and Ministry of Economy and Finance (MEF), which acts as the Government's executive agency in managing State properties.

Thus, with the potential of REDD+ for setting the new overall framework for managing forests and associated resources across the country, there exists a remarkable opportunity to take advantage of climate change financing to address the underlying drivers of deforestation and land use change that have been so contentious in the past, while putting in place a viable mechanism for livelihood improvement

and conservation. If the challenges associated with REDD+ were addressed effectively, Cambodia has the potential to be a world leader in REDD+.

Other finance sources: Voluntary Carbon Markets

Economic incentives for the private sector are also emerging from new financing mechanisms. The most well known in Cambodia is the case of fuel-efficient cook-stoves. As discussed in Chapter 3, rural people are highly dependent on fuelwood. This presents a significant economic cost to households, while also placing a level of demand on forest resources that is unsustainable. The uptake of fuel-efficient cook-stoves serves to both reduce the demand for fuelwood, while making economic sense for rural households.

A commercial enterprise has developed in Cambodia that markets these stoves in rural areas and is also able to earn carbon credits (see Box 30).

Fisheries

The challenges facing the fisheries sector are very much related to other sectors – particularly those involving land use changes and water resources development. As discussed above, the consequences of serious declines in fisheries for rural people and the national economy would be severe. Building resilient fisheries requires action at different scales and across sectors. But so far, across the world, there is limited success in achieving such action.

Current pressures on Cambodian fisheries

Even without factoring in climate change, concern is growing regarding the pressures that capture fisheries are under. With the commercialisation of fisheries in many parts of the country, it is not simply a matter of the numbers of fishers that influences fishery productivity; it is also essential to consider distribution of access to fisheries. Large-scale commercial fishing, often using highly efficient yet destructive gear, is abundant. Much of this is illegal but continues unabated. Land use changes, including illegal clearing of key fishery habitats such as the flooded forests around the Tonle Sap, persists. Evidence also suggests that this degree of inequitable access to the fisheries has had a disproportionate impact on small-scale fishers, with many forced to seek opportunities outside the sector. Far from being a simple matter of too many people fishing, the situation in Cambodia is one of a crisis of governance over access to and control over fishery resources.

Fisheries and water resource development

The dependence of inland fisheries on natural hydrology brings water resource management and fisheries management close together. With ambitious water resource infrastructure plans throughout the Mekong basin, there is an urgent need to ensure effective assessment processes that adequately address fishery issues. The rapid pace of hydropower on the Mekong mainstream and tributaries (including the Sekong, Sesan and Srepok) has serious consequences for Cambodian fisheries production and, consequently, overall food security and nutrition. The most recent Strategic Environmental Assessment (SEA) conducted for the MRC indicates that total losses could be as much as 550,000 to 800,000 tonnes (ICEM/MRC 2010), a staggering figure. For Cambodia, this could mean the greater part of domestic production would be lost. Most significantly, there are no food security alternatives. The same estimate suggests that nearly 200,000 people in Cambodia will be directly or indirectly affected.

Dealing with climate change impacts on fisheries will require consideration of efforts at different scales. Most management effort is currently directed at community and commercial fishing lots. However, given the nature of the drivers of productivity and the dimensions of climate change, there will be a need to refocus fisheries management on management of broader landscapes and waterscapes. Community fisheries regimes that are isolated from each other

will be ill-prepared to tackle the broader challenges of a resource that migrates and depends on river flows as well as the ecological condition of watersheds and floodplains. Thus, management of fisheries will inevitably need to be directed toward other sectors.

Whether such a shift can occur is unclear. Fisheries are rarely incorporated into the planning of other sectors, even water resource management. The potential for how fisheries can contribute to economic development is often neglected, with assumptions that capture fisheries are somehow doomed (Friend et al. 2009). Impact assessment procedures are still weak in the region, and infrastructure projects can easily proceed without adequately identifying and costing impacts, and without developing viable mitigation and compensation measures.

As with rice producers, poor access to markets – including distribution channels and information – also acts as a major constraint to fishers deriving economic benefits from their catch. Very little organisation exists amongst fishers, 87 percent of whom are small-scale and geographically dispersed. This limits value chain members' ability to effectively access higher-value markets and advocate for the sector as a whole. More importantly, given the low investment in the sector, few viable processing plants exist in related industries such as fish meal producers, fish canneries and others. As a result, those fish not consumed in the local market are exported to neighbouring countries for higher value-added processing.

The role of Community Fisheries

Cambodia has a unique place in the world for its bold policy experiment in supporting Community Fisheries and in turning over commercial fishing lots to local communities. While this process began in 2001, performance has been mixed between areas of the country. The complex procedures for official recognition of Community Fisheries, and the need for official approval at key stages of the process, have been noted as hindering progress. However the Fisheries Administration (FiA) is now aiming to support 470 Community Fisheries to be officially registered and operating effectively by the end of 2019.

Debate continues as to whether restrictions on Community Fisheries members to engage in only 'subsistence' or 'family' fishing limits the potential for fisheries to contribute to income generation and local development, thereby exacerbating fishing households' vulnerability and poverty (Serey 2010). In the most extreme cases, there is a sense that Community Fisheries actually protect the stocks that are then caught by adjacent commercial lots, while local fishers themselves are denied access to this rich resource.

Despite clear benefits from the Community Fisheries reform process, and the potential of well-managed Community Fisheries to provide long-term livelihood benefits, evidence suggests that benefits do not accrue to poorer members of the community and are often captured by community elites (Blomley et al 2010, Sok Serey 2010). Women are often particularly excluded from influencing and benefiting from management (Resurreccion 2002). Compelling evidence also exists that where illegal activities do occur, it is local elite groups who are most likely to be able to take advantage.

At a more local scale, a growing body of experience illustrates how capture fisheries management – often combined with fish raising or aquaculture – can both strengthen resilience of and provide tangible livelihood benefits to poor people. The potential of aquaculture to meet the needs of the poorest groups of people has been subject to much critical review in Cambodia and the region (Friend and Funge-Smith 2002). Generally, poorer people lack the assets and capital to be able to invest or to take the risks; however, when combined with capture fisheries management, several areas of opportunity arise. Being able to take advantage of both capture fisheries and aquaculture allows people more flexibility, with each initiative acting as insurance against failure in the other.

Conserving fishery resources

Sustainable management of fishery resources also requires additional interventions beyond Community Fisheries to meet the needs of poor people. Cambodia has been at the forefront of these efforts and has considerable experience in innovative small-scale fisheries management targeting the management of vulnerable fish habitats.

Dry season refuges

Managing fish habitats to which fish retreat during the dry season has proven an effective fisheries management initiative in Cambodia. During the dry season, many species of fish retreat to 'dry season refuges' – small areas within floodplains or deep pools in the rivers that still contain water. These refuges support the brood stock that will migrate to breed and spawn across the floodplain as rains arrive and the floodplain comes under water. Dry season refuges tend to be common property resources, and the benefits of their protection go beyond individual farmers or those involved in their protection. Managing dry season refuges therefore depends on a high degree of collective action, with resource users agreeing on rules for protection and access and supporting their enforcement.

A more household-level approach has also been tested in Cambodia with the construction of artificial recesses within private rice fields. Using concrete drainage rings from road construction in rice fields (see Box 30) acts as a dry season refuge, storing some amount of water in the dry season and again protecting brood stocks for private and public benefits.

During two years of piloting, the project has installed 898 shallow concrete CARE rings and 18 deep concrete CARE rings in nine communities in Kampong

Box 30: Fish conservation using concrete ring intervention

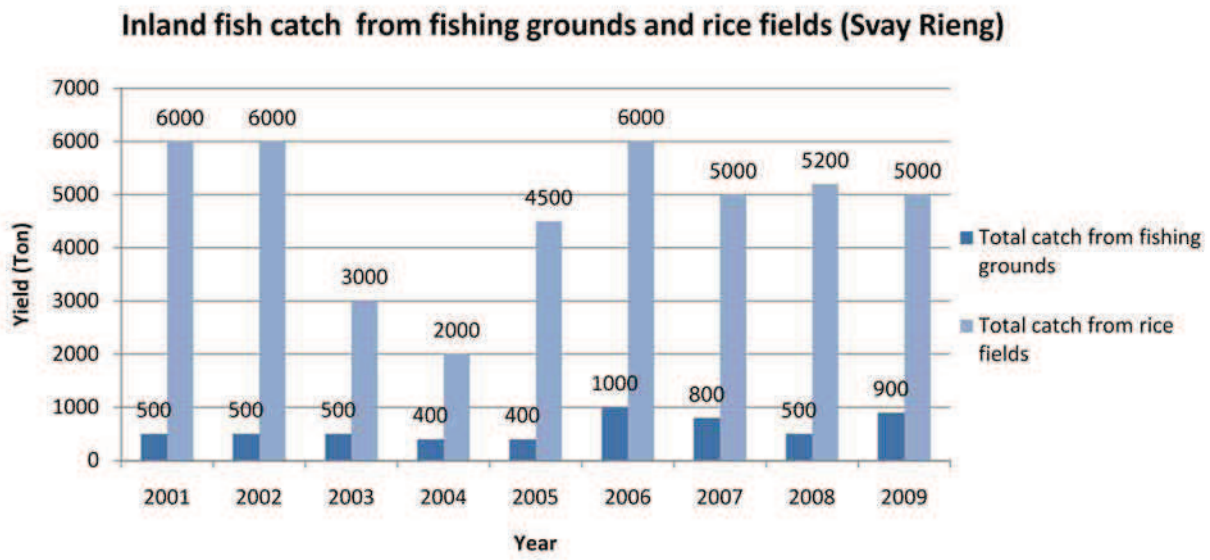
The aim of the 'ring' intervention is to build habitat for aquatic organisms by installing concrete rings in rice fields, canals and ditches. Two kinds of ring systems have been installed and tested in Cambodia since 2008.

1. Shallow Concrete Rings (SCRs): Concrete well rings measuring 1.2 metres in diameter and 1-1.5 metres in depth are installed in rice field habitats to increase the survival rate of aquatic organisms during times of erratic rainfall in the monsoon season. The rings are installed at the lowest point in each field, or for a number of fields, so that the last remaining water that is trapped in the rings acts as a fish refuge.

2. Deep Concrete Rings (DCRs): About 3-4 metres deep and used in areas where there is a known high water table, and in which they will be able to maintain water throughout the entire dry season. Generally DCRs are installed in canals. This helps to increase the survival rate of mature and immature aquatic organisms during the dry season for propagation during the next monsoon.

Source: Innes-Taylor and Sengvilaykham 2010
Photos courtesy of Agriculture Technology Services Association

Figure 17: Recent trends in fish catch from Svay Rieng, 2001-2009



Source: FiA 2010

Cham, Kampot and Pursat Provinces. These pilots have been highly successful, and a relatively robust model has now been developed suitable for expansion at both community and family levels. The combination of the two ring systems provides both communities and individual farming families with an estimated 50 percent increase in their overall aquatic animal production in rice field environments. It thus serves as insurance against the shocks of increased vulnerability of poor communities to climate change, while providing a stock of biodiversity in aquatic environments at critical times of the year.

The success of management of dry season refuges has been recognised by the RGC, with the Prime Minister encouraging every district to support the establishment of at least one such refuge.

Rice field fisheries

Traditionally, rice fields and related ecosystems have been an important source of fish and other aquatic creatures for Cambodian farmers. Recent studies show wild fish yield from rain-fed rice fields stands at 119-25 kg/ha/year. The economic value of the catch of aquatic resources from rice fields is roughly two-thirds that derived from the rice itself. Farmers who own land earn about US$150 per hectare for rain-fed rice production, while even in their underdeveloped state, fisheries are valued at around US$102 per hectare.

Rice field fish production tends to increase if there is effective enforcement of the ban on illegal fishing, as well as effective dissemination of information about punishment for such illegal activities (Kunthea 2010).

Figure 17 shows an example from total fish catch from wet rice ecosystem in Svay Rieng province (FA 2010). This means other provinces with similar ecosystems also have similar situations in terms of rice fish production.

However, many farmers are reluctant to make necessary investments to increase this natural production. This reluctance is largely attributed to perceptions of risk and a lack of technical knowledge about proper integrated farming techniques.

Profitable community fish ponds can also be established in schools, where students and teachers can play roles in fish raising and breeding. The draft

Box 31: Using improved cook-stoves to save forests and promote clean development

In Cambodia, well over 90 percent of rural households use charcoal and wood for cooking, and wood cook-stoves are very common scenery on urban streets as well. Yet use of firewood is known to create health hazards, while collection of firewood is time-consuming work for rural households, especially women and children, the latter of whom may have to spend time collecting wood, which they could alternatively spend at school. The loss of forest land further aggravates competition over limited resources.

As a simple solution to such issues, the Improved Cook Stove (ICS) has been introduced by several NGOs, including GERES (Group for the Environment, Renewable Energy and Solidarity). The technology of producing fuel-efficient cook-stoves has been available since the 1970s and introduced in various countries – but the problem has been how to get those stoves to the people who need them most, and then persuade people to use them. The approach taken by GERES in Cambodia was to combine a traditional local stove design with modern knowledge of combustion and thermal exchange. This resulted in a simple stove that appealed to local communities and at the same time saved 22 percent of their fuel wood use. The stove, called New Lao Stove (NLS), lasts two to three times longer than traditional stoves.

Benefits have been multi-fold, for both consumers and natural resources, as well as for both economic and human development impacts. Over the last few years, with the rising cost of wood and charcoal in the local market, sales of the NLS have more than doubled, to over 290,000 stoves per year. Between 2003 and March 2010, more than 1 million NLSs were sold by distributors contracted or supported by GERES. This means that over half of all urban households in Cambodia have at least one NLS, and many have two or even three, saving over US$9 million in fuel wood costs since 2003.

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The energy-efficient cook-stoves also reduce indoor air pollution compared to the traditional stove – good news especially for women. And because families use less wood, GERES estimates that more than 5,000 ha of Cambodia's natural forests were spared from being cut down for fuel, saving more than 500,000 tonnes of CO_2.

The trick behind the success of the NLS has been the approach to local manufacturing, by training local manufacturers and using locally available materials. This allows low-cost production as well as new job opportunities in production, distribution and sales (involving both men and women). By early 2010, NLSs were produced by 32 producers (5 in Battambang, 17 in Kampong Chhnang, 2 in Pursat, 1 in Siem Reap, 5 in Phnom Penh and 2 in Kampot) and sold by 200 distributors and around 100,000 retailers across the country.

The scheme is funded by donors, but it also generates carbon credits from one of the voluntary markets that support the project funding. In addition, the community fund is established through cooperatives.

The value of ICSs have also been recognised by the development community in the country, and now it is also used as a low-carbon input to be distributed to vulnerable farmers who may not have even the capital to buy low-cost stoves.

Source: Based on GERESMarch 2010 press release, authors' May 2010 interview with GERES, and FAO.

Strategic Planning Framework 2010-2019 for fisheries shows at least 140 schools are already involved.

Rural energy

Providing energy across the country is an important ingredient of national development. But it is also in the energy sector that both the greatest challenges and opportunities exist for securing low-carbon development.

Cambodia has the lowest electrification rates in Asia, with only 17.2 percent of its population (NIS 2008) connected to a power supply. Most electrification is concentrated in Phnom Penh and a few cities, while outside the provincial towns, power supply is rare and meagre. Only about 6 percent of Cambodia's rural households have access to electricity, while another 3 percent own some type of individual power generating unit.

Electricity power consumption per capita in 2008[27] was about 88 kWh per year, the lowest in the region. At the same time, electricity tariffs are among the highest in the region, ranging from US$0.09 to $0.23/kWh in Phnom Penh to US$0.20 to US$1/kWh in rural areas. In rural areas, most of the energy supplied is supported by small-scale private diesel generators, at high cost (3,000 Riel/kWh).

Need for strategic options for rural energy

Cambodia is at a crossroads in determining future energy generation pathways. Without being lumbered with existing power generation schemes, an opportunity exists to identify a national power generation approach that is in line with climate change adaptation and mitigation needs. Moreover, such an approach could be designed so that the energy needs of rural people, and their potential to act as energy providers, could be central.

The Government policy commitment is on securing national energy self-reliance, and also on export. This entails 100 percent electrification in all rural areas, as well as being able to power urban areas and the growing industrial sector.

A cornerstone of Cambodia's energy policy is hydropower. More than 10,000 MW is under development, 50 percent in the Mekong mainstream, 40 percent in its tributaries and 10 percent in the south-western coastal area outside the Mekong basin (Phan 2009, Piseth 2009). Yet hydropower remains controversial with regard to potential impacts on people's livelihoods, food security, environmental sustainability and forest degradation (ICEM 2010). There are also concerns about net carbon emissions from hydropower reservoirs.

Many ways exist in which energy needs can be met. Increasingly, these will need to be shaped by climate change considerations as well as issues of efficiency. Experience from around the world is also growing in distributed or decentralized power production. Such distributed power production would allow for small-scale power producers with greater emphasis on small-scale renewable energy technologies (Ryder 2009). For Cambodia, distributed energy production is argued to be a more effective way of bringing energy to remote areas, while taking advantage of locally available renewable energy sources such as biomass (Majanne et al 2010).

Many options for small-scale energy production are being implemented to meet energy demand in rural and remote areas, especially off-grid areas. In addition to the ICS project noted above, these include:

- **Small-scale biomass projects,** run by SMEs, use fine grain biomass such as rice husks, woody biomass and corn cobs. The projects have reduced consumption of diesel from 26 litres per hour (8,400 litres per month) to 6 litres per hour (1,900 litres per month), with gasifiers[28] in 'dual fuel' mode. Duel fuel has replaced up to 77 percent of diesel-powered operations and saves beneficiaries up to US$6,000 per month total.
- **Household Biogas Project:** Some 10,000 biogas

Box 32: Using bio-digesters

Bio-digesters use biogas (methane produced by processing animal dung) to generate energy for household use. The bio-digester is a household plant constructed with bricks and mortar and buried underground. The plants turn animal and human dung into methane gas. Water is added to the dung to nurture bacteria, which in turn decompose the dung, giving off odorless methane gas. This is piped into the farmer's home, where it fuels a stove and gas lamps, while the decomposed slurry can be used as non-chemical fertiliser for crop production.

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As in the case of ICSs, bio-digesters are believed to have environmental, economic and human development gains: reducing expenses on fuelwood while also reducing health hazards and household burdens, especially for children, who will have more time to study if they do not have to collect wood.

Bio-digester installation requires some initial capital investment. A plant costs US$450-1,000 per unit, depending on the size (4-10 cubic metres). However, the scheme is able to generate carbon credits from reduced GHG emissions due to reduced fuelwood consumption. In turn, profits from carbon credit sales are used to provide a US$150 discount/subsidy for farmers to construct the plants. In the past two years, microfinance companies Prasac and Amret started providing special low-interest credit for installing bio-digesters, which has led to increased demand from farmers.

Programme officials are hopeful that the bio-digesters are 'gaining momentum' by increasing understanding and trust amongst farmers on biogas technology.

The challenge for upscaling and sustainability lies in linking with local producers, so that the scheme does not continue to depend on subsidies and donor funding. The programme is addressing this by training local biogas construction companies to develop an independent, market-based biogas sector.

Despite these important opportunities, the scheme remains out of reach for the poorest, who cannot provide the initial capital even with subsidies, or who do not own enough cows or pigs to produce 20 kgs of dung per day. This means bio-digesters will never directly benefit those without livestock, generally among the very poorest strata of the society. To address this, NGOs may need to promote an extension of bio-digesters on the basis of self-help that can bring this technology within the reach of all.

Source: The Cambodia Daily, 13-14 November 2010; interview with programme coordinator, 01 March 2011.

Box 33: Relying on biomass

Nothing is wasted in rural life. In Svay Rieng, little forest is left for farmers to source fuelwood from, which leads to their reliance on cow and buffalo dung, mixed with straw, to make fuel sticks. Women play a key role in making the sticks and using them as important energy sources. Around 10 sticks are used per day to cook meals for a family of five.

Based on field visit to Por Thireach Commune, Svay Rieng, February 2010

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Some 10,000 biogas units have been installed in 12 provinces under the Household Biogas Project. With this technology, each household can save up to US$29 per month in fuel costs.

units have been installed in 12 provinces under this project. With this technology, each household can save up to US$29 per month in fuel costs. Under the MAFF/SNV National Bio-Digester Programme (NBP), household biogas is expected to cover up to 18,400 households (see Box 32).

These initial energy projects hold considerable potential for meeting a significant proportion of rural energy needs while also supporting small-scale private enterprise, and contributing to Government targets for rural electrification (Majonne et al 2010).

Summary

Considerable potential exists for improved technologies, techniques and practices that will assist rural people to address the uncertainties and risks associated with climate change. Already, there is a growing body of experience within Cambodia in this area.

Yet dealing with climate change is not only a technical challenge. Ultimately, the widespread uptake of these technologies – and the degree to which they address the needs and circumstances of rural people, particularly the rural poor – will depend on putting in place the planning, implementation and decision-making institutions and processes that allow for a more integrated approach to sectoral responses. These will need to address the degradation of key natural assets as well as the limited access and entitlements of poor people, ensuring more effective public participation, transparency and accountability in how development options are assessed, decisions made and actions implemented.

For all sectors, addressing constraints to poor people's access to productive resources and extension support, market opportunities and information and technology will be necessary. Specific examples of technology and practices that are appropriate for poor people, and that fit with principles of climate change resilience, offer considerable scope in Cambodia. It is also in the area of appropriate technologies that much of the new climate change financing opportunities are becoming available.

CHAPTER 8

Realising opportunities for informed local action

Impacts of climate change will be felt differently across the country. Much of the action required for building resilient rural livelihoods will be required at sub-national level. While this is in line with current decentralization reforms, climate change will also require sub-national level planning and development to move toward:

- More strategic, long-term planning processes
- Assessments of options and impacts, including through Strategic Environmental Assessments and Environmental Impact Assessments
- 'Climate change screening' of existing national and sectoral strategies
- Moving from sectoral approaches to territorial approaches
- Promoting effective stakeholder participation
- Building adaptive, flexible, learning-oriented institutions

For climate change action to be capable of dealing with uncertainty and risk and meet the needs of the poor and marginalised, it is essential that decision-making processes are based on good-quality, locality-specific information and data analysis, and that information is accessible and acceptable to decision makers and stakeholders.

Introduction

Addressing the challenges of building resilient rural livelihoods according to sectoral concerns may best be achieved at local level. Working together, local authorities, communities, civil society and the private sector are well placed to achieve more integrated, cross-sectoral approaches (IFRC and ProVention 2009).

As Cambodia goes through a critical period in implementation of public administration reforms and expansion of Decentralization and Deconcentration (D&D), a great opportunity exists to think through what it will mean to address climate change at sub-national level. So far, however, this discussion has been rather limited. While the idea of mainstreaming climate change at sub-national level appears in policy documents and strategic plans, what this might mean in practice has only very recently become a subject for discussion. This chapter aims to open up for debate a range of considerations for mainstreaming climate change at sub-national level.

Why local action is needed for building resilient livelihoods

Several reasons for the comparative advantage of local institutions are found in the literature, based on the specifically local nature of threats of climate change that might not be addressed at national level (see UNCDF/UNDP/UNEP 2010, Cristopolos et al 2009, Agrawal et al 2009, Leary et al 2007, Adger 2002):

- Climate change adaptation and mitigation strategies need to be 'place-specific'
- Local-level interventions are most likely to allow for representation of different stakeholders' views and interests, allowing for more equitable outcomes and for managing conflict among stakeholders
- Local-level interventions are most likely to ensure effectiveness and efficiency in distribution and application of financial resources to meet these local needs and circumstances
- Local-level planning and administration mechanisms

can allow for building on cross-sectoral collaboration for more strategic long-term actions
- Local-level institutions are most likely to allow for the degree of learning and flexibility in the face of uncertainty and heightened risks, building on knowledge, experience and practice at community level

Mainstreaming climate change at sub-national level

Good governance is at the core of the national Rectangular Development Strategy. Under the framework of the Organic Law (2008), Cambodia has embarked on a radical set of governance reforms promoting D&D, with the twin objectives of strengthening and expanding local democracy and of promoting local development and reducing poverty (RGC 2010).

A series of elected councils have been established under the Organic Law. Under this structure, Commune Councils are the main interface with citizens, being at the level at which citizens directly elect representatives. The Commune Councils then act as representatives of citizens in the process of electing Provincial and District Councils, which have the responsibility to oversee the province and district administrations. Planning is based around a five-year development plan and a three-year rolling investment programme.

In addition to setting a framework for transferring responsibilities to sub-national level, the Organic Law sets out fundamental principles of accountable and representative governance founded on core principles, with gender as a cross-cutting theme.

The role of the councils is clearly in terms of strategic planning that is representative and accountable, by engaging in:

…problem-focused deliberative processes that aim at building consensus amongst councilors of different political orientation and producing decisions that are strategic in nature, impersonal in form and based on understanding gained from engagement with stakeholders (interest groups and affected individuals) and information (evidence) regarding actual problems and feasible solutions.

NCDD 2010

D&D requires Ministries to delegate authority to sub-national level, and most Ministries and Government line agencies have indeed delegated some degree of authority. For example, as noted previously, the Disaster Risk Management sector, responding to the very local and specific nature of its mandate, has created a tier of committees from central to village level. Health service delivery at local level involves a network of NGOs and village volunteers working in partnership with relevant line agencies.

In addition to the formal D&D process, the rights and responsibilities to participate in natural resource management of communities, grassroots organisations and NGOs is enshrined in national policy commitments and legislation that support community-based natural

Box 34: Principles of good governance in D&D

- Public representation
- Local autonomy
- Consultation and participation
- Responsiveness and accountability
- Promotion of quality of life of local residents
- Promotion of equity
- Transparency and integrity
- Measures to fight corruption and abuse of power

resource management (CBNRM) for forests, fisheries and protected areas. The main areas of responsibility for D&D are considered agriculture; education; forestry, natural resources and environment; health, nutrition and services for vulnerable groups; industry and support to economic development; land use; electricity production and distribution; water management; infrastructure; and special needs related to tourism, historical sites and cultural heritage.

So far, climate change has only recently entered the D&D debate, but the most recent strategy documents (such as the NP-SNDD 2010-2019 and the three-year Implementation Plan IP-3) call for the need to mainstream climate change. This is important, as it clearly identifies climate change as a crosscutting rather than a stand-alone issue. Discussions of what this would mean in practice have only just begun, but clearly, there will be important implications for each of the key areas of local responsibility outlined above to apply a climate change lens to their planning and action.

Local action can be targeted in the following priority areas:

- **Water resource management.** Without greater engagement between State, the private sector and the public, effective IWRM will not be possible. Much of the planning and implementation is required at local level, starting at watersheds within river basins. While much of the interest in IWRM has focused on the State-community axis, considerable potential exists for the private sector to fill key gaps – for example, generating the kinds of data and information that allow for public assessment of water balance, as well as supporting investment in restoration and protection measures. Ensuring efficient use of water resources and fair allocation among different uses also require more effective use of market pricing mechanisms, as well as penalties for wastage and pollution. These actions all need to be undertaken at local level.
- **Land use planning and monitoring.** As noted in Chapter 7, responsibility for land use planning

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Local-level institutions are most likely to allow for the degree of learning and flexibility in the face of uncertainty and heightened risks, building on knowledge, experience and capacity at community level.

is in the process of being devolved to Commune Councils through CLUP under the guidance of the SLMC at provincial level and the Ministry of Land Management, Urban Planning and Construction. All communes are now required to have a CLUP in place. This will be particularly useful in priority areas of high conflict, ambiguous or ineffective land management, or significant ecological importance.

- **Irrigation.** The effectiveness of irrigation systems also depends on their design and implementation fitting in with local needs and local circumstances. The State has often struggled to provide irrigation systems, with farmers also struggling to take on board the operations and management responsibilities required to ensure that irrigation is sustainable. There exists a clear need for more innovation, particularly for promotion of small-scale irrigation systems and planning of irrigation according to local ecological and socioeconomic circumstances.
- **Agricultural extension.** Ensuring that agricultural extension – of techniques, technologies, credit, inputs, value chain and market development – meets local needs also requires a high degree of local participation, ensuring that extension approaches are accessible to farmers, particularly those more marginalised or with limited assets.
- **Environmental quality and safety.** Much of the effort around natural resources management, restoration and enforcement of environmental standards needs to occur at the local level, with full and effective support from national authorities.
- **Fisheries and forestry.** The role of sub-national authorities in natural resource management is being reviewed, but with the policy push toward community-based management of forests and fisheries, there exists great potential to enhance the role of provinces, districts and communes and to encourage action across different local scales.

Existing across all these key priority areas for local action is the need to ensure effective representation and participation of more marginalised people, including women and indigenous peoples. This requires public access to relevant and accurate information.

The principle of ensuring public Access to Information is clearly enshrined in the Organic Law and the constitution.[29] Currently, information that is absolutely critical for sound decision-making is not freely available and indeed, many government agencies carefully guard their own information. While information might be channeled upwards through tiers of government, it is rarely channeled back down again. At the same time, demand from citizens and civil society for information is also limited (Malena and Chhim 2009).

Financial implications of mainstreaming climate change at sub-national level

Mainstreaming climate change means that it cuts across all areas of activity, but there are also additional costs associated with climate proofing of existing actions and investments that demand more finance. For example, ensuring that roads are constructed so that they are capable of withstanding more intense flooding, while at the same time allowing for effective drainage, will add to the cost of overall road construction and maintenance.

Consensus is growing in the literature on local government that climate change finance should be included within existing finance mechanisms, rather than operating as a separate budget (Satterthwaite and Sauter 2008).

However, some limitations to this approach also exist, requiring additional reporting. For example, the additional costs of climate proofing infrastructure, such as roads, so that they are able to withstand possible levels of floods associated with climate change will need to be clearly identified. But for many funding sources, this also raises a problem of attribution – of how to account for the efficiency and effectiveness of funding related to climate change.

Challenges facing D&D

Global experience demonstrates that decentralization takes many years. In Cambodia, while there is considerable experience of local action, the formal D&D process has only really begun fully with the passing of the Organic Law in 2008.

Given this relatively brief history it is perhaps not surprising that reviews of the national D&D process have highlighted a number of obstacles and weaknesses that are significant for the discussion of climate change adaptation and mitigation (RGC May 2010; Flam 2008, NLCS 2010):

- **Lack of strategic planning.** Local development planning tends to be project-focused, based on 'wish lists' of annual activities and the perceived need to be spread investments among constituents rather than target them strategically
- **Tendency to focus on infrastructure projects.** Infrastructure projects are more easily planned within the annual planning and budgetary cycle, delivering clear, tangible outcomes
- **Limited number and capacity of local service providers.** Local investments often are not completed successfully because of a lack of competent service providers from the State, private and voluntary (NGO) sectors
- **Limited levels of participation, representation and accountability.** Participation and representation of local interests and concerns – in particular, the voices of poorer, more marginalised people, including women – remain limited. Constituent interests tend to be easily influenced by higher authorities
- **Limited budgets.** Available funds are not substantial enough to undertake meaningful investments, even as there is limited absorptive capacity for a greater volume of funds
- **Uncertainty over mandate.** The review of roles and responsibilities or functions of sub-national authorities in Cambodia has only just begun. However, the experience of the natural resources sector offers some important lessons: Where sub-national authorities have no clear formal functions for natural resource planning and management, action has rarely been taken, even if requested by local citizens

Applying principles of D&D for mainstreaming climate change

Despite these obstacles, D&D reforms in Cambodia present a considerable opportunity to take on board much of the action associated with climate change adaptation. The challenge now is how to ensure that these processes are indeed strategic, engaged with different stakeholders, based on wide sources of information – and take on board the principles of what is required of local institutions and processes in the face of climate change.

Moving away from a 'predict and act' approach to local development requires a more adaptive and inclusive planning process, taking on board the challenges of risk and uncertainty. As Mearns and Norton (2010, p. 36) suggest:

Adaptive policymaking under these circumstances will require policymakers to treat policies and programmes as ongoing experimental and learning processes, based on targets and milestones, strong performance-based monitoring and evaluation systems, and enabling frameworks for interactive engagement with multiple stakeholders. It also calls for much greater public participation in defining what climate change adaptation means in particular contexts. This could include, for example, the use of participatory scenario techniques, with multiple stakeholders jointly projecting anticipated changes and planning for the kinds of public policy and other forms of support they need to help them adapt to those changes.

In trying to respond to these questions, the following section considers the basic ingredients of climate change action.

Applying scenarios

Since the science of climate change is uncertain, this means considering a range of different possible futures or different scenarios over different time periods – for example, 20, 50 or 100 years into the future. Scenario planning is thus explained as using *"uncertainty in a constructive way to imagine multiple futures and consider how they might be influenced"* (SOS/IIED 2009, p. 5).

Such planning depends to some degree on information derived from climate science. At the moment, predictions for climate change in Cambodia cover the country as a whole and as a part of the Mekong region. Sub-national scenarios are not yet available.

As discussed in Chapter 2, current data and information systems on key variables that would need to be included in climate change scenarios remain weak. This reinforces the importance of strengthening existing systems for data and information generation and dissemination.

However, a growing body of information and knowledge at sub-national level nonetheless exists. For example, the comprehensive CDB, which provided much of the input into the analysis of human development, is updated annually and allows for analysis of trends. The CDB already has been applied to development of district-level analysis of progress in meeting the MDGs, providing a detailed analysis of key aspects of poverty and vulnerability. In addition, NGOs and local projects have their own wealth of information – often more qualitative and interpretative, and more locally specific.

As follow-up to the SNC, the Climate Change Department of MoE is also preparing sub-national vulnerability assessments as the basis for local planning. All this will allow climate change science to be brought into sub-national planning processes – and thereby open up planning horizons to broader futures.

Thus, there still exist good reasons to consider climate futures based on the best available information rather than stalling. It is increasingly possible to downscale regional climate models to provide a good picture of more local climates in the future. Such models are more readily available, even if expensive. These are areas in which global finance mechanisms could be accessed to build information systems and capacity.

The experience of focusing on proxy indicators – or indicators associated with climate change – likewise can be informative. For example, much of the concern regarding climate change relates to changing patterns of floods and droughts. While climate change is certainly more than a matter of disasters, this can be a convenient entry point for planning for climate change adaptation. Drawing on historical evidence, including people's own perceptions and recollections of floods, can help assess trends and inform flood preparedness. Putting in flood markers or information boards on floods, as is being supported by the Asian Disaster Preparedness Centre, is allowing people to observe trends and respond to immediate threats. Critically, it provides the basis for predicting future changes.

Strategic assessments and climate proofing

Because the impacts of actions to adapt to and mitigate climate change need to be carefully considered, this raises the profile of a range of impact assessment tools. Presently there are NCDD safeguard policies and guidelines for land acquisition, EIA and participation of indigenous peoples when implementing projects within the D&D framework.

The legal requirement for assessing the environmental impacts of development activities – from infrastructure to economic land concessions – is already well established in legal frameworks and policy in Cambodia. However, in practice such impact assessments are not always carried out, especially for what are deemed smaller-scale projects. Where impact assessments are undertaken, public consultation often

is limited, and assessments themselves are rarely available later to the public. This means that the technical quality and neutrality of the impact assessments cannot be scrutinised. It also means that in practice, the projects concerned are less likely to gain the degree of public acceptance that is necessary to avoid conflict.

Interest is steadily growing in moving beyond impact assessments that deal with specific, localised impacts of separate projects toward considering the combined and cumulative impacts of various development interventions. Known as Cumulative Impact Assessments (CIA), these approaches allow for assessing development trends of various sectoral interventions and considering a more complete picture. For example, CIAs have been applied for assessing a series of hydropower dams in the same river basin, and also for considering the impacts of other development interventions such as mining and land concessions.

In moving from assessing impacts toward considering options and alternatives, SEAs (Strategic Environmental Assessment) are increasingly being applied (MRC/ICEM 2010). A key element of an SEA is to assess the sustainability principles of existing policy and planning (OECD 2008). This allows for development to consider different options and ensure that sustainability is not undermined. For example, the government of Viet Nam has now made an SEA a legal requirement for the development of the hydropower sector to both avoid negative impacts and ensure optimal benefits (Soussan and Nilsson 2009). This follows a period of conflict with resettled people and concerns for the long-term economic and ecological viability of some dam projects.

In addition, local planning and development will need to apply standards for climate proofing to assess the extent to which plans and actions take on board the risks of climate change. For example, rural infrastructure development will need to be planned for a future in which the incidence and intensity of flooding might increase. This will mean that roads will need to be designed accordingly, for example, by being raised higher and ensuring adequate drainage systems. Proofing will require the application of clear criteria and standards and a mechanism to assess additional costs and benefits.

A need to improve existing infrastructure by considering risks associated with climate change may also call for climate proofing. For example, previous infrastructure may require proofing to ensure it is able to withstand the likely impacts of climate change (see Box 35). Often such infrastructure has been constructed without adequate assessment or consideration of potential climate change impacts.

Moving from sectors to territories

As noted previously, much of the work on climate change in Cambodia so far has been based on sectors. Increasingly, there needs to be a shift toward considering territories and developing a basis for more integrated planning and action. While this principle underpins much of the D&D reform, practical and technical obstacles remain considerable.

One of the greatest challenges posed by climate change is the need for putting ecological considerations more firmly at the heart of economic activity. This requires reconciling administrative boundaries with ecological boundaries and landscapes. Moreover, this becomes especially significant for implementing more integrated, cross-sectoral approaches, and for managing key resources such as water, forests, fisheries and agriculture that are likely to be vulnerable to climate change and to face intensified competition. This can present risks of maladaptation: For example, climate change adaptation measures adopted in one district might include developing infrastructure to reduce risks to flooding. However, doing so might alter the natural hydrological flows and displace the problem downstream to a neighbouring or even more distant district.

Box 35: Rehabilitating an irrigation system

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Prey Nup polder separates freshwater from seawater.

Prey Nup Polder stretches along the coast of Preah Sihanouk to protect rice paddies and people's livelihoods from seawater. The polder, built during the French colonial period, was left without maintenance under the Khmer Rouge. From 1998 to 1999, it was renovated with funding support from AFD through GRET and MoWRAM.

The scheme consisted of rehabilitation of six polders with flood protecting dikes of 90 km, main canals of 113 km, 36 drainages, and 78 water gates. The scheme can irrigate more than 10,000 ha of farmland in this major rice cultivation area. It represents one of the first large-scale irrigation renovation works in the country. Overall, the polder benefited 11 communes comprising 43 villages, with a total membership of 16,000.

Despite this major achievement, polder renovation was carried out without considering possible impacts from climate change. Farmers in Prey Nup still experience damage from seawater intrusion, especially during the wet season (October and November). In 2009 the sea spilled over the main dike and water gates, affecting the rice crop just before it was to be harvested. The RGC provided financial support to repair 70 km of water controlling dikes.

Interview with Nub Meng, farmer representative, and Yim Boy, chief of Farmer Water User Committee of Prey Nup Polder, 3 February 2010

Throughout the world, applying an integrated territorial approach to planning has proved difficult. There are, however, opportunities that Cambodia is well placed to explore. The coastal provinces have already established initial coordination mechanisms to deal with some of the challenges facing coastal areas, such as encroachment into Cambodian territorial fishing grounds (see Box 36). In addition, there is well-established experience of community-level management of coastal resources. At the same time, more formal institutional structures required for effective management have not yet been established.

A key unit for territorial integration exists in water catchments and river basins. With its commitment to IWRM and the D&D process, Cambodia has an opportunity to build local institutions within the framework of D&D reforms linking watersheds that might cross river basins and cover several provinces. This is no easy task. But as recent reviews of water resources have suggested, building up dialogue forums across river basins that could bring different stakeholders together is a feasible and potentially influential step forward (cf. Clausen 2009).

Management of land and associated resources, particularly forests and fisheries, is central to the territorial approach for rural agricultural areas. With forest degradation and agriculture both serving as major contributors to GHG emissions and comprising

key elements of resilient rural livelihoods, any long-term planning for climate change must address issues of land use. The tools and techniques are in place with the development and widening adoption of CLUP, but major governance constraints still will need to be addressed.

Without clear mandates and information on the status and ownership of land – in Cambodia, including economic and social land concessions – it is impossible to develop an integrated planning process that can address the complex demands of climate change. Yet land conflicts still dominate the work of local councils. While there have been some successes, for example through the mechanism of Land Use Reform Committees (LURC), no effective mechanisms are available for sharing information or enhancing conflict resolution. Thus, it is critical that information on land be made publicly available so that it can be incorporated into planning processes.

Stakeholder engagement: Setting visions for the future

Planning requires bringing different stakeholders together and creating a forum for debate. This is a basic principle of the current governance reforms and of decentralization. But putting such principles into practice has proved to be an area of weakness so far.

"A key path to reducing vulnerability to climate change is strengthening rural knowledge institutions while empowering rural people through improved access to relevant knowledge and information, and promoting their active participation in decision-making. In this context, knowledge and communication processes play a special role and have to be considered as strategic assets in the livelihood approach to climate change adaptation."

FAO 2010, p. 18

A key stumbling block is that public planning and decision-making arenas are often 'uneven', making it difficult for rural people with limited formal education to engage. More transparent, equal engagement is essential to address the challenges of climate change.

Important local knowledge, particularly related to natural resources, agriculture and environment, can

Box 36: Integrated Coastal Zone Management is an option for climate change adaptation and territory-based approach

Coastal areas around the world have long faced problems associated with poorly planned and poorly coordinated development, as well as competition among different sectors and resource users. Such problems will be exacerbated by climate change.

The IPCC has recommended adoption of a more integrated approach to planning and management designed for the special circumstances of coastal areas.

Integrated Coastal Zone Management (ICZM) is an approach for sustainable use, development and protection of coastal and marine areas and resources. ICZM is also widely promoted as an appropriate policy framework to deal with current and long-term coastal challenges that cut across traditional departments.

However, establishing ICZM in practice comes up against familiar obstacles. Coastal zones cut across administrative boundaries of provinces and districts. Thus, integrated approaches require coordination among different Government agencies with their own mandates and interests. In addition, ICZM places high priority on conservation of natural resources, sustainable management practices, and participatory processes that are often in conflict with the immediate commercial interests of coastal development for tourism, industry, marine fishing and the growth of urban areas.

play a critical role in decision-making about how the environment is managed. Communities can engage in research and learning, helping them assess and manage their own development priorities, and in turn empowering them to voice their concerns in formal policy and planning arenas.

The experience of Sala Phoum (see Box 37) demonstrates the capabilities of local people and the potential for them to take on important information activities that can improve awareness and provide a basis for monitoring change. In so doing, they are better able to inform planning processes, and these processes are more likely to be representative of local needs and interests. Thus, where local people are able to represent their interests based on their own evidence that stands up to external critique, it appears that these interests are more likely to be addressed in local planning processes (Blomley et al 2010).

For many rural people, often with limited formal education, but extensive knowledge and expertise, techniques based on drama, music or visual arts often can also form the basis for group discussion and learning.

With Information and Communication Technologies (ICT) more readily available, there exists enormous potential for promoting social learning and action, often in innovative ways. The experience of supporting farmer photographers to document their concerns visually (see Box 38) and using this as a basis for representing their interests has served as a vehicle for rural people to engage in issues that are often difficult to explore using more traditional learning and communication approaches. The resulting images also create powerful educational materials for both local and international audiences, helping to dispel stereotypes of rural life.

Equally, it is important that local communities and civil society are better able to access information about

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A key unit for territorial integration exists in water catchments and river basins. With its commitment to IWRM and the D&D process, Cambodia has an opportunity to build local institutions within the framework of D&D reforms linking watersheds that might cross river basins and cover several provinces.

climate change. Currently there is very little information available, constraining understanding of causes, implications and possible actions. A key role for non-governmental and civil society organisations, often with support from the international community, is in making such information available and accessible, as well as building networks within the country and abroad (see Box 39).

Strengthening community-based adaptation

There exist well-established arguments for local action to occur at community level. Interest in community management has often focused on the management of complex natural resources systems that are owned publicly as common property, such as water, forests and fisheries. In response to the failures of state- and market-based management arrangements to ensure sustainability of use, or fair and equitable access to resources, rural communities have managed these resources sustainably according to their own rules and regulations, and their own knowledge and values.

As Chapter 5 has highlighted, experience of community-based natural resource management in Cambodia is firmly established through Community Forestry, Community Fisheries and Community Protected Areas. Again, a key lesson from this experience indicates that where community institutions have secure access to viable resources, and necessary support from State authorities, natural resources can be managed sustainably and in ways that generate important livelihood benefits for community members, including the poor.

Community-level interventions have proved particularly important for addressing Disaster Risk Reduction (see Box 40). These interventions cover many aspects of disasters, including building livelihood security and infrastructure as well as strengthening flood preparedness. So far, much of what has been done under DRR has tended to focus on post-disaster responses and relief efforts. In particular, children and youth can play critical roles in mobilising community efforts with regard to DRR, with valuable experience already available from peer education groups in some districts, supported by Plan International Cambodia.

Box 37: *Sala Phoum:* A village school

The experience of villagers conducting their own research in Stung Treng and Rattanakiri provides many lessons for climate change adaptation.

Villagers have been conducting their own research and training other villagers in a growing network along the Mekong and Sesan Rivers. They have identified research topics that are of special interest, including fisheries (species, migration patterns, habitats), river ecology and medicinal plants. The villagers, including those with little or no formal education or those who are illiterate, have carried out the research themselves.

This research has not only been a way for local people to document what they know, but also a way of learning from each other and better understanding their resource base so that they are better able to make management decisions. Having conducted this kind of research and documented findings in books, they have also been better able to engage in policy debates with the Government and other actors, and have been recognised as important sources of knowledge.

The *Sala Phoum* research was responsible for identifying the spread of a filamentous alga in the upper stretches of the Mekong in Stung Treng. This had not been observed by scientific research and had not been documented. Input from the *Sala Phoum* research therefore has helped to raise this area of concern and identify parts of the river in special need of protection.

Box 38: On Photography (Cambodia)

On Photography (Cambodia) Co. Ltd. initiated the *Kaksekor Tothrup* (farmer photographer) project to enable a wider range of Cambodian voices and experience to address climate change, and to consider different ways of viewing and producing knowledge and communicating.

Farmer photographers themselves identified three themes to explore in their photography: traditions, village stories and changes. This has led to the production of their stories in a bilingual magazine, *Farmer Photographer: Stories from Pnom Thmey Village*.

The exercise provided important insights. For example, the farmer photographers documented the 'candle ceremony,' a traditional practice for predicting the weather that has proven 80 percent accurate when cross-checked with formal data. The photography also illustrated the hard work that women contribute to households – work that is often overlooked.

In terms of climate change, the exercise observed significant changes:

- "The weather is hotter than ever before"
- "Houses and trees are being destroyed through heavy storms"
- "Water often runs out"
- "Soil is often too dry to grow good rice"
- "Unpredictable, changing weather conditions make life very difficult"
- "Children get sick easily"

Benefits to local communities run even deeper than this documentation, however. As one elder comments:

"I am so surprised, first, that my daughter can do something like this, second, that people are interested in our stories. … Looking at the things we do every day without thinking about it makes it very interesting. Hopefully, it will help us and others to think more about our everyday life and how to survive better."

Box 39: Building NGO capacity

A group of international NGOs with offices in Cambodia has been running training programmes for local partner organisations since early 2010, with the aim of raising awareness and building capacity to address threats posed by climate change.

Now in its second year, Cord, DCA/CA and Forum Syd, with financial support from SIDA, work with more than 20 local organisations involved in a diverse range of fields throughout Cambodia.

Workshops and mentoring/coaching run for a year and include building an understanding around climate change impacts, adaptation and mitigation as well as Disaster Risk Reduction. The focus of the training is on how to integrate climate change into existing and future programmes alike.

In this way, climate change is built into the capacity of local organisations and the people they target. Working with the rural poor, women and indigenous groups makes local organisations well placed to support these groups to prepare and adapt to climate change, while also linking them to resources and funding opportunities that otherwise may be difficult to access.

Critically, community scale does not only refer to communes and villages. Community action can occur at many levels, including community members, farmer associations, Farmer Water User Communities and trade associations.

One local group that is especially active is the Farmer Organization (FO). In 2006 MAFF and AFD documented 13,000 FOs in Cambodia. Legal frameworks already exist for different kind of FOs: agricultural cooperatives, Farmer Water User Communities, CFs, CPAs and Community Fisheries.

Various responsibilities could be taken up at community level if appropriate structures are in place. These might include livelihood diversification, agricultural techniques, early warning systems and climate information systems. Clearly, these community-level organisations are important resources for mobilising action for building climate change resilience.

Building adaptive, learning institutions

The climate change literature argues the case for institutions to be flexible, adaptive and learning-oriented so as to be better placed to learn from current actions and able to alter future actions with regard to climate change. In many ways, this is a straightforward argument: the uncertainty of climate change means that future actions are always contingent on future circumstances.

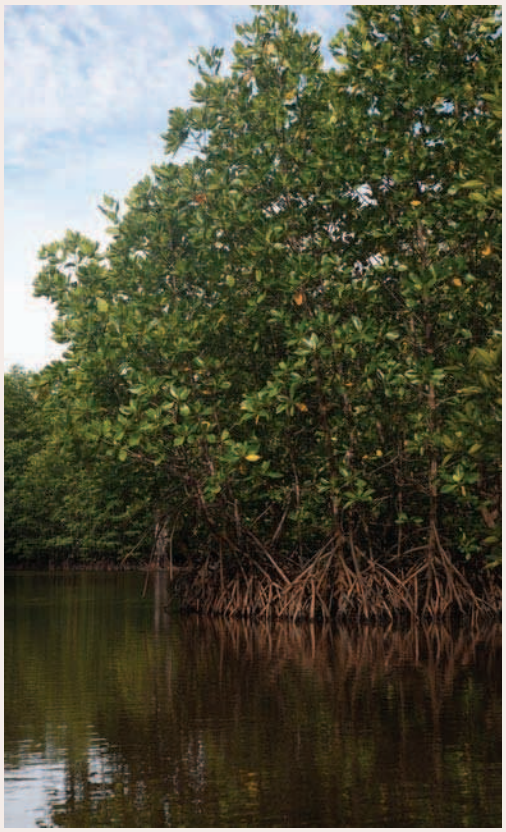
Again, putting these kinds of principles into action is less straightforward. Basic principles of accountable

Box 40: Community-based adaptation in the coastal zone

Coastal communities have long been involved in managing their natural resources to both conserve and ensure the productivity of these resources. These actions include rehabilitating and conserving mangrove forests and sea grass, as well as initiatives such as establishing crab banks – areas for growing juvenile crabs to maturity.

These actions serve two purposes. They protect natural assets to ensure that local people derive livelihood benefits, thus reducing human vulnerability. But many of these actions – particularly those associated with rehabilitating mangrove resources – are also widely argued to reduce the severity of natural hazards such as storms and sea level rise.

The threat of climate change has raised the profile of mangrove resources and the need for local resource users, the State and the private sector to support their protection and rehabilitation. Cambodia has important experience in these areas, with long-term activities in Koh Kong, Kampot and Kep, increasingly implemented through commune-level planning processes with support from Government agencies, NGOs and international donors.



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governance call for a degree of predictability in the ways that local institutions operate – and that the rules that guide their actions are clearly understood by all. In Cambodia, these principles have been rigorously applied to ensure greater accountability and transparency. For example, exhaustive planning guidelines have been produced, with strict mechanisms for monitoring and reporting of development implementation and of financial reporting on development investments. This is clearly a strong framework for preventing financial mismanagement. Moreover, planning follows an annual cycle of identifying activities and allocating resources. Current evaluation mechanisms mean that not following agreed plans is seen as an indicator of poor performance. Reconciling the need for accountability on one hand, and flexibility on the other, is not easily achieved.

At the same time, putting principles of flexible, adaptive institutions into practice may require rethinking current planning frameworks to allow for more discretion, while maintaining the needed degree of accountability and transparency. As always, making sure that there are effective checks and balances in place – that decisions and information are firmly in the public domain – is essential.

Summary

Cambodia possesses considerable strengths for effective local action. Rural communities are highly adaptive, if assets are protected and enhanced and adequate support provided. The moves toward decentralization and deconcentration that form the basis of future rural development create an institutional framework that fits well with the challenges of implementing more integrated, accountable and transparent decision-making and action. But it is also important that local institutions fit better with ecological boundaries.

It is at this local level that decision-making can be closer to the specific needs and circumstances of citizens. However, this depends to a large degree on effective governance mechanisms and civil society institutions that can ensure fair representation and accountability. Evidence clearly demonstrates that when these kinds of systems are put in place and people's voice is strengthened through improved access to information and participation, with adequate checks and balances, more sustainable and equitable outcomes are more likely to result (Foa 2010, Foti 2008).

IV Part

CONCLUSION

While climate change threatens the future of agriculture and rural livelihoods, it is clear that much of the wealth and prosperity of the people of Cambodia will continue to depend on agriculture and natural resources. These sectors constitute the backbone of the national economy and will continue to provide opportunities to improve human well-being while also driving further national prosperity.

CHAPTER 9

The way forward for building climate change-resilient rural livelihoods

Introduction

Climate is one of many drivers of change influencing Cambodia and the Mekong region. In some ways it is more distant and remote than other drivers of change, but its impacts will be far-reaching. The way that the country responds now will go a long way toward shaping the development options of future generations.

Climate change for Cambodia is fundamentally a development challenge – to address current vulnerabilities and short-term shocks and crises, but also to forge a long-term development pathway for the country. Defining development pathways that are appropriate and viable for the needs and circumstances of people in Cambodia, and that ensure equitable distribution of benefits, is at the core an issue of societal choice.

The discussion has demonstrated that low adaptive capacity is the main factor in Cambodia's vulnerability to climate change, related to deep-rooted and long-standing challenges. These can be seen in persistent poverty according to key indicators, inequality, insecure access to land, water and other key resources, low levels of education and health, and weak institutions and governance. Building on recent progress in poverty reduction and establishing national policies, strategies and institutions, as well as taking full advantage of new climate change funding mechanisms, could present significant opportunities for the country.

Overall, dealing with climate change means coping with higher degrees of risk and uncertainty. Current scientific assessments provide a broad understanding of probable impacts and the ways in which Cambodia will be vulnerable. Yet climate change science cannot state categorically what will happen, or when it will happen.

While adaptation needs to be well informed, it is not possible or desirable to simply 'predict and act.' This means that there is a need for more adaptive, responsive, inclusive and accountable development institutions and processes and, critically, for informed public debate.

Responding to climate change thus requires new ways of working. In particular, it requires a more deliberative approach that involves a wide range of knowledge, from different technical disciplines and local knowledge as well as a variety of stakeholders, and that provides space for negotiation, debate and shared learning. For this to occur in Cambodia there will need to be mechanisms in place that empower citizens to be able to participate meaningfully.

Climate change adaptation is becoming the new sustainable development paradigm. So far in Cambodia, climate change has been taken up by specific sectors and particular stakeholders, but calls for mainstreaming into broader development processes have only recently begun to be acted on.

In this concluding section, we review some key priority areas for action and the critical importance of building

knowledge and capacity, ensuring access to finance, and strengthening rights of access.

Key priority areas for intervention

1. Bring social protection, DRR and climate change together

Despite the significant degree of risk and uncertainty that climate change brings, there are measures that can be adopted that are 'no regrets' – or 'safe to fail.' Such measures will provide benefits by addressing current development priorities and thus strengthening resilience for responding to climate change impacts.

Foremost among these actions, in the context of Cambodia today, is the need to address key factors in people being poor and vulnerable to becoming poor. These include challenges in ensuring universal access to health care and enhancing the quality of health service delivery, as well as in improving disease monitoring and surveillance; establishing social safety nets; and improving Disaster Risk Reduction. These climate change priorities fit well with current development priorities and figure prominently in national development strategies and action plans. However, there is greater urgency in addressing these challenges. By strengthening these critical areas of vulnerability and poverty, the likely impacts of climate change can be reduced. At the same time, the human capital of the country can be strengthened and directed toward the kinds of actions needed to make positive longer-term development changes.

At the same time, there exists a critical institutional challenge to avoid creating specific 'sectors' out of crosscutting issues of social protection and DRR, and to make sure that these ways of acting shape more integrated development strategies at both national and local levels.

2. Combine planning and action with technologies and practices

Considerable potential exists for improved technologies, techniques and practices that will help rural people address the uncertainties and risks associated with climate change. In addition to the growing body of experience in this area within Cambodia, opportunities are emerging to draw from international and regional expertise.

As the discussion has noted, dealing with climate change is not only a technical challenge. Ultimately, the widespread uptake of these technologies, and the degree to which they address the different needs and circumstances of rural people, particularly the rural poor, and of men and women, will depend on putting in place the planning, implementation and decision-making institutions and processes that allow for a more integrated approach to sectoral responses. These will need to address the degradation of key natural assets as well as the limited access and entitlements of poor people. For all sectors, addressing constraints to poor people's access to productive resources, as well as their limited access to extension support, market opportunities, information and technology, will be critical.

Many of the impacts of climate change will be mediated through careful stewardship of water. This is all the more the case for Cambodia, with its dependence on the Mekong River system and the central importance of agriculture (Johnston et al 2010). Much of the response to climate change in the country will depend on the establishment of effective mechanisms for management of water as well as land resources. Already, these have been identified as priority areas under the RGC development strategy. However translating these policy commitments into meaningful actions calls for significant changes in the way that resources are planned.

Managing water in the face of climate change requires moving away from sectoral approaches based around infrastructure solutions to more integrated approaches that allow for efficient and equitable distribution of water resources, and for effective management of key ecosystems. Land resources have been a contentious issue since the 1990s, but it will simply not be possible to respond to the challenges of climate change without addressing these underlying problems associated with access to land, or without promoting a more effective, transparent and accountable system of land planning, management and allocation.

Within the key rural productive sectors of water resources, agriculture, fisheries and forestry, significant opportunities may also be seized to improve overall planning and management, while also promoting technologies and practices at farm, household and community levels.

With one of the highest rates of forest cover and environmental protection in the region, perhaps the clearest opportunity for Cambodia comes through the new finance mechanisms of Reducing Emissions from Deforestation and Forest Degradation (REDD+). Potentially, REDD+ creates an opportunity to generate funds to manage forest resources such that local communities can derive economic benefits from sustainable forest management while also contributing to national and local development. The RGC has actively and effectively started to prepare for tapping into this mechanism, but there is still a long way to go before the scheme becomes operational. Existing pressures on forest resources, which have proved so contentious in the past, will need to be addressed effectively. To access the financing opportunities of REDD+, therefore, effective mechanisms for the management of resources and benefit sharing, as well as for monitoring, need to be established so that they are internationally credible.

Many of the impacts of climate change will be mediated through careful stewardship of water. This is all the more the case for Cambodia, with its dependence on the Mekong River system and the central importance of agriculture.

While climate change threatens the future of agriculture and rural livelihoods, it is clear that much of the wealth and prosperity of the people of Cambodia will continue to depend on agriculture and natural resources. These sectors constitute the backbone of the national economy and will continue to provide opportunities to improve human well-being while also driving further national prosperity. Increasingly, this prosperity will depend on strengthening linkages between human development, environmental protection and sustainability, and social equity.

Across all of these key sectors, it is essential that rights of access to key productive resources – most importantly, land – are secured to allow for households and communities to make the long-term commitments to resource management that will create tangible livelihood benefits while securing the sustainability of these resources (Namrata 2010, Markussen 2008). But this also requires a dramatic shift in the way that natural resources and development planning and action are conceived and implemented.

3. Take action at sub-national level, but also national and regional levels

As this report has sought to demonstrate, much of the action required in Cambodia needs to be carried out at sub-national level. It is at this level that development planning and administration will increasingly be targeted under the RGC's decentralization and deconcentration reforms, and it is at this level that many of the locally specific actions that best fit the needs and circumstances of rural people will most likely occur.

As this reform process begins the phase of reassigning Government functions from national to sub-national level, it is important that the implications of climate change are adequately addressed. This is not simply a matter of what functions are transferred, but how functions are carried out, and critically, how institutions and processes operate. The need to respond to climate change may also require working across administrative units as well as building closer correspondence between administrative and ecological boundaries.

However, the need for focused action at sub-national level does not preclude actions at national and regional levels. The RGC has a convincing record of putting in place the necessary policies, strategies and institutions for beginning to prepare for climate change. With the completion of the SNC reporting to the UNFCCC in 2011, there will be a stronger scientific basis for integrating climate change adaptation across sectors and Ministries.

Perhaps the greatest challenge will be tackling climate change as a cross-sectoral challenge – building the science, strengthening coordination and collaboration between Ministries, and putting in place the governance and market reforms that will allow for investment and support from donors and from the private sector. Developing a National Strategy and Action Plan for Climate Change, with effective participation of different stakeholders, would mark an important step forward toward a more integrated approach.

At the same time, many of the most acute climate-related challenges that Cambodia will face have a clear regional dimension. This is most apparent in the sphere of water resources. With Cambodia's central place within the Mekong River basin, much of the action will need to be at this regional, river-basin level.

Some key institutional processes for more effective sharing of water resources across the basin, and for meeting the challenges of climate change, already are in place. The 1995 Agreement between Cambodia, Lao PDR, Thailand and Viet Nam under the MRC has been applauded as a strong basis for regional collaboration. But as the 20th anniversary of this landmark agreement approaches, the challenges facing the basin as a whole are intensifying: each of the countries involved has plans for water resource infrastructure development to extract the river's resources for hydropower generation and irrigation.

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It is essential that rights of access to key productive resources are secured to allow for households and communities to make the long-term commitments to resource management that will create tangible livelihood benefits while securing the sustainability of these resources

These actions come with clear risks, costs and far-reaching implications – to fisheries and food security, and to ecological integrity. So far, the effectiveness of the MRC mechanism to address needs for well-being, social development, economic development and environmental sustainability have not been tested. However, as these pressures intensify, it is all the more important that decisions are informed by climate change risks and are made in tune with the needs and circumstances of the 60 million people whose well-being depends on the Mekong River basin. Managing water resources at this scale has never been achieved anywhere in the world. For the Mekong, it is further complicated by China's absence from the agreement.

Other regional mechanisms for cooperation will need to take climate change considerations on board. Several regional initiatives are in place, whether under ASEAN or the Asian Development Bank's Greater Mekong Sub-Region programme. Each provides opportunities for strengthening cooperation and opening up trade, as well as mechanisms for strengthening social welfare, environmental protection and technical collaboration. Increasingly, climate change will shape the work of these cooperation mechanisms. As a country both particularly at risk and also with considerable potential to benefit from climate change finance mechanisms, Cambodia will need to be an increasingly active and vocal partner in these arrangements.

Lastly, regional cooperation is not only a matter for governments to address. Already NGOs, academia and the region's private sector are building partnerships and exchanging information and expertise. These need to be strengthened.

4. Build awareness, knowledge and capacity

Three key areas that need to be addressed in responding to climate change in order to build awareness, knowledge and capacity:

- Improving knowledge and education

- Building research capacity
- Improving data and information systems

Improving knowledge and education

Cambodia has made important progress in improving access to education, including in critical rural areas. But the combination of a young population about to enter the adult workforce, and education standards that lag behind other countries in the region, put Cambodia at a disadvantage in its efforts to secure long-term sustainable development. For rural Cambodia, this story of education has an additional twist, with many rural children combining work with education, often to the detriment of their educational development. Improving the education of girls and women remains a challenge.

As with many of the development challenges facing Cambodia, improving education requires a concerted effort across many sectors, at many scales and involving many stakeholders. The education sector requires greater investment – to provide the physical infra-structure and materials, but also to improve conditions and career development for the teaching profession. This is most acute in more remote rural areas, where education is so clearly needed and where access to and quality of education is so variable, as well as where there are still significant gender disparities.

There exists a clear link between improving education and developing the kinds of skills that are required for rural people – households and communities – to adapt to the challenges and opportunities of climate change. Education raises the quality of human resources and opens up new opportunities for rural households. The kinds of shifts in agricultural practice that are expected, and the potential benefits from accessing new knowledge and technologies, improved weather forecasting and extension advice, will all be strengthened through education and more targeted vocational training for rural people. With women's critical role to play in climate change adaptation, it is important that they are able to benefit from improved access to education. In addition, education allows for citizens to participate more fully in political processes.

Much of what is required is already laid out in the principles of the policies on Education for All and on strengthening non-formal education. Moreover, providing a clearer voice to parents, teachers and local authorities in deciding on local education development opens an opportunity for an education system and local curriculum that are more suited to local circumstances. This also provides a governance mechanism so that access to education and the quality of education provided is indeed for all.

Building research capacity

Research capacity within Cambodia has developed over recent years, but still remains inadequate to meet the challenges of climate change. A recent assessment of tertiary research capacity within Cambodian universities, both public and private, points out the limited number of post-graduate qualifications among faculty and the lack of institutional incentives for Cambodian academics to conduct original research (CDRI 2010, Sola 2010).

In its review of the level of awareness within tertiary education, the SNC notes that awareness remains very limited and that, despite some stated interest in ensuring that climate change is incorporated into teaching and research across a range of disciplines, *"very little climate change-related capacity building opportunities have been provided to date"* (MoE 2010, p. 182). Within primary and secondary schools the situation is similar, with limited capacity among teaching staff, and limited teaching resources. However, through the efforts of Government agencies, NGOs and internationally funded and partnered research projects, the availability and quality of climate change-related educational materials is improving.

Taking up these efforts remains hindered by the structural challenges facing the education sector. While the situation in urban areas, particularly Phnom Penh, is slightly better, the greatest challenge lies in providing appropriate climate change education in rural areas. It is here that education requirements will be more firmly embedded in day-to-day needs of rural households, and in the potential contribution that young people can make to their families and communities. But as the discussion of agricultural education has also pointed out, facilities for education in rural areas, and vocational training that could provide a basis for strengthening agricultural practices, are both extremely weak.

Improving data and information systems

Responding to climate change depends on a great deal of information covering different topics and from different sources. Climate change is becoming a growing area of concern for Cambodian people from all walks of life, but the complexities and implications are often poorly understood (cf. MoE/BBC Trust 2011). Critical gaps exist in not only technical data and information, but also in public information systems and understanding. The knowledge needed is not always new – attention needs to be directed to dissemination, uptake and application of existing knowledge, practice and innovation (Jones et al 2009).

The gaps in technical data impede effective long-term responses to climate change. Much of the technical data and information systems – such as those related to hydrological and meteorological data – is extremely limited and a clear constraint in managing water resources, for example. This will only be exacerbated in the future unless action is taken. Using the water resources example, demands and competition between different users most likely will intensify; putting in place acceptable mechanisms for sharing water will depend to a large degree on availability of information to assess and monitor the water balance, including water availability, quantity and quality.

Opportunities emerging from international carbon finance mechanisms such as REDD+ also depend on effective baseline information, and credible, transparent monitoring of forest cover across the country. The requirements under REDD+ for monitoring, reporting and verification are likely to be rigorous, and beyond the current technical and institutional capacity within the country.

Responding to these challenges needs to occur at both a very local level as well as at national and regional levels. Many of the data required for climate modeling and monitoring must come from local sources. Equally, much of the demand for information is at local level. The case of monitoring and surveillance of malaria in Cambodia demonstrates that when these systems are in place, responses can be efficient. Indeed, much of the success in reducing and limiting the spread of malaria in the country has been attributed to the combination of local surveillance volunteers and the laboratory diagnosis system in Phnom Penh.

A need therefore exists to put in place the institutional mechanisms that link the generation of data and information and its analysis between these different levels. Early warning systems for disasters and natural hazards also require strong local-level monitoring mechanisms working together with national- and regional-level systems, ensuring that there is efficient, effective and timely dissemination of reliable information to the people who need it most, and in ways that are accessible and understandable.

There are clear advantages to establishing these linkages from local to national and regional levels. Much of the technical modeling capacity could more efficiently be established at regional level – for example, as a shared enterprise across the countries of the Mekong basin under the auspices of the MRC or the Greater Mekong Sub-Region mechanism, or even more widely across ASEAN. However, it also must be acknowledged that there are institutional and political constraints to sharing information that is often deemed sensitive. Progress in making hydrological

Table 11: Actors' roles in information and data dealing with climate change

Actor	Role
Climate Change Department	Central agency responsible for coordination, collation and dissemination of climate change information within the country, for formal communication with the international community and to international conventions (e.g. UNFCCC, the Kyoto Protocol and CDM focal points in Cambodia), and for development of draft climate change policy, strategies, action plans and legal instruments. In turn, CCD coordinates inter-ministerial technical working groups specialising in sectors (energy and forestry), and along climate change themes (GHG inventory, mitigation, vulnerability and adaptation, and UNFCCC implementation).
Private sector	Potential role in 'filling the gap' by conducting assessments and monitoring of areas and on topics of commercial strategic interest. For example, for industries reliant on sustainable sources of water, it would be beneficial for them to conduct their own assessments of water balance and support the regular monitoring of water demand, supply and quality.
Government agencies (i.e. line agencies)	Government agencies at different levels regularly collect a wide range of data and information. One of the main weaknesses, common to many countries, is that these data are not always accessible to other agencies, and in some cases, efforts of one agency duplicate the efforts of another. There is great potential for improvement in sharing, dissemination and making information available to the public.
Local government (Commune Councils)	As representatives of local citizens, local government institutions, such as Commune Councils, can act as a bridge between central agencies and the public, bringing information from one to the other. Currently a great deal of information is collected regularly at the local level. For example, the CDB is a comprehensive data set covering a wide range of local development indicators. Already used for preparation of Provincial CMDG Scorecards, this type of data set could be a useful tool for communes monitoring vulnerability in their own constituencies.
Farmers' groups	Local interest groups – e.g. farmers, water user groups, savings groups, Community Fisheries or Community Forestry groups – are often well placed to monitor local circumstances of importance to their livelihoods and resource base. If systematised and networked, these groups can provide sustainable ways of generating monitoring information that can also help them conduct their own analysis and determine their own management practices.
NGOs	NGOs often have a close direct relationship with local groups and local people, and expertise of a range of issues. NGOs in Cambodia conduct a great deal of research on issues relevant to climate change and information dissemination. In addition, NGOs can play a role in validation of other sources of information, and facilitating public dialogue.
Academia	In conducting technical research, academia can play a role in 'filling the gaps' for Government agencies and other actors. Academia can play an indispensable role in both collecting and validating socioeconomic and technical information and a convening role in bringing different stakeholders together. In addition, collaboration between national and international researchers in the field of climate change is necessary in order to obtain more comprehensive understanding of the impacts and coping strategies. Many of the outstanding research questions associated with climate change could be integrated into long-term research and teaching programmes of universities and colleges.
Media	The media have a critical role to play in making information available to the public at large – for example, on weather, rainfall and risks of storms. They can raise public awareness and act as a set of 'checks and balances' on other actors. Popular media – print (newspapers), television, radio and Internet – have an extensive reach across virtually all areas of the country and all sections of the population.
Schools	Climate change is an issue of the future and is inextricably a priority for young people and future generations. It is important to raise awareness among young people about climate change, but young people could also play a role in collecting and analysing data related to local climatic circumstances, as a way of monitoring change. This type of effort can be incorporated into local school curricula. For example, incorporating monitoring of climate-related variables into the secondary school curriculum could provide an affordable, sustainable way of gathering data, while at the same time building awareness and technical skills of young people.
Young people	Climate change is a challenge for younger generations. With a young population, many of the risks associated with climate change will affect the young. But at the same time, Cambodian young people are a vital asset for the country's prosperity. Mobilising young people to generate, share and disseminate information is essential

data available across the MRC countries has been slow, mainly constrained by concerns of member countries with regard to the need to protect national information. Building these information systems is therefore as much about trust and understanding among the countries as it is about technical challenges.

Improving information is not simply for the State to take on. Through civil society efforts – from NGOs, academia and the media – there exists a wealth of information and knowledge being generated within the region and across the world. Accessing these networks and making the information available and intelligible within the country represents a key task. Much of the information that is generated by research efforts, but most needed by rural people, is simply not reaching the people. A clear role for civil society networks exists here: to help disseminate the growing body of knowledge about climate change, adaptation, mitigation and resilience that would be of benefit to rural Cambodians. Efforts to establish knowledge networks among different actors involved in climate change should be strengthened, with particular attention on how to build the learning and dissemination mechanisms between and among rural people and sub-national actors.

The private sector also has an important role to play. Increasingly, private sector investment for the long-term will depend on reliable information systems, while much of the finance and technical expertise required for building these systems could come from the private sector. At the same time, it also has to be acknowledged that in the commercial world such information can also be guarded as sensitive.

5. Ensure secure and reliable access to finance

The costs of climate change adaptation and mitigation will be considerable. Yet the clearest opportunity from climate change appears in the growing availability of international finance to support countries such as Cambodia. Currently, donor commitments to the country are growing, with additional opportunities being created under REDD+ and the CDM.

This finance could represent a significant addition to current official development assistance (ODA), and as such, an opportunity to overcome Cambodia's underlying vulnerabilities to climate change while also creating conditions for investment in more long-term, low-carbon development pathways. Given the long-term nature of building climate change resilience, it is essential that the availability of finance is secure to allow for the kinds of long-term planning and investments required.

Ensuring that climate change funding does indeed add value to development efforts rather than dilute them, and ensuring that the finance is put to good use, depends on building on donor harmonisation efforts as well as the transparency and accountability of funding allocations. As funding opportunities emerge, it is essential that donor support is aligned with the needs and priorities of the country.

Increased volume of finance can itself be a mixed blessing. It is essential that the finance is managed well and put to good use. However, the absorptive capacity of Government institutions, both at national and particularly sub-national levels, is limited and in many cases already overstretched. Additional finance may exacerbate institutional weaknesses unless support is adequate.

In its review of climate change finance, the Organization for Economic Cooperation and Development has outlined key principles of ownership, alignment, capacity development, harmonisation and managing for development results. The potential application of these principles is summarised in Table 12.

Indeed, the greater availability of climate finance can be seen as a potential 'resource curse'. This is all the more so when governance systems are weak. While finance is clearly a necessary condition for building climate resilience, managing the finance again opens

up critical questions of governance, accountability and transparency. This in itself requires that relevant information is fully in the public domain and easily accessible, and that there are agreed rules and procedures for public consultation and monitoring.

Such concerns for accountability and transparency will best be met by ensuring mechanisms for informed public dialogue and debate, with effective participation of State, civil society and private sector stakeholders. Existing civil society forums and networks – building linkages between NGOs, media, academia and grass-roots organisations – have an important role to play in supporting this informed dialogue, identifying and assessing development options, and ensuring effective communication and understanding. While the private sector has been relatively slow in engaging in climate change debate in Cambodia, it is expected to play an increasingly critical role (cf. UNDP 2010a).

An added responsibility exists for development partners – donors, development banks and United Nations Agencies – to coordinate their efforts and work in tandem. Establishing platforms for cooperation and agreed mechanisms for monitoring the delivery and impact of climate change finance then will allow for more efficient delivery and more equitable and sustainable outcomes.

Table 12: OECD key principles to inform climate change financing

Ownership	Activities in response to climate change should be country-driven and based on needs, views and priorities of partner countries. National sustainable development strategies and climate change policies should be taken into account where they exist. Recipient countries should lead in establishing and implementing their climate change strategies in a broad, consultative process, ensuring full integration into policies, plans and programmes in all relevant sectors.
Alignment	Climate change financing needs to be integrated into countries' own planning and budgeting mechanisms to ensure genuine ownership. Where possible, new and additional climate change financing should be channeled through existing financial allocation systems.
Capacity development	Capacity development is critical to ensure that recipient countries have sufficient capacity to absorb and manage climate change financing.
Harmonisation	To reduce administrative costs, it is important that the international community coordinates their actions, simplifies procedures and shares information to avoid proliferation and duplication of funding mechanisms. A shift to programmatic approaches can help.
Managing for development results	The Bali Action Plan, a global climate change road map for the post-2012 period, acknowledges the challenge of yielding results on the ground and stresses the need for actions to be undertaken by parties to implement the UNFCCC, in order to be measurable, reportable and verifiable.

Source: UNDP 2010a

Box 41: Enhancing aid effectiveness for climate change finance

"A regular forum to jointly plan, report and monitor activities would facilitate an all-of-Government and multi-stakeholder approach and also enable development partners to jointly track the response to climate change in Cambodia. This could be achieved by building on the robust aid management structures already in place – by introducing a dedicated multi-stakeholder climate change Technical Working Group, and by developing Joint Monitoring Indicators to ensure mutual accountability. Classification of climate change in the ODA database will facilitate closer monitoring of climate change financing and the impact of climate change financing on other sectors."

Source: UNDP 2010a

6. Strengthen access rights

Underpinning these policy options is the need to strengthen governance and decision-making – to allow for more participatory, deliberative and informed debate, and to ensure that appropriate checks and balances are in place to protect the rights of vulnerable people.

Running through the discussion in this report is the need, on the one hand, for capacity development and awareness raising, while on the other hand promoting rights of access to information, participation, and redress and remedy. This concluding section draws on the principles outlined in access rights to consider ways forward for strengthening local action.

Access to information

As climate change takes hold, it will be increasingly important to monitor and debate the significance and implications of changes, and to determine the extent to which human actions are either creating further vulnerability or strengthening resilience. For this to occur, information must be freely available.

Key areas in which access rights can strengthen decision-making processes around climate change adaptation include:

- **Environmental quality monitoring.** By monitoring changes to the environment, for example, in terms of air and water pollution, forest and land degradation, and making this information accessible to the public, it will be easier to assess changes and identify options to avoid negative outcomes before it is too late.
- **Hazards** (storms and disasters). Ensuring that information is available can reduce impacts and aid recovery.
- **Environmental and social impact assessments.** Ensuring that EIA and SIA are conducted in a transparent manner strengthens the likelihood that all areas of concern are assessed adequately and that the projects will gain public acceptance, thus reducing the potential for social conflict.
- **Climate change finance.** Ensuring information on finance – through ODA, CDM and other sources – allows for greater transparency and accountability, and thereby encourages more equitable allocations.

In Cambodia, access to information for rural people remains constrained, as does people's access to information directly related to their ability to function as fully engaged citizens. Access to information differs according to wealth, gender and location, with poorer, more remote people, and particularly women, less able to gain such access (MoE/BBC Trust 2011). As well as being able to observe, publicise and share information, citizens must also enjoy the protection of the rule of law and have their grievances resolved through due legal process.

Experience suggests that the more sensitive the nature of information, the less likely it is to be readily accessible. A key area in which information is not accessible and in the public domain relates to land tenure, conflicts and concessions. Land issues are highly contentious – and stand out as prominent areas of concern to rural people. As observed in a recent study, land use changes (particularly associated with forest loss) are closely associated with popular perceptions of climate change (MoE/BBC Trust 2011). However, this is an area that will need to be addressed if Cambodia is to take advantage of the opportunities under REDD+ finance mechanisms. Two critical aspects comprise a clear need to establish a baseline on area and quality of forests, as well as a process for monitoring deforestation rates and benefit sharing.

The media and civil society have a vital role to play in making information available and in holding both the State and private sector accountable. Recent assessments have raised serious causes for concern relating to freedom of expression and the independence of the media, as well as to people's rights to petition State authorities or to pursue actions through

the courts. These kinds of rankings can certainly be argued. But similar kinds of concerns are voiced in a more general assessment of rights and freedoms in the country (Subedi 2010, CCHR 2010).

It is timely that the RGC is in the process of going through consultation on the development of legislation regarding the right to information. Putting in place such a legal framework will go a long way to opening up space for public debate about many important aspects of climate change, while further strengthening overall transparency and accountability. Including specific guidelines on access to information as it relates to climate change issues will strengthen the country's capacity to respond.

Final word

Climate change is essentially a challenge of governance – about what development means, how it can be realised, and who should be involved in the process of making decisions and taking action.

While limited adaptive capacity is considered the main factor in Cambodia's vulnerability to climate change, much of the groundwork – through policy reform – that could allow the country to rise to the challenges is now being prepared.

Despite hurdles, the new mechanisms for climate change finance and technology transfer promised by international agreements could provide a new opportunity for Cambodia. In all, having put in place many of the institutional arrangements for addressing climate change, the country stands well placed to take advantage of this opportunity.

Clearly, finance alone will not solve the problems associated with climate change. Ensuring that finance is used wisely – in ways that benefit all, but particularly the most vulnerable, and that provide lasting solutions – will require new ways of working, new partnerships and more informed public debate. This means that institutions will need to work to build cross-sectoral coordination, strengthen mechanisms for public participation and accountability, and build partnerships with the private sector.

This will also require strengthening rights of access as well as decision-making frameworks that consider development options and their impacts. The decisions and actions that are taken today will have far-reaching implications for future generations. It is essential that these decisions are well informed, and represent the needs and interests of the many Cambodians whose lives remain precarious.

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Climate change puts rural livelihoods once again under the spotlight, begging the question of both how rural people will be affected by climate change, and also for what kind of a future should Cambodia strive.

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ANNEX

Technical Annex on the Human Development Index [30]

Mr. Ny Boret

The Human Development Index (HDI) is a composite index covering education, health and income aspects of well-being. Essentially, HDI is a measurement of a country's ability to offer its people opportunities to improve their lives based on economic opportunities, and access to health care and education…Every year since 1990 the HDI has helped shift the debate away from GDP per capita as the only measure of development by measuring the broader achievement of a country's citizens' access to knowledge, leading a long, healthy life, and attaining a decent standard of living.

Human Development Report 2009 [31]

The Human Development Index provides a snapshot of human development across several dimensions: education, health and income. For 20 years the global HDI has focused attention on the human aspects of development. Global HDI is calculated based on similar national level data across all participating countries. In preparing a country level HDI, it is necessary to take that assessment a step further and to survey data at the provincial level.

The methodology for computing the global HDI was revised in 2010, but this report utilises an augmented approach to the original HDI methodology to assess HDI at the provincial level. This approach is aligned with RGC's D&D priorities and allows for comparison across different parts of the country to see what is happening in different regions and to identify areas of concern.

1.The data source

The main data source used for computing the Cambodia HDI is the Commune Database (CDB). CDB is an information system developed by the Ministry of Planning (MoP) and development partners to support Commune and Sangkat[32] (CS) planning, CS fund allocation as well as sub-national administration management and development. It keeps yearly records of official data related to the economy, natural resources and the environment, public administration and security, social and gender information. The data is collected by Village Chiefs and Commune/Sangkat clerks and later aggregated to commune, district and provincial levels.[33] CDB became fully operational in 2002, but many additional indicators related to local socio-economic situations were added in 2006.[34]

The CDB is also used by the MoP to compute poverty rates and the Cambodia Millennium Development Goals (CMDGs) scorecards at the sub-national level.

Other official data sources available in Cambodia, some of which are also used for the current CHDR, include the Cambodia Socio-Economic Survey, the ID Poor project and the Anthropometrics Survey.

The current HDI analysis looks at trends from the end of 2006. For example, the HDI 2008 refers to 2007 available data and so on.

2. Indicators selection (Table 1.1)

For the current HDI analysis, proxies have been used to represent the Income, Education and Health components. These indicators are consistent with the computation of local CMDG indicators and poverty rates at the sub-national level by MoP.[35]

The Indicators used for HDI are:

- **Income:** *consumption expenditures from small area estimations expressed in Riel per day. (See note following annex for a detailed model presentation)*

  Derived from regression modelling through small area estimation methods (Lanjouw P., J. Lanjouw and C. Elbers 2002) combining data from CDB with data from the Cambodia Socio-Economic Survey.[36] This regression model uses the same indicators presented in the computation to derive the Cambodia poverty rate by MoP.

- **Education:** *literacy rate for age group 18-60 combined with school attendance rate for age group 6-14.*

  The choice for this indicator is related to the data availability from the CDB. In particular, for the second component it was not possible to use gross enrolment ratio (as used in the traditional HDI formula until 2009) because the CDB does not record the specific class attended by 6-14 year olds, but only whether 6-14 year olds are currently at school.

- **Health:** *child survival rate beyond age 5.*

  This indicator is derived from the under-5 mortality rate which refers to the number of deaths under the age of 5 per 1000 live births. Its complement, the child survival rate beyond the age of 5, is reached by subtracting the under-5 mortality rate from 1000. This indicator is used rather than life expectancy because data is unavailable at the sub-national level. [37]

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There exists a clear link between improving education and developing the kinds of skills that are required for rural people – households and communities – to adapt to the challenges and opportunities of climate change. Education raises the quality of human resources and opens up new opportunities for rural households.

TABLE1.1 INCOME, EDUCATION AND HEALTH

PROVINCE	INCOME [Per capita consumption in Riel/day]				EDUCATION [% Adult (18-60) Literacy rate]				EDUCATION [% Children (6-14) attending school]				HEALTH [Child survival rate beyond age of 5]			
	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010
1-Banteay Meanchey	3541	3813	4027	4794	86.2	87.1	88.0	87.7	83.8	84.9	84.7	87.5	950	969	977	980
2-Battambang	3863	4225	4603	5292	86.0	86.8	87.6	87.7	83.8	83.9	85.0	85.4	955	969	939	976
3-Kampong Cham	4214	4472	4839	5708	82.8	82.9	84.7	85.8	86.4	86.5	87.2	85.9	949	951	957	963
4-Kampong Chhnang	3310	3547	3869	4581	86.8	88.0	90.4	90.9	86.3	87.8	89.1	90.4	935	937	955	965
5-Kampong Speu	3370	3758	4340	5205	86.1	92.6	93.2	93.7	92.1	89.9	91.1	91.7	946	960	980	984
6-Kampong Thom	3122	3216	3618	4240	76.9	76.9	77.7	79.6	84.1	86.2	85.1	85.8	933	958	972	970
7-Kampot	4210	4411	4928	5646	83.6	85.4	85.5	86.6	86.1	86.7	88.9	89.1	943	958	965	977
8-Kandal	6095	6490	7296	8628	91.6	91.7	92.8	93.2	92.9	91.0	91.8	92.8	970	977	983	990
9-Koh Kong	3493	3747	4288	4837	76.3	78.7	77.4	79.1	77.7	73.6	83.2	83.5	922	914	963	955
10-Kratie	2913	3105	3319	3967	78.3	80.5	82.0	84.1	82.4	81.0	83.4	81.1	930	944	973	957
11-Mondulkiri	2847	3018	3407	3695	52.5	57.9	60.8	59.8	72.6	67.7	73.2	76.9	895	880	906	923
12-Phnom Penh	17144	18062	18431	20425	96.4	97.2	97.4	97.8	92.6	94.7	95.5	94.3	979	976	988	994
13-Preah Vihear	2256	2368	2564	2976	66.3	67.2	67.9	69.3	82.9	81.9	82.3	84.6	836	879	890	877
14-Prey Veng	3887	4117	4499	5314	88.4	88.2	88.7	89.6	91.7	92.5	92.6	93.2	934	936	962	963
15-Pursat	3048	3377	3644	4394	82.3	83.9	84.6	83.9	82.2	83.0	82.6	81.1	929	956	960	969
16-Rattanakiri	2164	2275	2707	2827	52.2	45.1	46.1	47.0	51.4	52.0	57.3	62.0	820	882	886	884
17-Siem Reap	3481	3729	4032	4605	76.9	77.8	79.9	81.4	82.8	83.6	86.7	85.8	950	956	978	981
18-Preah Sihanouk	5050	5663	6210	7023	90.8	93.3	93.6	95.6	85.7	89.1	90.2	93.2	937	902	973	958
19-Stung Treng	2446	2562	2747	3135	66.7	68.9	68.3	70.2	80.2	76.9	78.7	76.8	882	897	934	815
20-Svay Rieng	4356	4807	5377	6461	89.4	88.6	89.6	90.1	91.6	92.2	92.7	94.7	923	947	944	948
21-Takeo	4077	4318	4699	5612	87.7	87.7	89.4	89.3	92.3	91.4	92.0	91.6	951	952	965	964
22-Oddar Meanchey	2596	2846	3150	3691	68.0	72.4	72.7	73.6	77.2	79.6	80.8	81.4	915	938	961	969
23-Kep	3496	3960	4524	5153	85.4	87.4	85.9	85.4	83.1	79.8	73.1	83.5	971	969	983	901
24-Pailin	3660	4046	4969	6525	76.8	78.1	79.7	80.7	78.4	75.5	80.7	82.7	926	883	916	954
0-CAMBODIA	**4525**	**4822**	**5242**	**6149**	**85.2**	**85.9**	**86.9**	**87.6**	**86.9**	**87.0**	**87.9**	**88.2**	**941**	**952**	**964**	**967**

Source: CDB 2007-2010/MoP and NCDD/M&E Unit

3. HDI methodology (Tables 1.2 to 1.7)

3.1 Normalisation (Tables 1.2 and 1.3)

These components have different units of measurement, so they were converted into comparable units. The normalisation method described below was used to convert all components into normalised indices that range from 0 to 1.

Normalised index = (Actual value – minimum value) / (maximum value – minimum value)

Using the data from the selected indicators in the CDB, indices were normalised before computing HDI.

Moreover, goalposts and a rescaling factor, specific for each component, are used.

Rescaling factors and other discount or recounted factors are used in statistical indices estimation to allow more reasonable comparison while not affecting the analysis of different geographic areas or different time lines.

Normalised index = [(Actual value – minimum value) / (maximum value – minimum value)]* rescaling factor

In this case the UNDP global 2006 HDI for Cambodia has been used as an index reference for calculating the rescaling factor:

Rescaling factor = (global HDI for Cambodia 2006 normalised component/ local HDI for Cambodia 2006 normalised component)

Income rescaling factor = 0.469/ 0.413 = 1.136
Education rescaling factor = 0.700/0.852 = 0.820
Health rescaling factor = 0.584/0.651 = 0.897

Normalised Income Index:

For the Normalised Income Index the following formula is applied:

Income index = [(Actual income value-5.760) / (12.187-5.760)] *1.136

Where the Actual income value (Riel) is expressed in a natural logarithm and the rescaling factor is 1.136.

In order to achieve the appropriate goalpost, to make the normalised index follow a smooth function and to avoid the problem of outlier observation, the minimum value was deflated by 25 percent and maximum value was inflated by 25 percent[38] of its original value before computing the normalised income index (5.760 is the minimum value for 2007 minus 25 percent of its original value, and 12.187 is maximum value for 2007 plus 25 percent of its original value).

The normalised income indices for other years are obtained using the same procedure and figures as in 2007, in order to allow consistent trend observation from year to year.

Normalised Education Index:

The Education Index has two components, school attendance and literacy, so two separate normalised indices have been calculated (table 1.2) and then combined in the Normalised Education Index (table 1.3)

In this case, as the values are expressed as percentages, the minimum and maximum values are 0 and 100:

Normalised literacy index = [(Actual education literacy value -0) / (100-0)] *0.820
Normalised attendance index = [(Actual education attendance value-0) / (100-0)] *0.820

Normalised education index = 2/3 Normalised literacy index+1/3 Normalised attendance index

Normalised Health index:

The normalised Heath Index equals:

Health index = [(Actual Health value-779) / (1000-779)] *0.897

Where the maximum value is 1000 (no children died) and the minimum value corresponds to the minimum value observed in 2007 in Rattanakiri province (820) discounted by 5 percent[39] in order to obtain a smoother function.

TABLE 1.2: NORMALISED INCOME, EDUCATION AND HEALTH INDEX

PROVINCE	NORMALISED INCOME [Per capita consumption in Riel/day]				EDUCATION [% Adult (18-60) Literacy rate]				EDUCATION [% Children (6-14) attending school]				HEALTH [Child survival rate beyond age of 5]			
	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010
1-Banteay Meanchey	0.426	0.439	0.449	0.480	0.707	0.714	0.722	0.719	0.675	0.679	0.678	0.700	0.616	0.684	0.713	0.724
2-Battambang	0.442	0.458	0.473	0.497	0.705	0.712	0.718	0.719	0.675	0.671	0.680	0.683	0.634	0.684	0.576	0.710
3-Kampong Cham	0.457	0.468	0.482	0.511	0.679	0.680	0.695	0.704	0.696	0.692	0.698	0.687	0.612	0.620	0.641	0.663
4-Kampong Chhnang	0.414	0.427	0.442	0.472	0.712	0.722	0.741	0.745	0.696	0.702	0.713	0.723	0.562	0.569	0.634	0.670
5-Kampong Speu	0.418	0.437	0.462	0.494	0.706	0.759	0.764	0.768	0.742	0.719	0.729	0.734	0.602	0.652	0.724	0.738
6-Kampong Thom	0.404	0.409	0.430	0.458	0.631	0.631	0.637	0.653	0.678	0.690	0.681	0.686	0.555	0.645	0.695	0.688
7-Kampot	0.457	0.465	0.485	0.509	0.686	0.700	0.701	0.710	0.694	0.694	0.711	0.713	0.591	0.645	0.670	0.713
8-Kandal	0.522	0.533	0.554	0.584	0.751	0.752	0.761	0.764	0.749	0.728	0.734	0.742	0.688	0.713	0.735	0.760
9-Koh Kong	0.424	0.436	0.460	0.481	0.626	0.645	0.635	0.649	0.626	0.589	0.666	0.668	0.515	0.486	0.663	0.634
10-Kratie	0.392	0.403	0.415	0.446	0.642	0.660	0.672	0.690	0.664	0.648	0.667	0.649	0.544	0.594	0.699	0.641
11-Mondulkiri	0.388	0.398	0.420	0.434	0.431	0.475	0.499	0.490	0.585	0.542	0.586	0.615	0.418	0.364	0.458	0.519
12-Phnom Penh	0.705	0.714	0.718	0.736	0.790	0.797	0.799	0.802	0.746	0.758	0.764	0.754	0.720	0.710	0.753	0.775
13-Preah Vihear	0.347	0.355	0.369	0.396	0.544	0.551	0.557	0.568	0.668	0.655	0.658	0.677	0.205	0.360	0.400	0.353
14-Prey Veng	0.443	0.453	0.469	0.498	0.725	0.723	0.727	0.735	0.739	0.740	0.741	0.746	0.558	0.566	0.659	0.663
15-Pursat	0.400	0.418	0.431	0.465	0.675	0.688	0.694	0.688	0.663	0.664	0.661	0.649	0.540	0.638	0.652	0.684
16-Rattanakiri	0.339	0.348	0.379	0.387	0.428	0.370	0.378	0.385	0.414	0.416	0.458	0.496	0.148	0.371	0.385	0.378
17-Siem Reap	0.423	0.436	0.449	0.473	0.631	0.638	0.655	0.667	0.667	0.669	0.694	0.686	0.616	0.638	0.717	0.728
18-Preah Sihanouk	0.489	0.509	0.526	0.547	0.745	0.765	0.768	0.784	0.691	0.713	0.722	0.746	0.569	0.443	0.699	0.645
19-Stung Treng	0.361	0.369	0.381	0.405	0.547	0.565	0.560	0.576	0.646	0.615	0.630	0.614	0.371	0.425	0.558	0.130
20-Svay Rieng	0.463	0.480	0.500	0.533	0.733	0.727	0.735	0.739	0.738	0.738	0.742	0.758	0.519	0.605	0.594	0.609
21-Takeo	0.451	0.461	0.476	0.508	0.719	0.719	0.733	0.732	0.744	0.731	0.736	0.733	0.620	0.623	0.670	0.666
22-Oddar Meanchey	0.371	0.388	0.406	0.434	0.558	0.594	0.596	0.604	0.622	0.637	0.646	0.651	0.490	0.573	0.656	0.684
23-Kep	0.424	0.446	0.470	0.493	0.700	0.717	0.704	0.700	0.670	0.638	0.585	0.668	0.692	0.684	0.735	0.439
24-Pailin	0.432	0.450	0.486	0.534	0.630	0.640	0.654	0.662	0.632	0.604	0.646	0.662	0.530	0.375	0.494	0.630
0-CAMBODIA	**0.470**	**0.481**	**0.496**	**0.524**	**0.699**	**0.704**	**0.713**	**0.718**	**0.700**	**0.696**	**0.703**	**0.706**	**0.584**	**0.623**	**0.666**	**0.677**

Source: table 1.1

3.2 Computing Human Development Indices (Tables 1.3 to 1.7)

3.2.1 HDI (Arithmetic mean – Table 1.3)

The yearly normalised indices are used to compute the HDI for each year with the simple formula:

HDI = 1/3 (INCOME+EDUCATION+HEALTH)

TABLE1.3: NORMALISED INCOME, EDUCATION, HEALTH AND HDI

PROVINCE	INCOME DIMENSION				EDUCATION DIMENSION				HEALTH DIMENSION				HDI			
	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010
1-Banteay Meanchey	0.426	0.439	0.449	0.480	0.696	0.702	0.707	0.713	0.616	0.684	0.713	0.724	0.579	0.608	0.623	0.639
2-Battambang	0.442	0.458	0.473	0.497	0.695	0.698	0.705	0.707	0.634	0.684	0.576	0.710	0.590	0.613	0.585	0.638
3-Kampong Cham	0.457	0.468	0.482	0.511	0.685	0.684	0.696	0.698	0.612	0.620	0.641	0.663	0.585	0.591	0.606	0.624
4-Kampong Chhnang	0.414	0.427	0.442	0.472	0.707	0.715	0.732	0.738	0.562	0.569	0.634	0.670	0.561	0.570	0.603	0.627
5-Kampong Speu	0.418	0.437	0.462	0.494	0.718	0.746	0.752	0.757	0.602	0.652	0.724	0.738	0.579	0.612	0.646	0.663
6-Kampong Thom	0.404	0.409	0.430	0.458	0.647	0.651	0.652	0.664	0.555	0.645	0.695	0.688	0.535	0.568	0.592	0.603
7-Kampot	0.457	0.465	0.485	0.509	0.689	0.698	0.704	0.711	0.591	0.645	0.670	0.713	0.579	0.603	0.620	0.644
8-Kandal	0.522	0.533	0.554	0.584	0.750	0.744	0.752	0.757	0.688	0.713	0.735	0.760	0.653	0.663	0.680	0.700
9-Koh Kong	0.424	0.436	0.460	0.481	0.626	0.626	0.645	0.655	0.515	0.486	0.663	0.634	0.522	0.516	0.589	0.590
10-Kratie	0.392	0.403	0.415	0.446	0.649	0.656	0.670	0.676	0.544	0.594	0.699	0.641	0.528	0.551	0.595	0.588
11-Mondulkiri	0.388	0.398	0.420	0.434	0.482	0.497	0.528	0.532	0.418	0.364	0.458	0.519	0.429	0.420	0.469	0.495
12-Phnom Penh	0.705	0.714	0.718	0.736	0.775	0.784	0.787	0.786	0.720	0.710	0.753	0.775	0.733	0.736	0.753	0.766
13-Preah Vihear	0.347	0.355	0.369	0.396	0.585	0.586	0.591	0.604	0.205	0.360	0.400	0.353	0.379	0.434	0.453	0.451
14-Prey Veng	0.443	0.453	0.469	0.498	0.730	0.729	0.732	0.739	0.558	0.566	0.659	0.663	0.577	0.583	0.620	0.633
15-Pursat	0.400	0.418	0.431	0.465	0.671	0.680	0.683	0.675	0.540	0.638	0.652	0.684	0.537	0.579	0.589	0.608
16-Rattanakiri	0.339	0.348	0.379	0.387	0.423	0.385	0.405	0.422	0.148	0.371	0.385	0.378	0.303	0.368	0.390	0.396
17-Siem Reap	0.423	0.436	0.449	0.473	0.643	0.648	0.668	0.673	0.616	0.638	0.717	0.728	0.561	0.574	0.611	0.625
18-Preah Sihanouk	0.489	0.509	0.526	0.547	0.727	0.748	0.753	0.771	0.569	0.443	0.699	0.645	0.595	0.567	0.659	0.654
19-Stung Treng	0.361	0.369	0.381	0.405	0.580	0.582	0.583	0.589	0.371	0.425	0.558	0.130	0.437	0.459	0.507	0.375
20-Svay Rieng	0.463	0.480	0.500	0.533	0.735	0.731	0.737	0.745	0.519	0.605	0.594	0.609	0.572	0.605	0.610	0.629
21-Takeo	0.451	0.461	0.476	0.508	0.727	0.723	0.734	0.732	0.620	0.623	0.670	0.666	0.599	0.602	0.627	0.635
22-Oddar Meanchey	0.371	0.388	0.406	0.434	0.579	0.608	0.613	0.620	0.490	0.573	0.656	0.684	0.480	0.523	0.558	0.579
23-Kep	0.424	0.446	0.470	0.493	0.690	0.691	0.664	0.689	0.692	0.684	0.735	0.439	0.602	0.607	0.623	0.540
24-Pailin	0.432	0.450	0.486	0.534	0.631	0.628	0.651	0.662	0.530	0.375	0.494	0.630	0.531	0.484	0.544	0.609
0-CAMBODIA	**0.470**	**0.481**	**0.496**	**0.524**	**0.699**	**0.701**	**0.710**	**0.714**	**0.584**	**0.623**	**0.666**	**0.677**	**0.584**	**0.602**	**0.624**	**0.638**

Source: table 1.1

3.2.2 Inequality adjusted HDI

IHDI (Inequality across villages - Tables 1.4 to 1.6)

The current traditional procedure of HDI calculation averaging within and then across dimensions is criticised on several grounds: the most significant of these criticisms is the fact that the HDI ignores the distribution of human development across people. It simply does not distinguish whether the benefits of development are reaching all strata of society, or whether they are concentrated among a fortunate few.[40]

For this reason, Inequality adjusted HDIs are elaborated. The Atkinson index[41] is chosen as the inequality measurement to solve the problem of subgroup consistency. This is important as explained by Foster and Schorrocks, (1991): "the direction of the change in HDI of one group is transmitted into a change of the same direction of the overall HDI, assuming that the HDIs of other groups remain unaltered."

On table 1.4 the Atkinson index is calculated for the four components (for education, it is calculated separately for literacy and attendance rate) aggregated from villages because the CDB data are at village level.

TABLE 1.4: ATKINSON INDEX

PROVINCE	Atkinson index INCOME (per capita consumption in Reil/day)				Atkinson index-EDUCATION (% literacy 18-60 years)				Atkinson index-EDUCATION (% 6-14 years attending school)				Atkinson index HEALTH			
	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010
1-Banteay Meanchey	0.220	0.212	0.206	0.214	0.297	0.262	0.259	0.308	0.269	0.244	0.245	0.235	0.230	0.210	0.210	0.200
2-Battambang	0.296	0.306	0.296	0.294	0.271	0.251	0.239	0.230	0.227	0.282	0.246	0.249	0.230	0.210	0.220	0.210
3-Kampong Cham	0.233	0.220	0.218	0.224	0.312	0.299	0.285	0.265	0.419	0.279	0.297	0.315	0.220	0.220	0.210	0.220
4-Kampong Chhnang	0.158	0.176	0.167	0.166	0.249	0.266	0.242	0.229	0.319	0.259	0.270	0.232	0.230	0.240	0.230	0.210
5-Kampong Speu	0.172	0.193	0.182	0.175	0.227	0.208	0.208	0.203	0.219	0.273	0.238	0.226	0.230	0.220	0.210	0.210
6-Kampong Thom	0.273	0.242	0.257	0.255	0.610	0.408	0.376	0.325	0.277	0.304	0.244	0.250	0.240	0.220	0.210	0.210
7-Kampot	0.163	0.160	0.185	0.164	0.261	0.237	0.234	0.221	0.302	0.264	0.230	0.260	0.220	0.210	0.220	0.210
8-Kandal	0.202	0.197	0.211	0.194	0.263	0.367	0.216	0.206	0.210	0.243	0.208	0.203	0.220	0.210	0.210	0.210
9-Koh Kong	0.305	0.305	0.317	0.267	0.378	0.379	0.350	0.425	0.371	0.531	0.469	0.256	0.250	0.250	0.210	0.210
10-Kratie	0.297	0.284	0.281	0.330	0.668	0.589	0.598	0.303	0.302	0.262	0.274	0.271	0.260	0.220	0.210	0.210
11-Mondulkiri	0.366	0.333	0.351	0.299	0.524	0.408	0.816	0.390	0.335	0.317	0.269	0.479	0.260	0.270	0.250	0.260
12-Phnom Penh	0.206	0.188	0.187	0.096	0.209	0.205	0.205	0.201	0.216	0.219	0.200	0.200	0.210	0.210	0.200	0.200
13-Preah Vihear	0.179	0.212	0.252	0.220	0.388	0.392	0.440	0.398	0.289	0.255	0.231	0.225	0.300	0.270	0.280	0.240
14-Prey Veng	0.117	0.117	0.121	0.114	0.234	0.232	0.238	0.220	0.222	0.215	0.210	0.209	0.240	0.230	0.220	0.210
15-Pursat	0.223	0.242	0.232	0.229	0.376	0.301	0.306	0.305	0.272	0.251	0.252	0.318	0.230	0.230	0.220	0.210
16-Rattanakiri	0.181	0.217	0.294	0.229	0.558	0.784	0.741	0.825	0.600	0.764	0.616	0.545	0.280	0.270	0.260	0.270
17-Siem Reap	0.309	0.314	0.285	0.290	0.347	0.352	0.385	0.265	0.303	0.265	0.238	0.238	0.230	0.210	0.210	0.200

PROVINCE	Atkinson index INCOME (per capita consumption in Reil/day)				Atkinson index- EDUCATION (% literacy 18-60 years)				Atkinson index- EDUCATION (% 6-14 years attending school)				Atkinson index HEALTH			
	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010
19-Stung Treng	0.284	0.284	0.321	0.321	0.685	0.557	0.559	0.503	0.295	0.295	0.264	0.272	0.240	0.250	0.230	0.270
20-Svay Rieng	0.118	0.130	0.139	0.139	0.206	0.225	0.216	0.211	0.221	0.214	0.215	0.208	0.240	0.220	0.220	0.230
21-Takeo	0.124	0.127	0.137	0.131	0.245	0.234	0.229	0.238	0.218	0.247	0.237	0.265	0.220	0.220	0.210	0.210
22-Oddar Meanchey	0.164	0.205	0.239	0.176	0.348	0.329	0.337	0.301	0.257	0.387	0.236	0.203	0.240	0.230	0.230	0.210
23-Kep	0.118	0.115	0.128	0.054	0.218	0.222	0.218	0.213	0.248	0.277	0.272	0.200	0.210	0.210	0.210	0.300
24-Pailin	0.362	0.391	0.421	0.438	0.285	0.407	0.267	0.218	0.290	0.269	0.206	0.246	0.290	0.240	0.220	0.260
0-CAMBODIA	**0.406**	**0.405**	**0.391**	**0.387**	**0.354**	**0.358**	**0.347**	**0.324**	**0.294**	**0.295**	**0.261**	**0.260**	**0.230**	**0.220**	**0.220**	**0.220**

Source: CDB 2007-2010/MoP and NCDD/M&E Unit/Boret 2010

The Atkinson index across provinces is based on the generalised mean.[42] Because here the inequality is calculated across villages and not across people, such inequality tends to be smaller. To enhance it a stronger aversion parameter ε = 2 is used.

$$A_\varepsilon(y_1,\ldots,y_N) = \begin{cases} 1 - \frac{1}{\mu}\left(\frac{1}{N}\sum_{i=1}^{N} y_i^{1-\varepsilon}\right)^{1/(1-\varepsilon)} & \text{for } \varepsilon \in [0,1)\cup(1,+\infty) \\ 1 - \frac{1}{\mu}\left(\prod_{i=1}^{N} y_i\right)^{1/N} & \text{for } \varepsilon = 1, \end{cases}$$

Atkinson index = 1-(Generalised mean/Arithmetic mean)

Here is an example of how the index is calculated. Using a province with only three villages with average per capita consumption in Riel/village obtains the following:

Village	Income (in riel)	Income (yi1-ε)*	Generalised mean
1	4000	4000-1=0.00025	
2	7000	7000-1=0.00014	
3	9000	9000-1=0.00011	
Average (Arithmetic mean)	6666	0.00017	
			0.00017-1=5952

*(-1 is obtained as 1-2=-1 where 2 is the aversion parameter ε).

Atkinson index = 1-(5953/6666) = 0.107

In table1.5 we calculated the normalised index discounted for inequality of all the components through the formula:

Normalised index adjusted for inequality = Normalised index*(1-I)

Where I = Atkinson index.

Here is an example:

Normalised Income adjusted for inequality for Banteay Meanchey in 2007

Normalised Income index adjusted for inequality= Normalised Income index*(1-IINC)

= 0.426*(1-0.220) = 0.332

Where $_{IINC}$ = 0.220 is the Atkinson index for income for 2007.

TABLE1.5: NORMALISED INCOME, EDUCATION AND HEALTH INDEX ADJUSTED FOR INEQUALITY

PROVINCE	NORMALISED INCOME INDEX ADJUSTED FOR INEQUALITY [per capita consumption in Riel/day]				NORMALISED EDUCATION INDEX ADJUSTED FOR INEQUALITY [adult (18-60) literacy]				NORMALISED EDUCATION INDEX ADJUSTED FOR INEQUALITY[children (6-14) attending school]				NORMALISED HEALTH INDEXADJUSTED FOR INEQUALITY [child survival rate beyond age of 5]			
	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010
1-Banteay Meanchey	0.332	0.346	0.357	0.377	0.497	0.527	0.535	0.498	0.494	0.513	0.512	0.536	0.474	0.540	0.563	0.579
2-Battambang	0.311	0.318	0.333	0.351	0.514	0.533	0.546	0.554	0.522	0.482	0.512	0.513	0.488	0.540	0.449	0.561
3-Kampong Cham	0.351	0.365	0.377	0.397	0.467	0.477	0.497	0.517	0.404	0.499	0.491	0.470	0.477	0.484	0.506	0.517
4-Kampong Chhnang	0.349	0.352	0.368	0.394	0.535	0.530	0.562	0.574	0.474	0.520	0.521	0.555	0.433	0.432	0.488	0.529
5-Kampong Speu	0.346	0.353	0.378	0.408	0.546	0.601	0.605	0.612	0.580	0.522	0.556	0.568	0.464	0.509	0.572	0.583
6-Kampong Thom	0.294	0.310	0.319	0.341	0.246	0.374	0.397	0.441	0.491	0.480	0.515	0.514	0.422	0.503	0.549	0.544
7-Kampot	0.383	0.391	0.395	0.426	0.507	0.534	0.537	0.553	0.485	0.511	0.548	0.528	0.461	0.510	0.523	0.563
8-Kandal	0.417	0.428	0.437	0.471	0.553	0.476	0.597	0.607	0.592	0.551	0.582	0.591	0.537	0.563	0.581	0.600
9-Koh Kong	0.295	0.303	0.314	0.353	0.389	0.401	0.413	0.373	0.394	0.276	0.354	0.497	0.386	0.365	0.524	0.501
10-Kratie	0.276	0.289	0.298	0.299	0.213	0.271	0.270	0.481	0.463	0.478	0.485	0.473	0.403	0.463	0.552	0.506
11-Mondulkiri	0.246	0.265	0.273	0.304	0.205	0.281	0.092	0.299	0.389	0.370	0.428	0.321	0.309	0.266	0.344	0.384
12-Phnom Penh	0.560	0.580	0.584	0.665	0.625	0.634	0.635	0.641	0.585	0.592	0.611	0.603	0.569	0.561	0.602	0.620
13-Preah Vihear	0.285	0.280	0.276	0.309	0.333	0.335	0.312	0.342	0.475	0.488	0.506	0.524	0.144	0.263	0.288	0.268
14-Prey Veng	0.391	0.400	0.412	0.441	0.555	0.555	0.554	0.573	0.575	0.581	0.585	0.590	0.424	0.436	0.514	0.524
15-Pursat	0.311	0.317	0.331	0.359	0.421	0.481	0.482	0.478	0.482	0.497	0.494	0.442	0.416	0.491	0.509	0.540
16-Rattanakiri	0.278	0.272	0.268	0.298	0.189	0.080	0.098	0.067	0.166	0.098	0.176	0.226	0.107	0.271	0.285	0.276
17-Siem Reap	0.292	0.299	0.321	0.336	0.412	0.413	0.403	0.490	0.465	0.492	0.529	0.523	0.474	0.504	0.566	0.582
18-Preah Sihanouk	0.272	0.265	0.319	0.344	0.580	0.605	0.607	0.626	0.514	0.497	0.570	0.587	0.450	0.319	0.559	0.477
19-Stung Treng	0.258	0.264	0.259	0.275	0.172	0.250	0.247	0.286	0.456	0.434	0.464	0.447	0.282	0.319	0.430	0.095
20-Svay Rieng	0.408	0.418	0.431	0.459	0.582	0.563	0.576	0.583	0.575	0.580	0.582	0.600	0.394	0.472	0.463	0.469
21-Takeo	0.395	0.402	0.411	0.441	0.543	0.551	0.565	0.558	0.581	0.550	0.562	0.539	0.484	0.486	0.529	0.526
22-Oddar Meanchey	0.310	0.308	0.309	0.358	0.364	0.399	0.395	0.422	0.462	0.390	0.494	0.519	0.372	0.441	0.505	0.540
23-Kep	0.374	0.395	0.410	0.466	0.547	0.558	0.551	0.551	0.504	0.461	0.426	0.534	0.547	0.540	0.581	0.307
24-Pailin	0.276	0.274	0.281	0.300	0.450	0.380	0.479	0.518	0.449	0.442	0.513	0.499	0.376	0.285	0.385	0.466
0-CAMBODIA	**0.279**	**0.286**	**0.302**	**0.321**	**0.452**	**0.452**	**0.466**	**0.485**	**0.494**	**0.490**	**0.520**	**0.522**	**0.450**	**0.486**	**0.519**	**0.528**

Source: table 1.2 and table 1.4

In table 1.6, after aggregating the Normalised Education index adjusted for inequality, the IHDI is calculated:

IHDI = 1/3 {[(INCOME*(1-IINC)] + [EDUCATION*(1-IEDU)] + [HEALTH*(1-IHEA)]}

Where

EDUCATION*(1-IEDU) = [1/3LITERACY1*(1-ILIT)] + [2/3 ATTENDANCE*(1-IATT)]

and IINC, ILIT, IATT, IHEA are the Atkinson indices calculated for each component.

The subsequent loss for inequality compared with the HDI is:

Loss of inequality = 1 - (IHDI/HDI)

TABLE1.6: NORMALISED INCOME, EDUCATION AND HEALTH INDEX ADJUSTED BY INEQUALITY AND IHDI-1

PROVINCE	INCOME DIMENSION (adjusted inequality)				EDUCATION DIMENSION (adjusted inequality)				HEALTH DIMENSION (adjusted inequality)				IHDI (adjusted inequality across village				% Loss from adjusted inequality across village			
	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010
1-Banteay Meanchey	0.332	0.346	0.357	0.377	0.496	0.522	0.527	0.510	0.474	0.540	0.563	0.579	0.434	0.470	0.482	0.489	25.1	22.8	22.6	23.5
2-Battambang	0.311	0.318	0.333	0.351	0.517	0.516	0.535	0.540	0.488	0.540	0.449	0.561	0.439	0.458	0.439	0.484	25.7	25.3	24.9	24.1
3-Kampong Cham	0.351	0.365	0.377	0.397	0.446	0.484	0.495	0.502	0.477	0.484	0.506	0.517	0.425	0.444	0.459	0.472	27.4	24.8	24.2	24.4
4-Kampong Chhnang	0.349	0.352	0.368	0.394	0.514	0.527	0.548	0.568	0.433	0.432	0.488	0.529	0.432	0.437	0.468	0.497	23.0	23.4	22.3	20.7
5-Kampong Speu	0.346	0.353	0.378	0.408	0.557	0.575	0.589	0.597	0.464	0.509	0.572	0.583	0.456	0.479	0.513	0.529	21.4	21.7	20.6	20.2
6-Kampong Thom	0.294	0.310	0.319	0.341	0.328	0.409	0.437	0.465	0.422	0.503	0.549	0.544	0.348	0.407	0.435	0.450	35.0	28.3	26.5	25.4
7-Kampot	0.383	0.391	0.395	0.426	0.499	0.526	0.541	0.545	0.461	0.510	0.523	0.563	0.448	0.476	0.486	0.511	22.7	21.1	21.6	20.7
8-Kandal	0.417	0.428	0.437	0.471	0.566	0.501	0.592	0.601	0.537	0.563	0.581	0.600	0.506	0.497	0.536	0.558	22.5	25.0	21.1	20.4
9-Koh Kong	0.295	0.303	0.314	0.353	0.391	0.359	0.393	0.415	0.386	0.365	0.524	0.501	0.357	0.342	0.410	0.423	31.5	33.7	30.4	28.4
10-Kratie	0.276	0.289	0.298	0.299	0.297	0.340	0.342	0.478	0.403	0.463	0.552	0.506	0.325	0.364	0.397	0.428	38.5	33.9	33.2	27.2
11-Mondulkiri	0.246	0.265	0.273	0.304	0.266	0.311	0.204	0.306	0.309	0.266	0.344	0.384	0.274	0.281	0.273	0.331	36.2	33.1	41.7	33.0
12-Phnom Penh	0.560	0.580	0.584	0.665	0.612	0.620	0.627	0.628	0.569	0.561	0.602	0.620	0.580	0.587	0.604	0.638	20.9	20.3	19.7	16.7
13-Preah Vihear	0.285	0.280	0.276	0.309	0.380	0.386	0.377	0.403	0.144	0.263	0.288	0.268	0.270	0.309	0.314	0.327	28.9	28.6	30.8	27.6
14-Prey Veng	0.391	0.400	0.412	0.441	0.562	0.564	0.564	0.579	0.424	0.436	0.514	0.524	0.459	0.467	0.497	0.515	20.4	19.9	19.8	18.7
15-Pursat	0.311	0.317	0.331	0.359	0.442	0.486	0.486	0.466	0.416	0.491	0.509	0.540	0.389	0.432	0.442	0.455	27.5	25.4	24.9	25.2
16-Rattanakiri	0.278	0.272	0.268	0.298	0.181	0.086	0.124	0.120	0.107	0.271	0.285	0.276	0.189	0.210	0.225	0.231	37.9	43.0	42.1	41.5
17-Siem Reap	0.292	0.299	0.321	0.336	0.430	0.439	0.445	0.501	0.474	0.504	0.566	0.582	0.399	0.414	0.444	0.473	28.9	27.9	27.4	24.3
18-Preah Sihanouk	0.272	0.265	0.319	0.344	0.558	0.569	0.595	0.613	0.450	0.319	0.559	0.477	0.427	0.384	0.491	0.478	28.3	32.2	25.5	27.0
19-Stung Treng	0.258	0.264	0.259	0.275	0.267	0.311	0.319	0.340	0.282	0.319	0.430	0.095	0.269	0.298	0.336	0.237	38.5	35.0	33.8	36.8
20-Svay Rieng	0.408	0.418	0.431	0.459	0.580	0.569	0.578	0.589	0.394	0.472	0.463	0.469	0.461	0.486	0.491	0.506	19.5	19.7	19.6	19.6
21-Takeo	0.395	0.402	0.411	0.441	0.556	0.551	0.564	0.551	0.484	0.486	0.529	0.526	0.478	0.480	0.501	0.506	20.2	20.4	20.0	20.3
22-Oddar Meanchey	0.310	0.308	0.309	0.358	0.397	0.396	0.428	0.454	0.372	0.441	0.505	0.540	0.360	0.382	0.414	0.451	25.1	27.0	25.8	22.2
23-Kep	0.374	0.395	0.410	0.466	0.533	0.526	0.509	0.545	0.547	0.540	0.581	0.307	0.484	0.487	0.500	0.440	19.5	19.8	19.8	18.6
24-Pailin	0.276	0.274	0.281	0.300	0.450	0.400	0.490	0.511	0.376	0.285	0.385	0.466	0.367	0.320	0.386	0.426	30.8	34.0	29.1	30.0
0-CAMBODIA	**0.279**	**0.286**	**0.302**	**0.321**	**0.466**	**0.465**	**0.484**	**0.498**	**0.450**	**0.486**	**0.519**	**0.528**	**0.398**	**0.412**	**0.435**	**0.449**	**31.9**	**31.5**	**30.3**	**29.7**

Source: CDB 2007-2010/MoP and NCDD/M&E Unit/Boret 2010

IHDId (Inequality adjusted through villages and dimensions – Table 1.7)

The IHDI does not ensure association sensitivity as it doesn't take into account inequality across dimensions.

IHDId discounts the mean of each variable by its Atkinson level of inequality (I) across villages and then discounts its Atkinson level of inequality (I) across dimensions, using the generalised mean formula:

IHDId = 1/3 { [INCOME*(1-IINC)] + [EDUCATION*(1-IEDU)] + [HEALTH*(1-IHEA)]} *(1-IINC,EDU,HEA)

Where IINC, EDU, HEA is the Atkinson index across normalised income, normalised education and normalised health components.

Then it is possible to calculate also the loss of multidimensional inequality on the HDI:

Loss of inequality = 1 - (IHDId/HDI)

TABLE1.7: NORMALISED INCOME, EDUCATION, HEALTH INDEX ADJUSTED BY INEQUALITY AND IHDID

PROVINCE	INCOME DIMENSION (adjusted inequality)				EDUCATION DIMENSION (adjusted inequality)				HEALTH DIMENSION (adjusted inequality)				IHDId (adjusted inequality across village and dimension)				% loss from adjusted inequality across villages and dimensions			
	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010
1-Banteay Meanchey	0.332	0.346	0.357	0.377	0.496	0.522	0.527	0.510	0.474	0.540	0.563	0.579	0.421	0.451	0.463	0.473	27.4	25.9	25.7	25.9
2-Battambang	0.311	0.318	0.333	0.351	0.517	0.516	0.535	0.540	0.488	0.540	0.449	0.561	0.417	0.433	0.423	0.463	29.4	29.5	27.7	27.5
3-Kampong Cham	0.351	0.365	0.377	0.397	0.446	0.484	0.495	0.502	0.477	0.484	0.506	0.517	0.417	0.436	0.451	0.465	28.6	26.1	25.6	25.5
4-Kampong Chhnang	0.349	0.352	0.368	0.394	0.514	0.527	0.548	0.568	0.433	0.432	0.488	0.529	0.421	0.425	0.455	0.485	24.9	25.4	24.4	22.6
5-Kampong Speu	0.346	0.353	0.378	0.408	0.557	0.575	0.589	0.597	0.464	0.509	0.572	0.583	0.438	0.459	0.492	0.513	24.3	25.0	23.8	22.5
6-Kampong Thom	0.294	0.310	0.319	0.341	0.328	0.409	0.437	0.465	0.422	0.503	0.549	0.544	0.340	0.392	0.414	0.434	36.5	31.0	30.1	28.1
7-Kampot	0.383	0.391	0.395	0.426	0.499	0.526	0.541	0.545	0.461	0.510	0.523	0.563	0.442	0.467	0.477	0.503	23.6	22.5	23.1	21.9
8-Kandal	0.417	0.428	0.437	0.471	0.566	0.501	0.592	0.601	0.537	0.563	0.581	0.600	0.497	0.491	0.526	0.550	23.9	26.0	22.6	21.4
9-Koh Kong	0.295	0.303	0.314	0.353	0.391	0.359	0.393	0.415	0.386	0.365	0.524	0.501	0.351	0.340	0.393	0.414	32.7	34.2	33.3	29.8
10-Kratie	0.276	0.289	0.298	0.299	0.297	0.340	0.342	0.478	0.403	0.463	0.552	0.506	0.316	0.350	0.371	0.405	40.1	36.4	37.6	31.1
11-Mondulkiri	0.246	0.265	0.273	0.304	0.266	0.311	0.204	0.306	0.309	0.266	0.344	0.384	0.271	0.279	0.261	0.328	36.8	33.5	44.3	33.8
12-Phnom Penh	0.560	0.580	0.584	0.665	0.612	0.620	0.627	0.628	0.569	0.561	0.602	0.620	0.579	0.586	0.604	0.637	21.0	20.4	19.8	16.8
13-Preah Vihear	0.285	0.280	0.276	0.309	0.380	0.386	0.377	0.403	0.144	0.263	0.288	0.268	0.229	0.301	0.308	0.318	39.6	30.6	32.1	29.6
14-Prey Veng	0.391	0.400	0.412	0.441	0.562	0.564	0.564	0.579	0.424	0.436	0.514	0.524	0.448	0.457	0.488	0.508	22.3	21.6	21.2	19.7
15-Pursat	0.311	0.317	0.331	0.359	0.442	0.486	0.486	0.466	0.416	0.491	0.509	0.540	0.380	0.414	0.426	0.442	29.2	28.5	27.7	27.3
16-Rattanakiri	0.278	0.272	0.268	0.298	0.181	0.086	0.124	0.120	0.107	0.271	0.285	0.276	0.162	0.158	0.196	0.196	46.6	57.1	49.7	50.4
17-Siem Reap	0.292	0.299	0.321	0.336	0.430	0.439	0.445	0.501	0.474	0.504	0.566	0.582	0.382	0.395	0.421	0.448	31.9	31.3	31.2	28.2
18-Preah Sihanouk	0.272	0.265	0.319	0.344	0.558	0.569	0.595	0.613	0.450	0.319	0.559	0.477	0.390	0.346	0.454	0.452	34.5	38.9	31.1	30.9
19-Stung Treng	0.258	0.264	0.259	0.275	0.267	0.311	0.319	0.340	0.282	0.319	0.430	0.095	0.269	0.296	0.322	0.175	38.6	35.4	36.6	53.2
20-Svay Rieng	0.408	0.418	0.431	0.459	0.580	0.569	0.578	0.589	0.394	0.472	0.463	0.469	0.447	0.478	0.483	0.499	21.9	21.0	20.9	20.7
21-Takeo	0.395	0.402	0.411	0.441	0.556	0.551	0.564	0.551	0.484	0.486	0.529	0.526	0.469	0.472	0.492	0.502	21.8	21.7	21.5	21.0
22-Oddar Meanchey	0.310	0.308	0.309	0.358	0.397	0.396	0.428	0.454	0.372	0.441	0.505	0.540	0.356	0.373	0.397	0.438	25.9	28.6	28.8	24.4
23-Kep	0.374	0.395	0.410	0.466	0.533	0.526	0.509	0.545	0.547	0.540	0.581	0.307	0.470	0.477	0.490	0.415	21.9	21.4	21.4	23.2
24-Pailin	0.276	0.274	0.281	0.300	0.450	0.400	0.490	0.511	0.376	0.285	0.385	0.466	0.353	0.311	0.366	0.404	33.6	35.9	32.6	33.7
0-CAMBODIA	**0.279**	**0.286**	**0.302**	**0.321**	**0.466**	**0.465**	**0.484**	**0.498**	**0.450**	**0.486**	**0.519**	**0.528**	**0.377**	**0.389**	**0.411**	**0.428**	**35.5**	**35.3**	**34.2**	**33.0**

Source: CDB 2007-2010/MoP and NCDD/M&E Unit/Boret 2010

HERE IS AN EXAMPLE WITH SAMPLE NUMBERS TO SHOW THE DIFFERENCE AMONG HDI, IHDI AND IHDID:

Province	Village	Health	Education	Income	Atkinson Index across dimensions	HDI	IHDI Across village	IHDId Across village and dimension
1	1	0.6	0.6	0.6	0.0			
1	2	0.6	0.6	0.6	0.0			
1	3	0.6	0.6	0.6	0.0			
1	Mean	0.6	0.6	0.6	0.0	0.6	0.6	0.6
1	Atkinson Index across villages (1,2,3)	0.0	0.0	0.0				
2	4	0.4	0.6	0.8	0.08			
2	5	0.4	0.6	0.8	0.08			
2	6	0.4	0.6	0.8	0.08			
2	Mean	0.4	0.6	0.8	0.08	0.6	0.6	0.55
2	Atkinson Index across villages (4,5,6)							
3	7	0.4	0.4	0.4	0.0			
3	8	0.6	0.6	0.6	0.0			
3	9	0.8	0.8	0.8	0.0			
3	Mean	0.6	0.6	0.6	0.0	0.6	0.55	0.55
3	Atkinson Index across villages (7,8,9)							

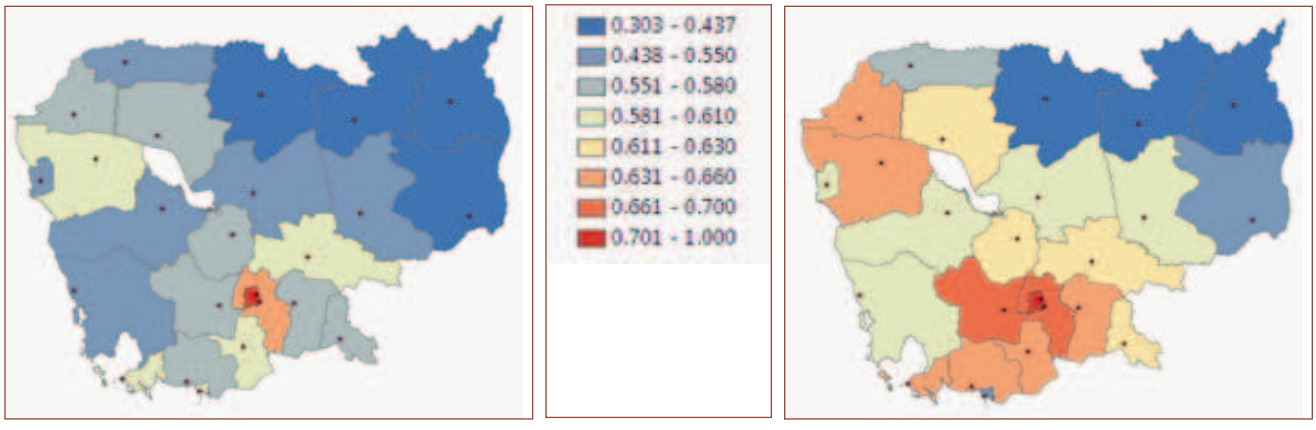
Looking at HDI, all provinces have exactly the same level. This is unreasonable since, looking at the data disaggregated by village and human development dimensions, provinces 2 and 3 face a problem of inequality.

Using the inequality adjusted IHDI, province 3 performs lower than province 1. This could be reasonable but it also performs lower than province 2, and this is not reasonable as both provinces 2 and 3 have exactly the same level of development.

Using IHDId that also takes into account inequality through dimensions, provinces 2 and 3 have exactly the same IHDId level and both perform lower than region 1, showing how this index gives the most reasonable representation of reality.

4. Maps and Graphs

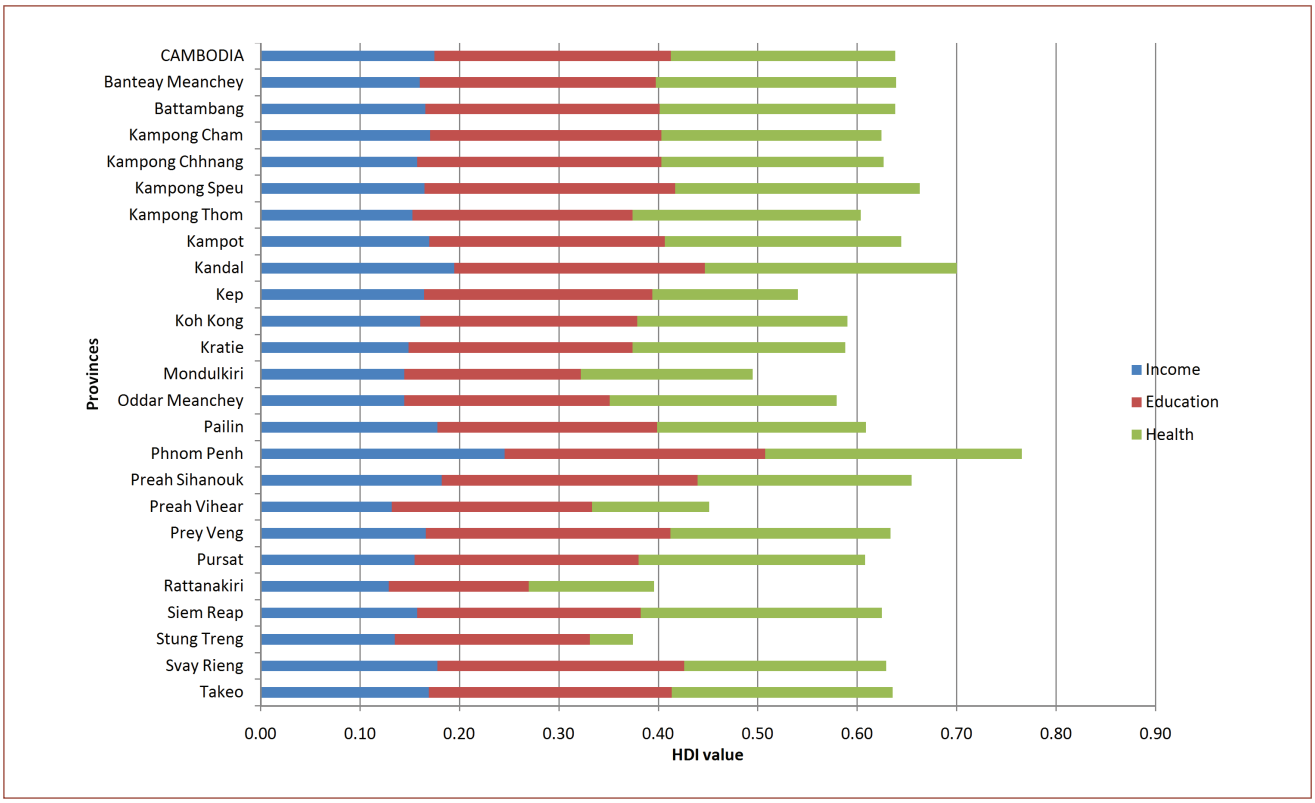
4.1 HDI per province



HDI Map 2007

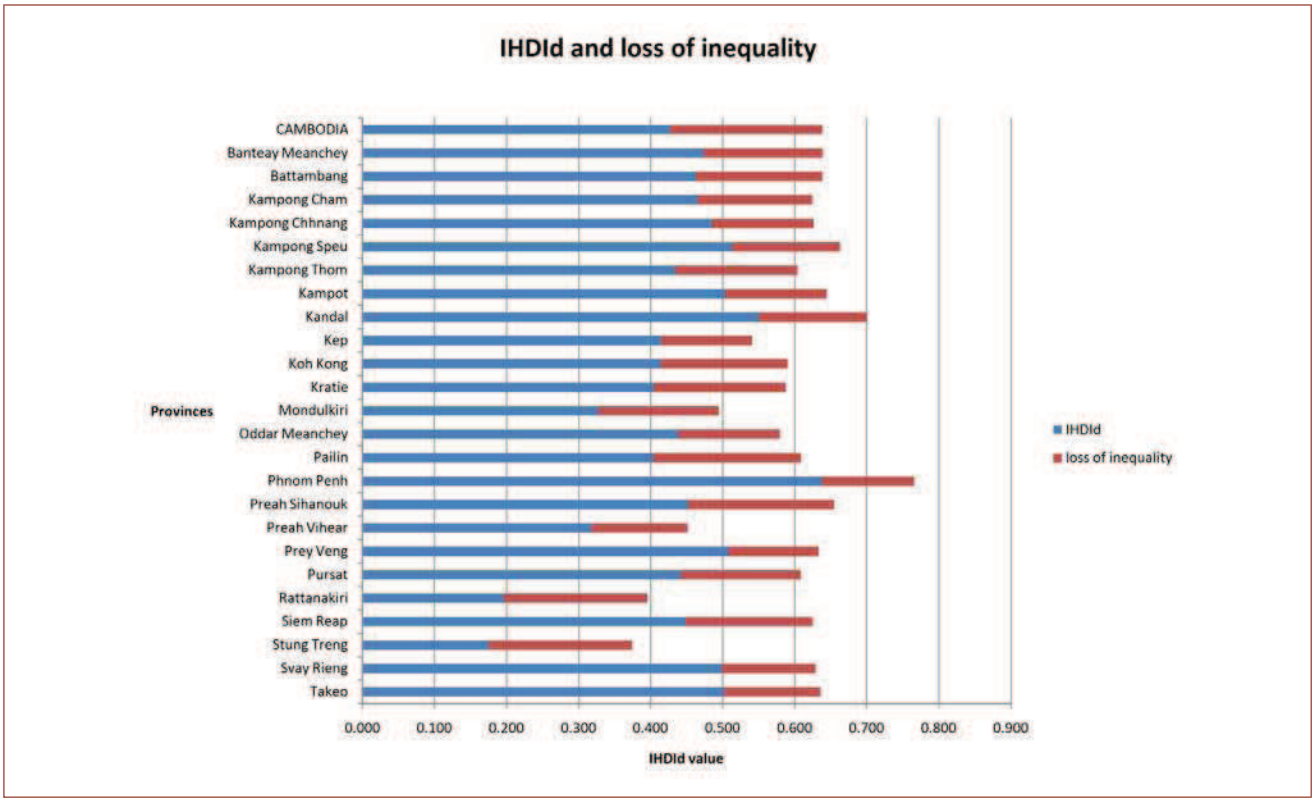
HDI Map 2010

4.2 2010 HDI and its components at national and provincial levels



Source: Computed by the HDI analysis team (NCDD) 2010

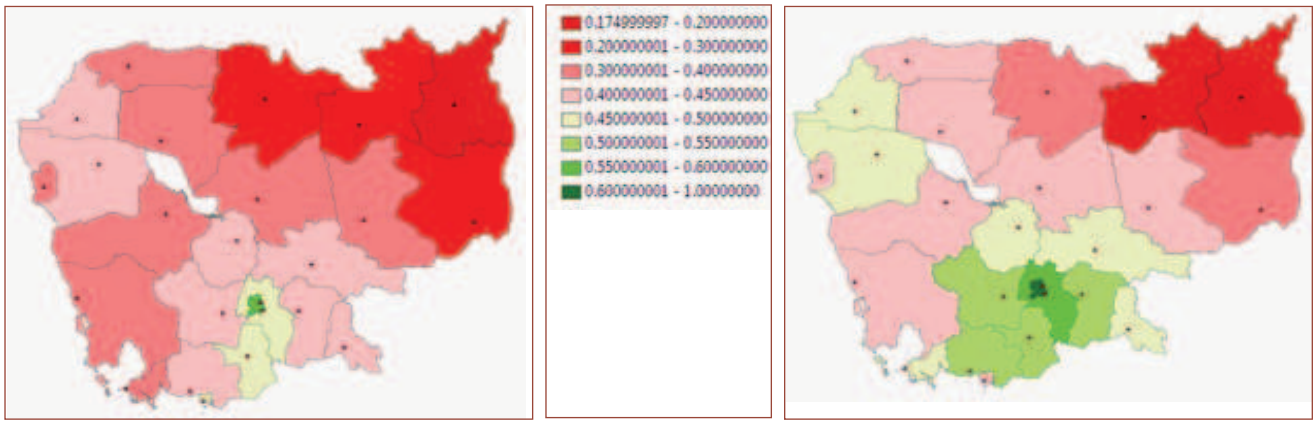
4.2 2010 HDI and its components at national and provincial levels



Source: Computed by the HDI analysis team (NCDD) 2010

4.4 Inequality adjusted IHDId at provincial level

Maps 1 and 2 show that there is regional (provincial) disparity in inequality adjusted IHDId across provinces. In terms of progress in IHDId from 2007-2010, many provinces experienced increasing IHDId, but there are also two provinces (Kep and Stung Treng) where IHDId decreased during the same period.



Map1: 2007

Map 2: 2010

Notes

Model to derive income/consumption: Small Area Estimation of per capita Income/ consumption

In Cambodia, annually updating small area estimations of per capita income/consumption expenditure at the sub-national level is possible by combining the Cambodia socio-economic survey (CSES) aggregated at village level and the commune and village census database (CDB).

The statistical technique of small area estimation (Ghosh and Rao 1994, Rao 1999, Rao 2003) provides a way of improving survey estimates at small levels of aggregation, by combining the survey data with information derived from other sources, typically a population census. A variant of this methodology has been developed by a research team at the World Bank specifically for the small area estimation of poverty measures (Elbers, Lanjouw and Lanjouw [ELL] 2001, 2003). The ELL method has been implemented in a number of countries including Thailand (Healy 2003), Cambodia (Fujii 2004), South Africa (Alderman et al 2002), Brazil (Elbers et al 2001), Bangladesh (Jones and Haslett 2003) and the Philippines (Haslett and Jones 2005a).[43]

The methodology to derive the per capita consumption at sub-national level on an annual basis use the village level modelling of CDB combined with the CSES to derive per capita consumption expenditure in every village.

The village level modelling, using CDB and ID Poor data at village level is also used to estimate a relative poverty line through robust multilevel-mixed effect regression. This exercise, conducted yearly by Boret et al (2009), has been published by the Ministry of Planning.

This method is elaborated in the World Bank's "User Manual for PovMap":[44]

> For simplicity, we assume the per capita consumption expenditure of a village is the basic left hand side variable

(1) $$\ln y_{ch} = E[\ln y_{ch} | \mathbf{x}_{ch}] + u_{ch}$$

Where (1) is estimated through OLS and

c is the subscript for the cluster (commune) c

h is the subscript for the village within cluster c.

y_{ch} is the per capita consumption expenditure of village h in cluster (commune) c.

$\mathbf{x}_{ch}$ is the village characteristics for village h in cluster (commune) c.

A linear approximation of model (1) is then written as:

(2) $$\ln y_{ch} = \mathbf{x}_{ch}'\boldsymbol{\beta} + u_{ch}$$ (Also referred to as **Beta** model)

Since survey data is just a sub-sample of the whole population, the location information is not available for all regions (commune) in the census data. We cannot include the location variable in the survey model. Thus, the residual of (2) must contain the location variance.

(3) $$u_{ch} = \eta_c + \varepsilon_{ch}$$

Here η_c is the cluster component and ε_{ch} is the village component. As mentioned above the estimate of η_c for each cluster in the census dataset is not applicable, therefore we must estimate the deviation of η_c . Taking the arithmetic expectation of (3) over cluster c

(4) $$u_{c.} = \eta_c + \varepsilon_{c.}$$

Hence:

$$E[u_{c.}^2] = \sigma_\eta^2 + \mathrm{var}(\varepsilon_{c.}) = \sigma_\eta^2 + \tau_c^2.$$

Assuming η_c and ε_{ch} are normally distributed and independent each other, Elbers et al gave a estimate of variance of the distribution of the locational effect η_c :

(5) $$\mathrm{var}\left(\widehat{\sigma_\eta^2}\right) \approx \sum_c [a_c^2 \mathrm{var}\left(u_{c.}^2\right) + b_c^2 \mathrm{var}(\widehat{\tau_c^2})] \approx \sum_c 2[a_c^2\{(\widehat{\sigma_\eta^2})^2 + (\widehat{\tau_c^2})^2 + 2\widehat{\sigma_\eta^2}\widehat{\tau_c^2}\} +$$

When the location effect η_c does not exist, equation (3) is reduced to $u_{ch} = \varepsilon_{ch}$.

According to Elbers et al, the remaining residual ε_{ch} can be fitted with a logistic model and will regress a transformed ε_{ch} on household characteristics:

(6) $$\ln\left[\frac{e_{ch}^2}{A - e_{ch}^2}\right] = \mathbf{z}_{ch}^T\widehat{\boldsymbol{\alpha}} + r_{ch}.$$ (also referred to as Alpha model)

where A set to equal 1.05*max{ }. The variance estimator for can be solved as:

(7) $$\widehat{\sigma}_{\varepsilon,ch}^2 = \left[\frac{AB}{1+B}\right] + \frac{1}{2}\widehat{\mathrm{Var}}(r)\left[\frac{AB(1-B)}{(1+B)^3}\right].$$

The result from the above indicates a violation of assumptions for using the OLS in model (2), so a GLS regression is needed. In GLS the variance-covariance matrix is a diagonal block matrix with structure:

(8)
$$\begin{bmatrix} \sigma_{\eta c}+\sigma_{\varepsilon} & \sigma_{\varepsilon} & \sigma_{\varepsilon} & \sigma_{\varepsilon} \\ \sigma_{\varepsilon} & \sigma_{\eta c}+\sigma_{\varepsilon} & \sigma_{\varepsilon} & \sigma_{\varepsilon} \\ \sigma_{\varepsilon} & \sigma_{\varepsilon} & \sigma_{\eta c}+\sigma_{\varepsilon} & \sigma_{\varepsilon} \\ \sigma_{\varepsilon} & \sigma_{\varepsilon} & \sigma_{\varepsilon} & \sigma_{\eta c}+\sigma_{\varepsilon} \end{bmatrix}$$

From (1) to (8) assuming consistent estimation can be estimated by ordinary least square regression or maximum likelihood or restricted maximum likelihood estimation.

Empirical Result [45]

Table 1: Determinant of daily per capita consumption expenditure (in log scale)

Independent variables	Coeff	Std Error	P > t	[95% Conf interval]	
Intercept	8.62	0.11	0.00	8.40	8.84
No. latrine per family	-0.51	0.05	0.00	-0.41	-0.61
TV per family	0.41	0.05	0.00	0.31	0.51
Mountain/plateau region:1=Yes, 0=Otherwise	-0.07	0.01	0.00	-0.05	-0.09
Tonle Sap region	-	-	-	-	-
Plain region: 1=Yes, 0=Otherwise	0.07	0.01	0.00	0.05	0.09
Coastal region: 1=Yes, 0=Otherwise	0.13	0.01	0.00	0.11	0.15
Phnom Penh: 1=Yes, 0=Otherwise	0.26	0.01	0.00	0.24	0.28
Urban area (other than Phnom Penh): 1=Yes, 0=Otherwise	0.14	0.02	0.00	0.10	0.18
Motorbike per family	0.47	0.07	0.00	0.33	0.61
Household size	-0.10	0.01	0.00	-0.08	-0.12
Concrete house per family	0.27	0.08	0.00	0.11	0.43
Ratio of literate women18-64	0.20	0.06	0.00	0.08	0.32
Ratio of men18-64 to all	0.78	0.26	0.01	0.27	1.29
Thatch house per family	-0.49	0.04	0.00	-0.41	-0.57
Bicycle per family	0.04	0.01	0.01	0.02	0.06
Ratio of houses with electricity	0.20	0.05	0.00	0.10	0.30
Ratio of family use traditional birth attendant-assisted births to all births	-0.65	0.10	0.00	-0.45	-0.85
Ratio of children aged 6-14 not attending school to age group	-0.21	0.06	0.00	-0.09	-0.33
Ratio of families with access to improved public water supply within 150m of home	0.10	0.03	0.00	0.04	0.16
N (number of villages observed)	900				
Adjust R-Square	0.7				

Source: Boret 2009 at Second National Research Forum hosted by CDRI, SNEC, RUPP and Statistics Canada, 9-10 September 2009, Phnom Penh.

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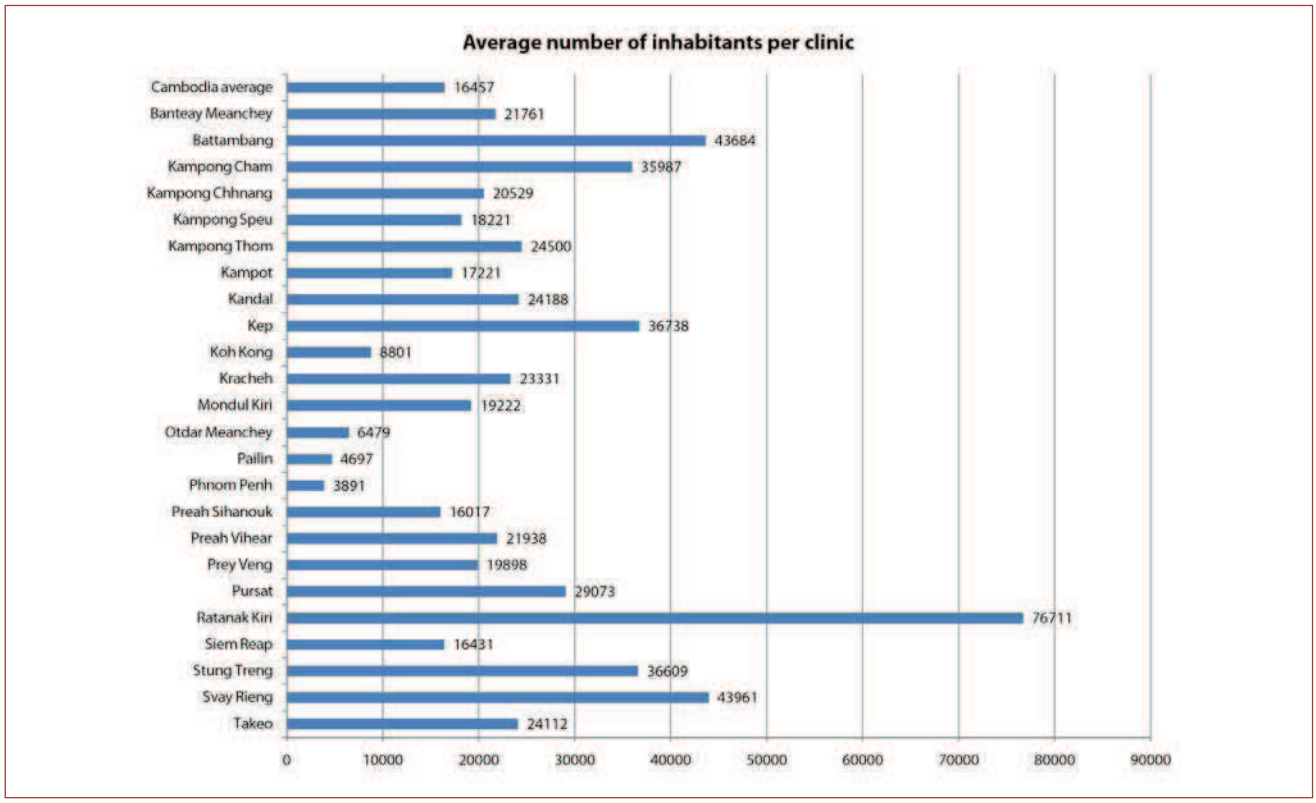
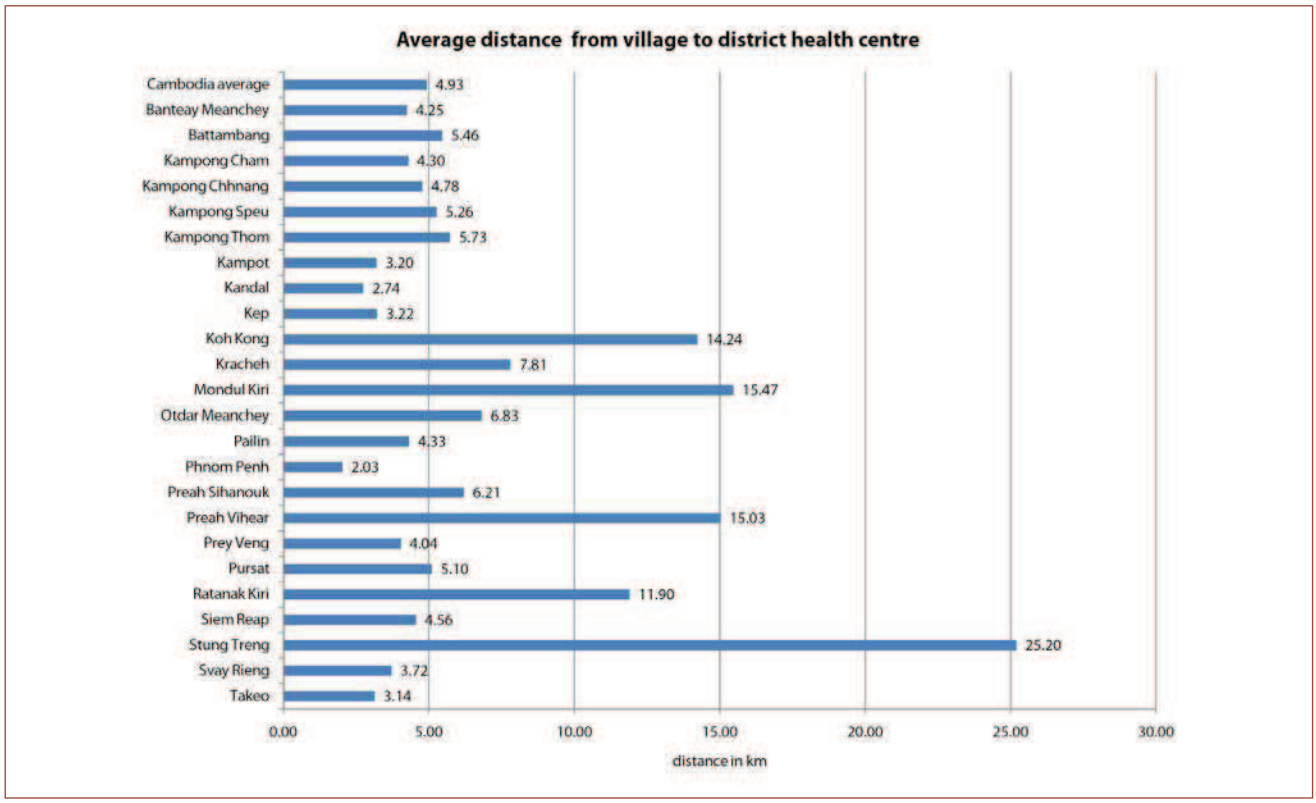
Health

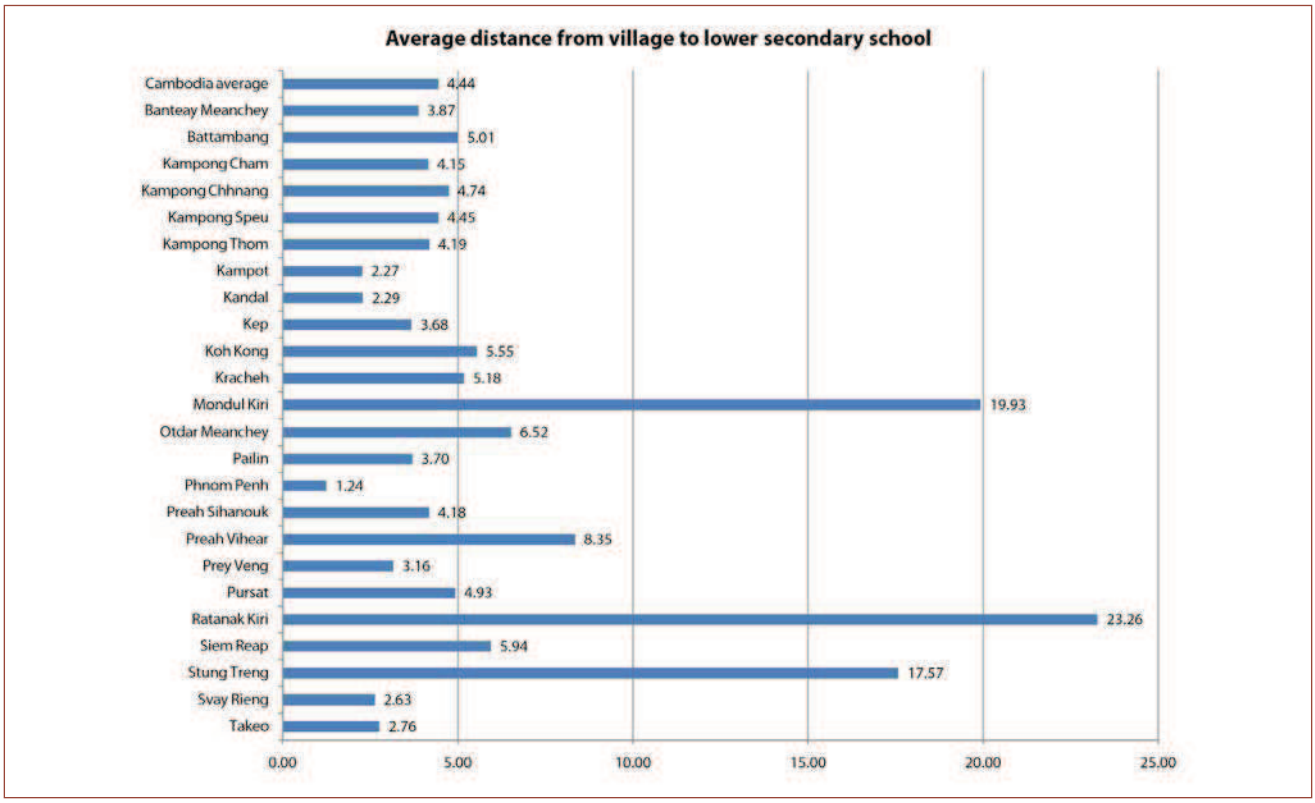


Source: CDB 2010

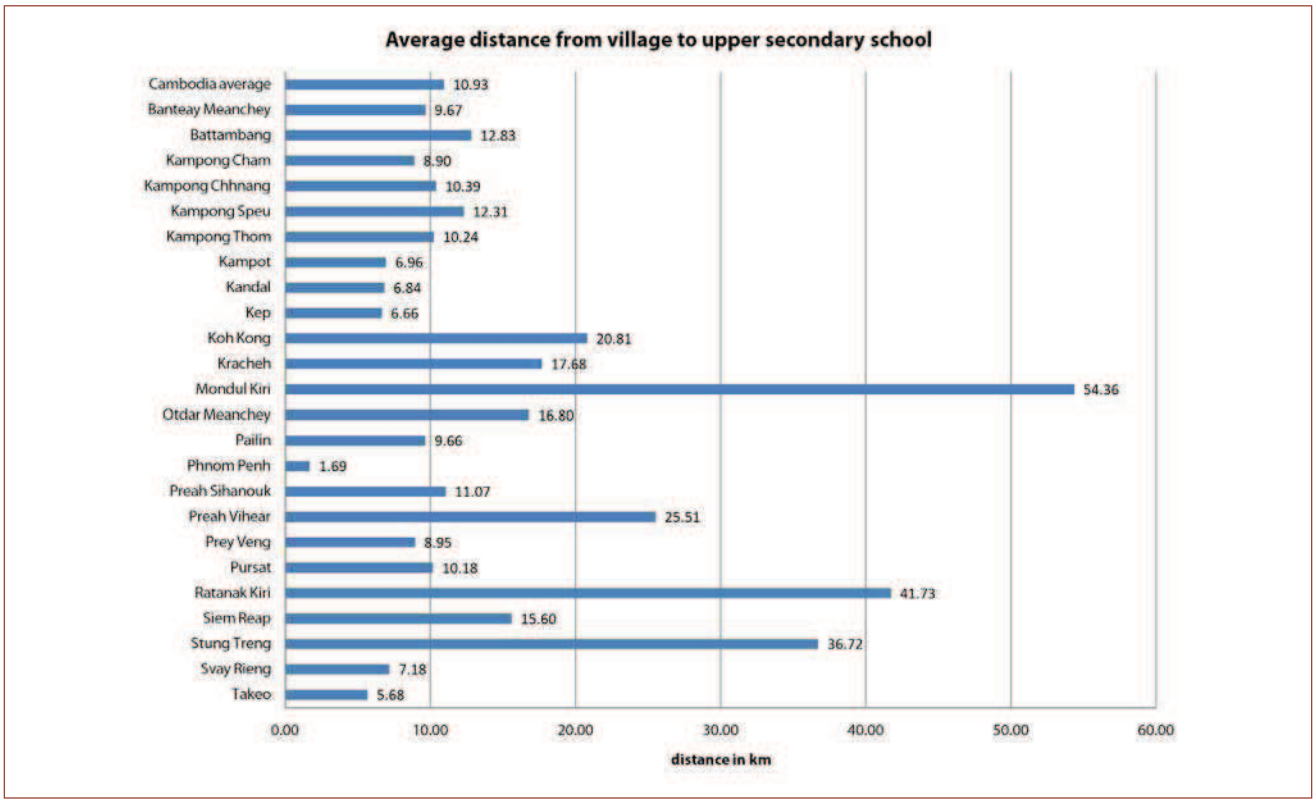


Source: CDB 2010

Education

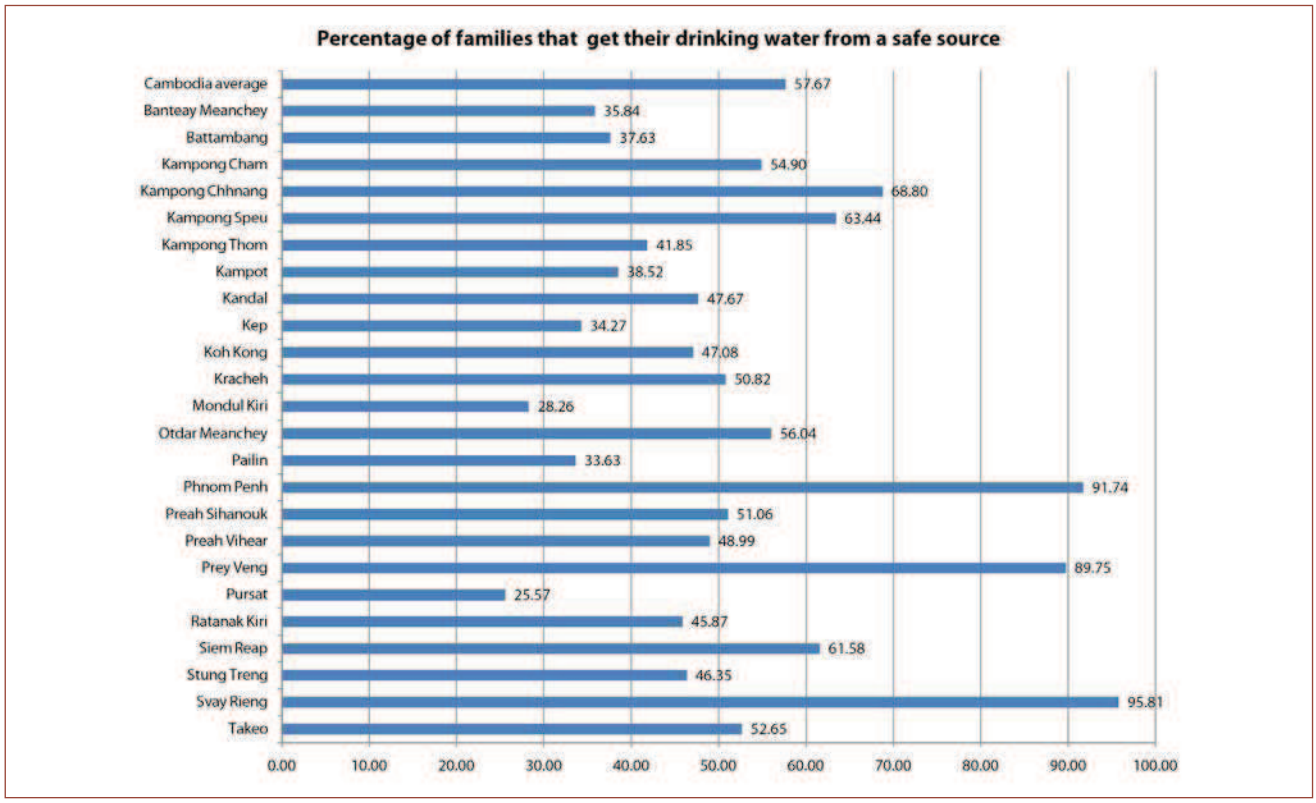


Source: CDB 2010

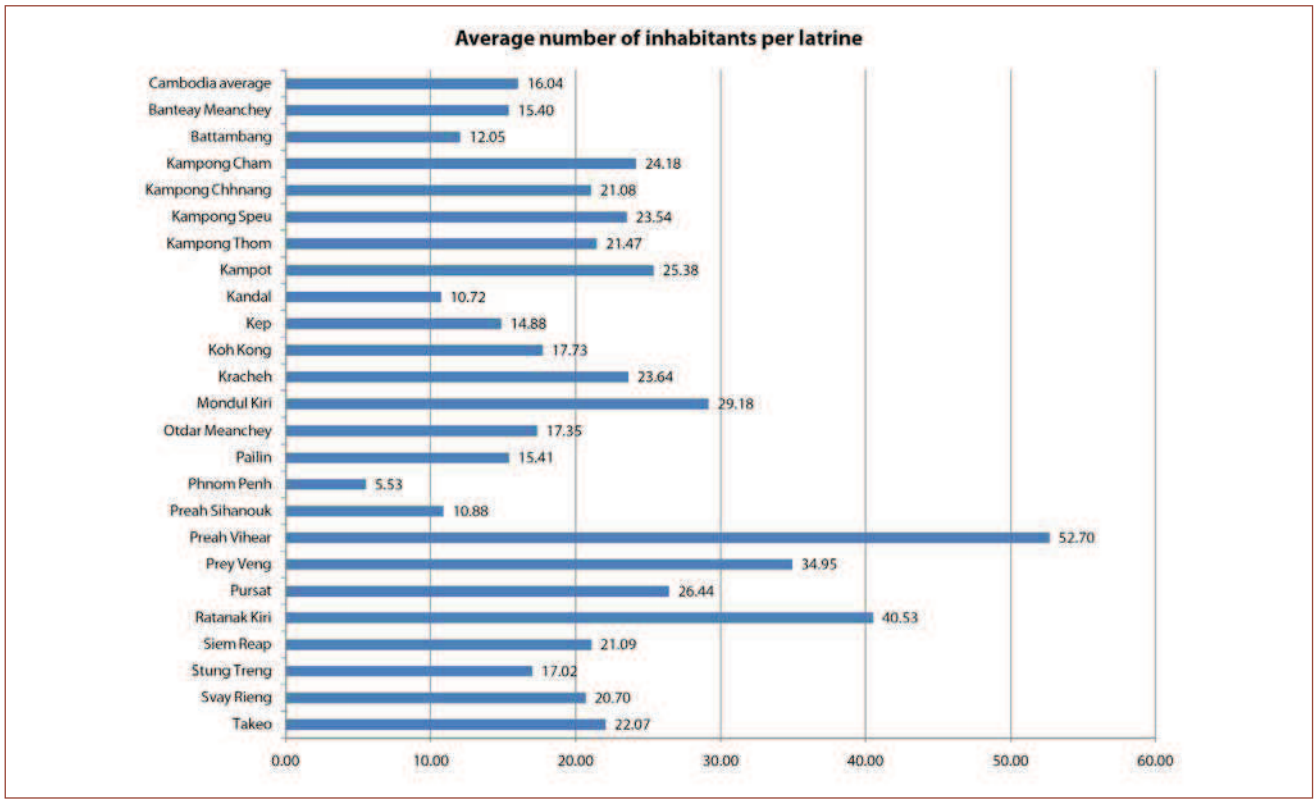


Source: CDB 2010

Water and sanitation



Source: CDB 2010



Source: CDB 2010

Commune Database Indicators

			Health			Education						Water and sanitation	
	Population	No. of families	No. of clinics	Inhabitants per clinic	Average distance from village to health centre (km)	No. of primary schools	Distance to primary school (km)	No. of lower secondary schools	Distance to lower secondary school (km)	No. of upper secondary schools	Distance to upper secondary school (km)	% of families that get drinking water from safe source	No. of inhabitants per latrine
Banteay Meanchey	696,355	145,639	32	24,112	4.25	503	0.60	65	3.87	24	9.67	35.84	15.40
Battambang	1,048,408	212,294	24	43,961	5.46	679	0.86	108	5.01	21	12.83	37.63	12.05
Kampong Cham	1,871,330	388,661	52	36,609	4.30	898	1.25	158	4.15	70	8.90	54.90	24.18
Kampong Chhnang	492,693	104,022	24	16,431	4.78	309	1.20	73	4.74	11	10.39	68.80	21.08
Kampong Speu	765,302	151,391	42	76,711	5.26	385	1.41	82	4.45	16	12.31	63.44	23.54
Kampong Thom	685,993	141,592	28	29,073	5.73	493	1.15	97	4.19	28	10.24	41.85	21.47
Kampot	637,179	129,846	37	19,898	3.20	342	0.72	86	2.27	15	6.96	38.52	25.38
Kandal	1,281,952	254,839	53	21,938	2.74	451	1.04	134	2.29	38	6.84	47.67	10.72
Kep	36,738	7,404	1	16,017	3.22	21	1.06	6	3.68	1	6.66	34.27	14.88
Koh Kong	123,219	24,310	14	3,891	14.24	84	5.38	20	5.55	5	20.81	47.08	17.73
Kracheh	326,630	65,586	14	4,697	7.81	268	0.82	47	5.18	12	17.68	50.82	23.64
Mondul Kiri	57,666	12,567	3	6,479	15.47	63	1.19	10	19.93	1	54.36	28.26	29.18
Otdar Meanchey	194,382	42,175	30	19,222	6.83	192	0.74	26	6.52	5	16.80	56.04	17.35
Pailin	61,058	13,528	13	23,331	4.33	51	1.15	7	3.70	2	9.66	33.63	15.41
Phnom Penh	1,085,539	206,154	279	8,801	2.03	116	0.82	37	1.24	25	1.69	91.74	5.53
Preah Sihanouk	192,207	39,337	12	36,738	6.21	78	1.26	26	4.18	7	11.07	51.06	10.88
Preah Vihear	175,500	37,456	8	24,188	15.03	191	0.50	41	8.35	9	25.51	48.99	52.70
Prey Veng	1,134,184	246,773	57	17,221	4.04	585	0.96	117	3.16	32	8.95	89.75	34.95
Pursat	436,094	87,422	15	24,500	5.10	313	0.94	59	4.93	14	10.18	25.57	26.44
Ratanak Kiri	153,422	32,547	2	18,221	11.90	173	5.05	11	23.26	3	41.73	45.87	40.53
Siem Reap	920,123	171,100	56	20,529	4.56	582	0.96	82	5.94	15	15.60	61.58	21.09
Stung Treng	109,826	21,928	3	35,987	25.20	149	9.83	24	17.57	6	36.72	46.35	17.02
Svay Rieng	571,491	125,115	13	43,684	3.72	297	0.96	71	2.63	17	7.18	95.81	20.70
Takeo	964,471	191,133	40	21,761	3.14	406	1.26	86	2.76	44	5.68	52.65	22.07
Cambodia	14,021,762	2,852,819	852	16,457	4.93	7629	1.23	1473	4.44	421	10.93	57.67	16.04

ENDNOTES

1 Yusuf and Francisco (2009) used three sets of indicators for adaptive capacity to analyse the vulnerability context of different countries in Southeast Asia – including socioeconomic, infrastructure and population. Other analyses apply related indicators for adaptive capacity. These include considering policy-based institutional arrangements such as agricultural and land tenure policies, public-private investment in technologies such as building infrastructure, irrigation systems or livelihood-based approaches that emphasise indicators related to livelihood security and diversification (Ayers and Huq 2009), health, education, and poverty rates, as well as access to common property (Kelly and Adger 2007, Brown, Slaymaker and Mann 2007, David et al 2009), and rates of poverty alleviation and achievement of CMDG goals (UN 2009, Brooks, Grist and Brown 2009).

2 According to COP15 and 16, the international community committed to pledge US$30 billion for the period 2010-2012 and to jointly mobilise US$100 billion per year by 2020 to address the needs of developing countries.

3 Total ODA disbursements in 2009 were US$989.5 million, an annual increase of 3.5 percent and equivalent to 9 percent of GDP. The amount of ODA has been rising since 2005 (UNDP 2010).

4 In the original report, based on projections of the IPCC 2001 report, the Stern Review put this figure at 1 percent. However, after the issuance of the IPCC 2007 report, this figure was revised to 2 percent.

5 IPCC 4AR WG-II SPM, p. 17: "While developing countries are expected to experience larger percentage losses, global mean losses could be 1-5 percent GDP for 4°C of warming".

6 IPCC 4AR SR p. 21: "In 2050, global average macroeconomic costs for mitigation toward stabilization between 710 and 445 ppm CO_2eq are between a 1 percent gain and 5.5 percent decrease of global GDP".

7 See "Report of the Conference of the Parties on its Sixteenth Session", held in Cancun from 29 November to 10 December 2010 (UNFCCC/CP/2010/7/Add.1).

8 These are by NBP, CRDT/WWG, SNV, GERES, at different stages.

9 Namely, carbon dioxide from fossil fuel use and other sources, as well as from deforestation, decay and peat; methane from agriculture, waste and energy; nitrogen dioxide from agriculture and others; and F-gases (fluorinated greenhouse gases).

10 In 2010 the MoE commissioned a nationwide survey to explore the state of knowledge, attitudes and perceptions (KAP) on climate change among Cambodian people. It was conducted in all 24 provinces, with a questionnaire survey of 2,401 randomly selected Cambodians (men and women aged 15-55, two-thirds from rural areas). This was supplemented by in-depth interviews with 101 key informants from the media, industry, national and provincial government, celebrities and local leaders, including commune council chiefs, village chiefs and elders, and religious leaders.

11 In the Khmer language, the term 'climate change' (in Khmer: preproul akas-theat) is very similar to the word 'weather' (theat-akas – literally, 'elements in the sky', with 'theat' meaning elements, and 'akas' meaning sky). This confusion in terminology makes it hard to differentiate whether people are talking about 'seasonal weather change' or long-term 'climate change' in the local language.

12 The term 'system' here can refer to an ecological system, an infrastructure system, a social system – or even a household.

13 Global and national Human Development Reports can use different data sources. The HDI for Cambodia presented in the global Human Development Report draws on data from international agencies in order to allow for comparison across different countries, but not at a sub-national level. For this reason, countries that aim to produce an analysis of HDI at sub-national levels need to draw on their own data sources, such as the CDB in Cambodia. This results in different national and global HDI scores.

14 Note: there are only seven key indicators for the above spider web (Seven goals).

15 The term planting index refers to increasing cropping cyles, or increasing cultivation seasons per year.

16 The term OAA refers to the crustaceans, amphibians and mollusks that are abundant in the floodplains and rice fields of the Mekong basin, and which are frequently harvested as important sources of food and income.

17 Source: www.twgaw.org, viewed in September 2009.

18 Draft SNC by MoE (p. 79).

19 These principles have been distilled from international literature, and refined through discussions with national stakeholders during the preparation of this report.

20 Disaster Risk Management (DRM) and DRR are sometimes used interchangeably in Cambodia. DRM focuses on systematic process of using administrative decisions, organization, operational skills and capacities to implement policies, strategies and coping capacities of the society and communities to lessen the impacts of natural hazards and related environmental and technological disasters. DRR is a systematic approach to identifying, assessing and reducing the risks of disaster. It aims to reduce socio-economic vulnerabilities to disaster as well as dealing with the environmental and other hazards that trigger them (commonly used in Cambodia).

21 To improve returns from rice production, such a shift toward export will also need to improve the volume of rice that is milled inside Cambodia. Official statistics for 2009 suggest that only 13,000 tonnes of milled rice and 20,000 tonnes of unmilled rice are exported through formal channels (RGC Rice Policy Paper 2010). These figures indicate both the high proportion of rice that is exported without being milled, while also suggesting the much larger volume of rice that is exported through informal channels.

22 Draft SNC, p. 54. This division is based on long-term mean rainfall data from 61 stations across the country, recorded before the civil war.

23 See Reyes and Domingo 2009.

24 Weather crop insurance scheme implemented by Infinity.

25 E.g. articles from Raksmei Kampuchea, "Farmers are trying to transplant only just when there is enough water" (Kep Province), 14 August 2010; "MAFF minister visits drought area where farmers are experiencing shortage of water for farming" (Takeo Province), 17 August 2010.

26 IDE note on FBA.

27 Source: International Energy Agency, Energy Statistics and Balances of Non-OECD Countries and Energy Statistics of OECD Countries. WB Data Finder.

28 It is recognized that these kinds of gasifiers do not come without their own costs. First, the gas produced (CO) is highly toxic and can be fatal when leaked in a closed environment. Second, the wastewater may contain phenol which is very harmful to human health.

29 A "Draft Policy Framework on Access to Information" was prepared by the Royal Government of Cambodia in 2007. The basic right of access to information is enshrined in the Constitution.

30 The CHDR team would like to thank Mr. Ny Boret, statistician at the M&E Unit of the National Committee for Sub-national Democratic Development (NCDD) Secretariat and H.E. Hou Tain Eng at the Ministry of Planning (MoP) for cooperation in generating the updated HDI analysis.

31 The analysis presented in this annex is based on the global HDI 2009 methodology.

32 The word Sangkat identifies the communes in Phnom Penh city.

33 Cambodia comprises 24 Provinces, 193 Districts, 1621 Communes and Sangkats. The Cambodian HDI calculation is aggregated at the provincial level.

34 v "Introduction to the Commune Database", prepared by the Working Group on D&D and Seth Koma, MoP.

35 Global and National Human Development Reports sometimes use different sources of data. The HDI presented in the global HDR draws on data from international agencies in order to allow for comparison across different countries, but not at the sub-national level. To produce an HDI analysis at the sub-national level, data must be drawn from different sources. This results in a variance between HDI scores at the national and global levels.

36 Data collection for the Cambodia Socio-Economic Survey (CSES) has taken place every year since 2007 (prior to 2007 there was no specific timeline for CSES updates). However, the size of the interviewed population is not always the same. Every five years a large survey is conducted (i.e. 12,000 household in 2004 and 2009) while in other years a small survey is conducted (i.e. 3,600 household in 2007, 2008 and 2010).

37 In Cambodia, life expectancy data is only available at the national and provincial levels through the Cambodia Demographic and Health Survey, which is conducted every five years.

38 Several sensitivity tests have been conducted. The results indicated that inflating and deflating the income component by 25 percent was the most reasonable means of reaching a smoother distribution.

39 In this case, to keep the data range from 0 to 1000, sensitivity tests indicated that the most reasonable adjustment was to discount the minimum value by 5 percent.

40 Foster, James E., L. López-Calva and M. Székely. 2003. "Measuring the Distribution of Human Development: Methodology and an Application to Mexico". UNDP Mexico: Mexico City. p. 3.

41 The Atkinson Index used here follows the same formula of Hicks sensitive HDIH = 1/3 [(INCOME*(1-G)) + (EDUCATION*(1-G)) + (HEALTH*(1-G)]. The HDIH discounts the mean of each variable by its Gini level of inequality (G), and then averages across the dimensional welfare levels using the standard mean.

42 The generalised mean is used in this case as the Atkinson index inequality adjustment using aversion parameter $\varepsilon = 2$ (generalised mean), as it has the most desired statistical properties compared to the geometric mean due to the closet correlation (close to 1) with the Gini index inequality adjustment based on some simulation studies.

43 WFP Bangladesh. 2004. "Local Estimation of Poverty and Malnutrition in Bangladesh". WFP Bangladesh: Dhaka. p. 2.

44 Qinghua Zhao. "User Manual for PovMap". World Bank: Washington, DC. p. 3.

45 The model was adjusted non-normality, heteroskedasticity, outlier and leverage observation for both y and x spaces and intra cluster correlation (commune as random effect) by using robust regression applying Bi-square weighted estimation methods. Variables inflation factors (VIF) of all independent variables are is less than 3.

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