HUMAN DEVELOPMENT REPORT CAMBODIA 2019

SUSTAINING NATURAL RESOURCES FOR ALL

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CAMBODIA 2019

SUSTAINING NATURAL RESOURCES FOR ALL

For the
United Nations
Development
Programme
(UNDP)

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Foreword

This National Human Development Report is essential reading for anyone concerned about the world's forests, our natural resources, and how better protection of our planet can help drive human development further and faster. It focuses on Cambodia, but its themes, findings and policy suggestions have global relevance. Like all Human Development Reports, it considers our well-being as people who have multiple and complex needs and are not just economic agents. That perspective profoundly changes the way we see the issue of natural resource management. It presents an opportunity, not a burden.

I have had the privilege to visit many of Cambodia's protected areas, such as Prey Lang, Phnom Kulen and the Cardamoms, as part of the work of the United Nations Development Programme (UNDP) to support the Royal Government of Cambodia in protecting these unique and beautiful national treasures. Cambodia has more than 40 percent of its land mass under environmental protection, making it a global leader in that respect. Yet, when I visit those forests, the threat they face from encroachment and degradation is clear. There has been great progress in slowing the rate of deforestation, but the problem remains to be solved.

The report is wide-ranging and gives an excellent overview of how natural resource management can drive human development in Cambodia. It contains many new and original pieces of research looking in depth at the development stories of the poorest and most remote rural communities, the market failures driving deforestation, and business models for sustainable production of charcoal and non-forest timber products. Our research, like all UNDP's work, is designed to help bring about positive change, and the findings of this report feed directly into our work with the Royal Government, local communities and others to stop deforestation, reverse its effects and better manage all protected areas for the nation.

There are compelling economic and empirical arguments to invest in effective natural resource management, some of which are presented here for the first time. The forests of Cambodia are also an essential cultural and religious part of the national identity, especially for the many indigenous communities for whom the forest is home. Many forests contain ancient Angkorian temples. Monks and lay people wishing to find spiritual peace and isolation to meditate and pray use the forests today as they have done for thousands of years. One of my most memorable experiences of Cambodia's forests was joining the Prey Lang festival and with the Venerable Monks leading us, blessing and protecting trees in the heart of the forest by wrapping them in the saffron cloth used to make the monk's robe. Readers of this report can find plenty of inspiration within for more activism, and practical suggestions on how the Royal Government, local communities and others might more effectively protect natural resources, and in doing so, find better human development outcomes for all Cambodian people.

Nick Beresford
Resident Representative
United Nations Development Programme

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Development processes and consultations

This report could not have been produced without the excellent support and guidance of the Royal Government of Cambodia, especially of the Ministry of Environment, the Ministry of Agriculture, Forestry and Fishery, the National Council for Sustainable Development, the Ministry of Economy and Finance, and the Ministry of Planning.

This Human Development Report is an outcome of numerous background studies and papers that UNDP Cambodia has conducted in support of the Royal Government of Cambodia on natural resources management.

- For the **introduction,** in-depth ethnographic studies of Aural Mountain and Kulen Mountain were conducted in preparation for the "Collaborative Management for Watershed and Ecosystem Service Protection and Rehabilitation" project and as a part of feasibility studies for payments for ecosystem services, respectively.

- **Chapter 1** on human development was developed in conjunction with the Ministry of Planning and the Ministry of Economy and Finance to provide the latest overview of progress on human development in Cambodia.

- **Chapter 2** on sustainable timber production drew on modelling that was developed to support the Government's interest in identifying the most economically viable and sustainable scenarios. This work was facilitated in 2017 and 2018 in conjunction

with UNDP's technical support for the formulation of a production forest strategic plan.

- **Chapter 3** on sustainable woodfuel and **Chapter 4** on non-timber forest products were prepared to contribute to the Government's ongoing efforts to improve the livelihoods of rural communities dependent on woodfuel and key non-timber forest products such as bamboo, rattan, resin, honey and medicinal plants. Many of the key findings of these analyses have been incorporated into national strategic plans on protected area strategic management and production forests, including through a series of consultations in 2017 and 2018.

- **Chapter 5** on community-based natural resource management was originally developed to support the Government in proposing a new measure of collaborative management under an environment and natural resources code. Initial draft background papers were reviewed by the working group on collaborative management under the environmental code in 2016 and 2017.

- **Chapter 6** on payments for ecosystem services was developed as a part of policy and research support for the Government in operationalizing conservation financing, based on two feasibility studies on Kulen Mountain in Siem Reap province and Kbal Chay in Sihanoukville. Key findings and recommended actions were presented and discussed in Siem Reap and Sihanoukville in March 2018.

- **Chapter 7** on spatial planning as a tool for natural resources management was developed to summarize experiences and analyses facilitated under the ecosystem mapping initiative led by the Department of Geographic Information Services of the Ministry of Environment The initial idea of ecosystem mapping was presented in October 2016; the final analyses of decision support systems were shared in August 2017.

UNDP Cambodia facilitated these initiatives in cooperation with Government partners, a range of development partners, non-governmental and civil society organizations, and academic institutions. A number of individuals consulted during the preparation of this report provided invaluable advice, information, and materials.

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Forestry and Fisheries in mid-February 2019. The UNDP team met with H. E. Dr. Tin Ponlok and officers from the Ministry and National Council to present the main findings on 3 April 2019, and incorporated final comments received from the National Council and the Forestry Administration. The team also presented the main findings to H.E. Ros Seilava, Under-Secretary of State, Ministry of Economy and Finance, and H. E. Thavrak Tuon, Secretary of State, Ministry of Planning on 25 April 2019, and sought to incorporate their comments in the final version of the report.

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Contents

Chapter 5 82

Chapter 6 96

Chapter 7 110

Conclusion 126

Figures

Tables

Boxes

Acronyms and Abbreviations

./.	Not Computable
[ ]	No Dimension

A

a/r	Afforestation / Reforestation

B

B-C	Benefit - cost ratio
BCCs	Biodiversity Conservation Corridors

C

CBD	Convention on Biological Diversity
CBE	Cash Break Even
cbm	Cubic Metre
CBNRM	Community-based Natural Resource Management
CCVI	Climate Change Vulnerability Index
CDHS	Cambodia Demographic and Health Survey
CDRI	Cambodia Development Resource Institute
CF	Community Forestry
CFA	Community Forest Agreement
CFM	Community Forestry Management
CFUGs	Community Forestry User Groups
CIFOR	Center for International Forestry Research
CMF	Community Managed Forest
CNMC	Cambodia National Mekong Committee
CPA	Community Protected Area
CPRM	Common Pool Resource Management
CRES	Compensation and Rewards for Ecosystem Services
CSES	Cambodia Social and Economic Survey

D

DSS	Decision Support System

E

EIA	Environmental Impact Assessment
ELC	Economic Land Concession
ES	Ecosystem Services

F

FA	Forestry Administration (in MAFF)
FAO	United Nations Food and Agriculture Organization
FiA	Fisheries Administration (in MAFF)
FRMIS	Forest Resource Management Information System
FSC	Forest Stewardship Council

G

GDANCP	General Directorate of Administration for Nature Conservation and Protection
GDEKI	General Directorate for Environmental Knowledge and Information
GDLC	General Directorate for Local Community
GDP	Gross Domestic Product
GEF	Global Environment Facility
GERES	Group for the Environment, Renewable Energy and Solidarity
GIS	Geographical Information System
GMS	Greater Mekong Sub-region
GTL	Grandis Timber Limited

H

Ha	Hectare
HDI	Human Development Index

I

IBA	Important Bird Area
ICDPs	Integrated Conservation and Development Projects
IRR	Internal Rate of Return
ITC	International Trade Centre
IUCN	International Union for Conservation of Nature

J

JFM	Joint Forest Management

K

KBA	Key Biodiversity Area

L

LEV	Land Expectation Value
LPG	Liquefied Petroleum Gas

M

MA	Millennium Ecosystem Assessment
MAFF	Ministry of Agriculture, Forestry and Fisheries
MAI	Mean Annual Increment
MEF	Ministry of Economy and Finance

MFV	Mondulkiri Forest Ventures
MLMUPC	Ministry of Land Management, Urban Planning and Construction
MoC	Ministry of Commerce
MoE	Ministry of Environment
MoIH	Ministry of Industry and Handicraft
MOT	Ministry of Tourism
MRD	Ministry of Rural Development
MSME	Micro, Small and Medium Enterprises

N

NAMA	Nationally Appropriate Mitigation Action
NBSAP	National Biodiversity Strategy and Action Plan
NCSD	National Council for Sustainable Development
NESAP	National Environmental Strategy and Action Plan
NFI	National Forest Inventory
NFM	Natural Forest Management
NFMS	National Forest Monitoring System
NFP	National Forestry Programme
NGO	Non-Governmental Organization
NHDR	National Human Development Report
NKS	Neang Kongrey Stove
NLS	New Lao Stove
NP	National Park
NPASMP	National Protected Area Strategic Management Plan
NPV	Net Present Value
NRM	Natural Resource Management
NRS	National REDD+ Strategy
NSDP	National Strategic Development Plan
NTFP	Non-timber Forest Product
NTFP-EP	Non-Timber Forest Products -Exchange Programme

P

PA	Protected Area
PES	Payments for Ecosystem Services
PKNP	Phnom Kulen National Park
PLUP	Participatory Land Use Planning

R

R&D	Research and Development
RAC	Rattan Association of Cambodia
RAPPAM	Rapid Assessment and Prioritization of Protected Areas Management
RECOFTC	The Center for People and Forests
REDD+	Reducing Emissions from Deforestation and Forest Degradation
RGC	Royal Government of Cambodia
RS	Rectangular Strategy

S

SDGs	Sustainable Development Goals
SESA	Strategic Environmental and Social Assessment
SEZ	Special Economic Zone
SFB	Supporting Forests and Biodiversity
SFM	Sustainable Forest Management
SLC	Social Land Concessions
SMART	Spatial Monitoring and Reporting Tool
SME	Small and Medium Enterprise
SO	Strategic Objective

T

TEEB	The Economics of Ecosystems and Biodiversity
TLS	Traditional Lao Stove

U

UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar

W

WCS	World Conservation Society
WHO	World Health Organization
WWF	World Wide Fund for Nature

Y

YC	Yield Class
yr	Year(s)

Executive Summary

Sustainable management of natural resources for long-term human development

Executive summary

Sustainable management of natural resources for long-term human development

As Cambodia continues its transition to a higher level of development, it faces a historic opportunity to manage its natural resources for the benefit of both people and the environment. Cambodia can mitigate mounting pressure on forests and other essential natural resources by diversifying patterns of access and use, while building the foundation for an economy that continues to be strong and fair, and, crucially, more sustainable.

Cambodia has made steady progress, with rising incomes, but the country faces long-term challenges. If Cambodia acts now, it can expand and improve the quality of its gains, as well as ensure that they can be maintained. Much depends on reaching the rural areas that are home to about 80 percent of the population, including the majority of people in poverty. Many remain highly dependent on natural resources for food, shelter and income, which in turn makes them acutely vulnerable to climatic and other shocks. The careful management of natural resources will enhance their resilience and improve future prospects for human development.

While there are often trade-offs between economic and environmental objectives, there are also points of complementarity. This National Human Development Report focuses on forests and protected areas, in exploring how the country might win on both fronts.

Cambodia is performing very well in terms of economic growth and human development. GDP expansion continues to top 7 percent annually, accompanied by one of the world's fastest rates of improvement in the global Human Development Index. Significant strides on life expectancy and to a lesser extent, higher incomes have been the primary drivers; however, educational advances lag behind those of Southeast Asian neighbours.

Human development performance has become increasingly equitable. Remote areas have seen major improvements, driven by dramatic decreases in child and infant mortality. Longer term trends towards gender equality are noteworthy. Yet disparities remain, and the current momentum will diminish if gaps between areas and groups do not continue to close.

Economic development has driven growth, but not without alarming pressures on natural resources. More rural communities than ever before have roads, energy and public services, and new economic and employment opportunities. Yet the current pattern of development has taken a clear toll on the environment. Forests offer a salient example; in 2010, they covered 57.07 percent of Cambodia, but only 46.86 percent by 2018.

The degradation of environmental resources may harm prospects for continued development. Large-scale developments such as dams and the loss of common resources, especially forests, have had major human development impacts in rural areas. Many people who directly depend on natural resources for subsistence, incomes and safety nets, are adversely affected. In the longer term, the degradation of ecosystems also leaves people at large more vulnerable to disasters, for example through flooding that strikes both rural and urban areas.

Market failures are among the sources of environmental degradation. The lack of a market value for environmental resources encourages exploitation for short-term economic returns, resulting in a proliferation of cheap, unsustainably sourced natural products. Producers have limited incentives to invest in measures such as energy-efficient charcoal kilns, improved cooking stoves and alternative energy. Complex regulatory requirements and insecure land tenure also discourage sustainable production as do significant uncertainties about which areas are prioritized for conservation.

Options for sustainable natural resources management exist, but are costly if only economic returns are factored in. For the first time in Cambodia, this report models a number of different options for timber production. It finds that illegal logging is far more lucrative, in purely financial terms, than any of the seven options examined for sustainable timber production. Yet, when an array of development benefits and longer-term costs are considered, some of the best options are private teak plantations and natural forests managed by communities. Community forestry has the lowest investment requirements and risks.

A broader set of human development costs and benefits need to be better understood and balanced in ecological, cultural and economic terms. Modelling work on alternative forms of timber production shows that while short-term economic gains from the extraction and use of natural resources are significant, the long-term gains decrease rapidly due to the finite supply of these resources. This also has ecological and cultural costs. Continued benefits, including human development gains, fundamentally depend on more sustainable management.

Collaborative natural resources management between the state and local communities offers a promising approach but its full potential remains untapped. Unsustainable extraction is inevitable unless communities enjoy secure resource rights and realize tangible benefits. Well-calibrated collaborative management could respond to the wide variances in community incentives and capacities, and guide consistent progress towards sustainability and human development.

How can Cambodia move forward?

Ensure that effective law enforcement deters illegally sourced products so sustainable products can better compete. This should fit within a framework to regulate and control illegal harvesting, production and sale of products from natural resources. It requires collaboration between Government enforcement agencies and communities, and a shared commitment to sustainability.

Take regulatory measures to accelerate the shift to sustainable production. These include ensuring property rights, so local communities and the private sector invest in long-term, higher value added, sustainable timber and non-timber forest products. Regulations, legal requirements and administrative procedures should be simplified to reduce transaction costs.

Make a start towards sustainable energy. Like all countries, Cambodia is undergoing a transition to energy sources that are sustainable and non-polluting. It can take an important early step in this direction through the sustainable management of woodfuel, which remains an essential source of energy and income in many rural communities.

Aim for more productive local economies that deliver higher returns for people and the environment. This depends on the successful development of promising markets for sustainable products. High value-added sectors include niche markets for high-end furniture made of timber, rattan and bamboo; environmentally friendly commercial timber production; and high-quality honey and medicinal plants. Economic returns may increase through simple and efficient equipment for processing and packaging, and improved local knowledge of production techniques. These should be geared towards meeting quality requirements, environmental standards and market demands, including in wider domestic and international markets. Other steps might encompass directly linking producers with consumers, and reducing transaction costs, for example, via mobile apps.

Reinforce the State's pivotal role in working with communities to co-manage natural resources. This starts with clearer recognition of the formal, secure and long-term rights of communities to sustainably manage natural resources and derive tangible benefits. The Government could consider accelerating approval time frames and reducing costs for community-based management, clarifying resource boundaries and strengthening law enforcement. Appropriate measures should be in place so that community-based institutions uphold community interests as well as environmental goals.

Roll out systems for payments for ecosystem services nationwide. Such payments should recognize the full economic value of goods and services from natural resources. Costs of preservation are reflected through a market mechanism, when people pay to use water, and funds go in part towards maintaining watersheds. Priorities include the full valuation of the environmental services of key ecosystems in Cambodia, the operationalization of two payments for ecosystem services pilots in Sihanoukville and Siem Reap provinces, and the development of policies to implement the approach nationally.

Apply integrated land-use planning to achieve economic and environmental goals. For strategic land-use decisions, a decision support system can facilitate assessments of both social and environmental impacts. It can offer vital insights into balancing economic development, poverty alleviation and the sustainable use of natural resources as part of shaping a next generation of medium and long-term human development strategies for Cambodia.

Introduction

Securing human development by safeguarding Cambodia's abundant natural resources

Introduction

Securing human development by safeguarding Cambodia's abundant natural resources

Cambodia has made great strides over the last three decades, transitioning to peace, transforming livelihoods and realizing striking gains in socioeconomic development. Accompanying economic growth, however, there have been growing pressures on land, water and forest ecosystems. These pressures are beginning to challenge the long-term viability of Cambodia's development model and its ability to achieve the objectives set out in *Vision 2050 and the Cambodian Sustainable Development Goals.* The goods and services as well as intangible benefits that accrue from Cambodia's natural resource base are fundamental to the well-being of millions of people. Prospects for sustainable and inclusive development greatly depend on improved ecosystem management.

This National Human Development Report explores how to activate the mutually reinforcing links between environmental and human well-being[1] with a view to creating a sustainable future, by focusing in particular on the management of forest resources. There are three reasons for this focus: First, forests are Cambodia's primary natural resource, and influence human development in numerous ways; second, forests vividly illustrate the importance of high-quality resource management; and third, the striking rate of deforestation in recent years has made conservation an urgent concern.

This National Human Development Report explores how to activate the mutually reinforcing links between environmental and human well-being

In making the case that the quality of natural resource management is fundamental to the human development of current and future generations, this report emphasizes three causal links.

First, poor ecosystem management results in resource degradation and depletion, which undermines human development. This occurs even if there are some initial dividends from resource exploitation. Intense forest exploitation and land conversion can be lucrative in the first year or two. But as soil fertility falls on recently cleared land, and as forest resources are no longer available for food and materials, livelihood opportunities decline, and human vulnerability increases.

Second, vulnerability, which is caused in part by the erosion or loss of ecosystems, leads to behaviours and choices that undermine human development. For example, vulnerable rural households may expend most or all of their available resources to cope with shocks or threats, leaving them unable to invest in the health and education of their children. Forest resources and ecosystems offer a vital safety net, providing food, medicine and income for rural dwellers as well as a healthy, clean environment.

Third, ecosystems offer intangible benefits. Sustaining their integrity supports a better quality of life, provides amenities, and underpins identity and culture, not to mention regulating the climate. With secure and clean water, farming households are healthier, for instance, and agricultural production more reliable. Well-managed forest ecosystems becomes reduce the risks of climate change, and mitigate vulnerabilities caused by disasters and extreme weather, benefitting both urban and rural dwellers.

Human well-being depends on ecosystems

Ecosystems play a vital role in Cambodian human development, urban as well as rural. A particularly striking example is provided by Cambodia's ancient forests (see Box 0.1).

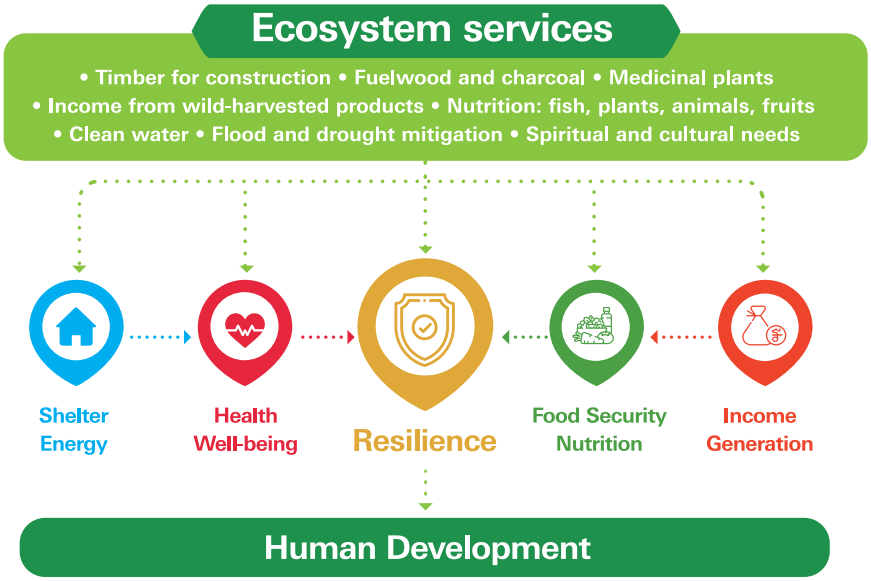
While urban dwellers also benefit from forest goods and the climate and ecosystem regulation of forested areas, the impacts are most important in rural Cambodia (Figure 0.1). These areas are home to about 80 percent of the population, including the majority of people in poverty. Their well-being and economic opportunities directly depend on the availability of natural resources.

Rural households use forest timber to construct their houses as well as fences for livestock and agriculture. They depend on rain to grow crops and fuelwood for cooking. In 2014, more than 2 million households relied on non-timber forest products such as bamboo, rattan, resin, honey and medicinal plants for income and subsistence.[2] Nearly half the population uses wild-harvested medicinal plants,[3] which is

part of the explanation for recent findings that have shown a clear relationship between forest degradation and decreasing human health.[4] A majority of rural populations practice rain-fed agriculture or engage in fishery. When drought threatens agriculture or fishery is insufficient, forest products provide a safety net.

Figure 0.1.

Many ecosystem services contribute directly to human development



Aquatic ecosystems, especially those of Tonle Sap Lake, provide other vitally important inputs. Fish are the main complement to rural people's rice-based diet, contributing more than 60 percent of rural protein intake. And fisheries are of fundamental commercial importance, employing about 2 million people.[5] Inland fisheries account for nearly 12 percent of gross domestic product (GDP), more than the contribution from rice production.[6]

Cambodia's heavy reliance on ecosystem goods and services makes it particularly vulnerable to environmental shocks and changes. The global 2014 Climate Change Vulnerability Index ranked Cambodia among the countries most vulnerable to climate change, in part due to its high dependence on agriculture and a large proportion of people living in flood-prone areas.[7,8] Recent floods and droughts have highlighted this extreme vulnerability, while climate change forecasts predict even more dire weather events in the future.[9]

One key way for Cambodia to successfully adapt to climate change risks and other stressors is to maintain healthy ecosystems, which mitigate against environmental and other stressors, and increase resilience.[10] The latest global agenda on climate and development places resilience at its core, noting it has to be achieved through social and ecological diversity on all levels.[11]

Forests, for instance, limit the negative effects of droughts and floods and are a sink for carbon emissions. According to the latest forest reference level report submitted to the UN Framework Convention on Climate Change,[12] Cambodia's carbon storage capacity could be significant in climate change mitigation efforts. It might generate new revenue streams under REDD+[13] that could bolster sustainable forest management.

Healthy ecosystems protect Cambodia's high levels of biodiversity, which provide economic opportunities and sustain livelihoods in various ways.[14] Cambodian forests shelter a range of rare, culturally significant, and threatened species. Moreover, rich ecological and species diversity represent a major opportunity for eco-tourism that supports both conservation and human development. Cambodia's 2016 National Biodiversity Strategy and Action Plan, part of its commitment to the Convention on Biological Diversity, provides a framework for conservation and sustainable use.

Box 0.1.

Protecting the forests: ancient wisdom, modern methods

For many indigenous communities, the value of the forest goes beyond the market price of land or timber. To the Souy people, an indigenous group in south-western Cambodia, the forest is divine, and has been a cornerstone of their culture for centuries.

"The spirit of the forest is our traditional belief. We call him Ta Tei," explains Srey, a 67 year-old community elder from the village of Putrea.

When Srey was growing up, she was surrounded by dense foliage. She could take her animals to graze in the forest or go fishing in the river. The community was spiritually tied to Ta Tei, and he provided for them through the land.

But in the last four years, everything has changed. The forest surrounding Srey's community has begun to disappear, part of a national trend that has seen forest cover decline.

"The spirit tries to protect the forest. But the forest is now gone—people are just cutting it down. They don't believe in the spirit forest as they did in the past," says Srey. "Before, we could get wild animals or fish for food. We would share within our community. Now that tradition is dead. We have to go buy it in the market".

Under the combined impacts of land concessions and forest degradation, with climate changing looming on the horizon, many in Srey's community worry that their culture and livelihoods will soon disappear forever.

"If this continues to happen, I don't know what I will do. I'm worried about the children. As it is now, it's so difficult for everyone. Our sacred Phnom Ta Tei is going to be sold," she says.

To Srey and many others, the forests and mountain are not merely symbolic, but living places. The land is the heart of the community, providing life-sustaining resources to all that depend on it. Without appropriate reparations and the building of new skills, communities like Srey's are left behind.

In 2007, a community protected area was established to engage all members of the community in managing communal lands. It was an important step, yet Srey and many within her community feel that current practices to protect the forests need improvement.

"We have been protecting the area, but threats to the forest have never been greater," explains Phal Noeun, the 53-year-old chief of the community protected area management committee in Kampong Speu province.

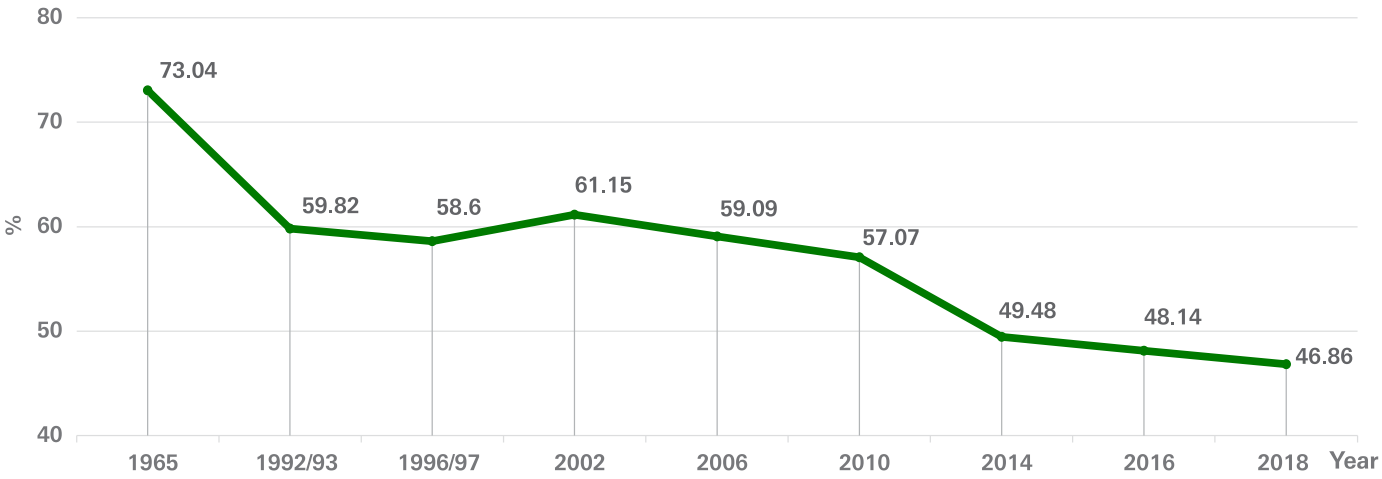
"The most important area for the community is the spiritual mountain and forests," Noeun emphasizes. "If you don't protect the land, you will lose the forest forever."

Costs and benefits of economic development and environmental degradation

Despite the value of Cambodia's forests and natural resources, forest coverage has been declining for decades, and from 2010 to 2016 shrank from 57.07 percent to 46.86 percent of national territory (Figure 0.2).[15] These losses occurred in the context of rapid economic growth and a transition to a market-oriented economy.

Figure 0.2.

Cambodia's forest coverage has declined for decades



National forest (including rubber and palm oil plantations)

Source: Royal Government of Cambodia 2019.

Many countries including Cambodia have promoted large-scale economic development as the primary strategy to lift rural people out of poverty, making them less dependent on natural resources. This approach stems from the view that remote communities in densely forested areas are trapped in poverty due to their dependence on natural resources for subsistence, and their limited access to public goods. As is clear from Cambodia's recent history, economic development has increased the access of rural communities to roads, energy and public services and created new economic opportunities and jobs.

Yet the sustainability of natural resources is vital for the prevention or minimization of poverty and long-term human development, as indicated by the continued high reliance of rural communities on forest products and fish for subsistence and income. With short-term maximization of economic gains comes the loss of natural resources, as well as a range of negative social and cultural externalities. Cambodia's ongoing construction of hydropower dams, for example, requires felling huge tracts of forests in upstream watersheds. A 2015 study on the influence of dams on river fisheries in the Mekong Region predicted that they may reduce fish populations by up to 50 percent,[16] which raises serious concerns about food and health security, given the reliance of Cambodia's rural population on fish for protein.[17]

Other examples of negative externalities are found in the two cases of Aural Mountain and Kulen Mountain National Park, which will be explored further below. (Box 0.2 and Box 0.3) The first shows how large-scale development and the expansion of commodity markets have resulted in the degradation of natural resources. The second illustrates how forest loss in the upper watershed threatens to reduce the downstream water supply, in addition to destabilizing culturally invaluable heritage monuments in the Angkor region.

All of the above points in the same direction: While short-term economic gains from the extraction and conversion of natural resources are significant, negative externalities and long-term costs and gains—in terms of human development, as well as ecological, cultural and economic value—need to be recognized and integrated into long-term development strategies.

Accordingly, the emphasis of the present report is on identifying and designing future development pathways in a manner that facilitates integration of human and economic development and environmental sustainability.

Two cases of rural transformation

Massive transformations are taking place due to Cambodia's rapid growth. Despite a dramatic decline in forest cover over the last decade, the country's forest coverage remains relatively high. This means that there are still possibilities for creating mutually reinforcing positive change for people and the environment. However, action is urgently required.

Many changes have been driven by commodity markets expanding into new frontiers, where resources are still plentiful, accompanied by associated shifts in access and control. Consequences include the degradation of land and other resources. Some actors have benefitted greatly, especially those with access to power, markets and authority. But significant numbers of rural families have faced livelihood losses and heightened vulnerability.[18,19,20]

One catalyst of change has been large developmental projects, such as economic land concessions, mines, dams, sand dredging, and roads. Incremental shifts in rural landscapes and livelihoods have further contributed to agricultural intensification and degradation of shared resources such as fisheries, land and water.[21] While new economic activities in rural Cambodia are often intended to usher in important economic benefits, they can also lead to environmental degradation.

UNDP selected two cases, the foothills of Aural Mountain in Kampong Speu Province (Box 0.2) and Phnom Kulen National Park in Siem Reap Province (Box 0.3) to illustrate this phenomenon. Both show how cycles of resource use and landscape change are transforming forests, with important implications for food security, equity and quality of life.

Box 0.2.

Aural Mountain: Logging takes a toll

The forest frontier of Aural Mountain, Cambodia's highest peak, provides a vivid example of how resource degradation impacts human development, and it demonstrates the deep connections between livelihoods and natural resources.[22] Logging began in the 1970s while the Khmer Rouge were present in the area and continued under the decade-long socialist Government of the 1980s. More organized logging operations began in the 1990s, and most slow-growing hardwoods became locally extinct by the mid-2000s.

The removal of large trees contributed to the unravelling of local and indigenous livelihoods, which formerly relied upon non-timber forest products, especially resin tapping from the now-missing hardwoods. This disruption prompted local people to "log down", targeting less valuable and faster growing tree species suitable for commercial purposes like charcoal production. Charcoal has been produced for the Phnom Penh market since the early 2000s. Local villagers and new migrants have engaged voraciously in the new trade, stripping the forest bare.

Once forested areas are cleared of all large and medium-sized trees, they are converted into private land parcels or economic land concessions for agricultural production. Some smallholder farmers have gained development and livelihood opportunities. But marginalized people, including many women and poor households, have not been able to secure sufficient land for livelihoods. For some, the pressure of debt, often due to loans for medical bills, agricultural inputs, or other essential items, has forced them to sell or mortgage their land, ultimately leading to landlessness.

A charcoal production site in the Aural foothills in 2017

Photo credit: S. Chann.

As forest resources are depleted, and family farmland is downsized, degraded or sold, traditional rural livelihoods can become severely compromised. A modest farm may struggle with stagnating prices for rice, cassava, mango and other crops, forcing farmers to engage in wage labour. Some smaller farmers secure work on larger plantations, but many leave for the city. Most poor households send at least one woman to work in peri-urban garment factories.

Box 0.3.

Kulen Mountain: Growing cashews instead of forests

Phnom Kulen National Park illustrates the challenges to effective conservation and watershed management.[23] Located about 50 kilometres from the town of Siem Reap and the Angkor Wat temples, the area was declared a national park of 37,375 hectares in 1993, in recognition of its natural and cultural values.

The watershed in the park supplies clean water to Siem Reap and maintains the underground aquifer that stabilizes the Angkor Wat temples. The park also contains Cambodia's most sacred mountain and over 50 ancient temples, many of which attract tourists. As Siem Reap's largest remaining forest area, it is home to globally threatened species, such as the silver langur.

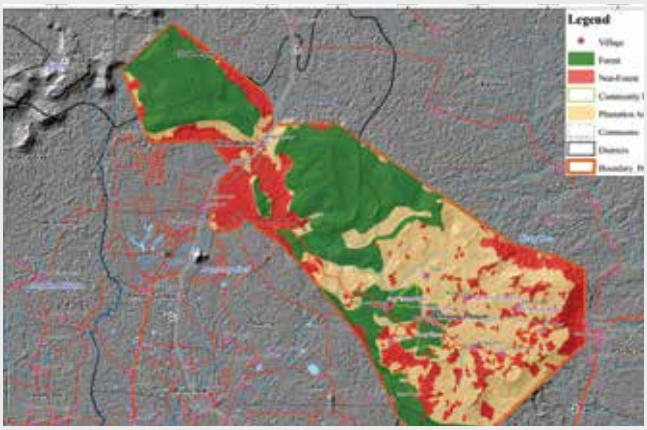
Up to 8,000 people still reside inside the park. They make a living from its resources and by running tourist stalls around the main waterfall site.[24]

Local residents do not have formal land titles. Nevertheless, villagers' customary rights to some forest resources are recognized through five community protected areas within the park. Totalling 923 hectars, these areas allow the sustainable harvesting of non-timber forest products that are sold by local families.[25]

The degradation of park ecosystems started with the illegal extraction of luxury and high-value timber, and continued with intensified harvesting of fuelwood for brick factories and charcoal kilns, and other timber for local livelihoods. Despite efforts by park rangers and police, it has proved difficult to put stop to these illegal activities. The remaining forest is now highly degraded and vulnerable to the expansion of agriculture, particularly profitable cashew plantations. Cashew has become the dominant local cash crop for villagers on the eastern plateau of the park, replacing most of the former natural forest and shifting agriculture systems. Since 2015, many cashew producers have introduced herbicides that pose threats to both human health and water quality.

Forest cover on the eastern plateau has decreased significantly, from 42 percent in 2003 to around 25 percent today (see map below).[26] The consequences for Siem Reap and its tourism industry are potentially devastating. They include declining water quantity and quality, and loss of irreplaceable cultural heritage.

Phnom Kulen National Park



Land use trends in 2017 in Phnom Kulen National Park showing forests under pressure

Forest clearing and herbicide use for cashew production in Kulen National Park

Source & Photo Credit:
Archaeological and Development Foundation 2017

A downward spiral of resource degradation and deterioration in human well-being

The Aural Mountain frontier demonstrates that social conditions can rapidly deteriorate when the resource base that people depend on is severely depleted, or when rural households' traditional access to resources is diminished by land enclosures and large-scale development. Such circumstances often lead local people to exploit natural resources in unsustainable ways. Under extreme pressure, they may sell land and natural resources that they have depended on for generations.

Phnom Kulen National Park exemplifies the immense management challenges faced by many protected areas in Cambodia. Most relate to the difficulty of balancing conservation and development, but they also point to the need for more funding and capacity dedicated to natural resource management.

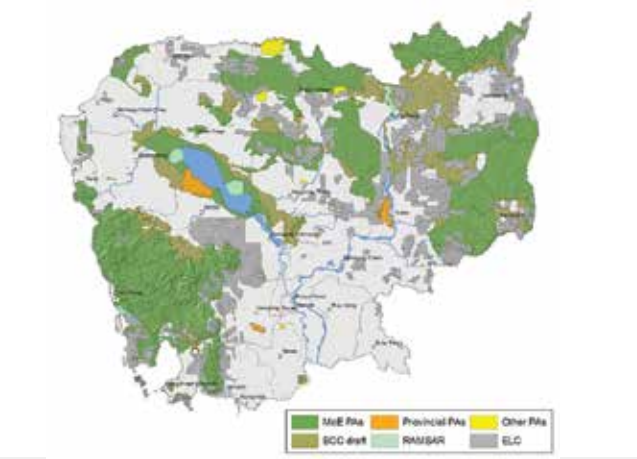
Both cases illustrate that resource degradation leads to the erosion of sustainable livelihoods and resilience. Together, the two cases highlight the critical importance of managing change to make the most of synergies between environmental sustainability and human development.

Cambodia's commitments and challenges

To sustain Cambodia's vital ecosystems, the Government has implemented environmental governance reforms. These include new policies and legal frameworks, jurisdictional reforms for ecosystem and protected area management, a new draft Environment and Natural Resources Code, decentralization of natural resource management functions and a moratorium on new economic land concessions (Box 0.4).

Box 0.4.

Recent reforms and policies aim for sustainability



As of 2017, Cambodia's protected area system covers 40 percent of the country

Source: Ministry of Environment; map created by the Wildlife Conservation Society (WCS) of Cambodia, 2017.

Cambodia is a party to the Convention on Biological Diversity, the United Nations Convention to Combat Desertification, and the United Nations Framework Convention on Climate Change. It is also a signatory to the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization, which was adopted by the Conference of the Parties to the Convention on Biological Diversity in 2010.

Besides these global commitments, new and emerging national policies reflect a strong commitment to ecosystem management and biodiversity conservation. They include a National Environmental Strategy and Action Plan, a National Biodiversity Strategy and Action Plan, a National REDD+ Strategy, a National Protected Area Strategic Management Plan and a Production Forest Strategic Plan.

Jurisdictional reforms in natural resources management

Since February 2016, the Government has implemented a major reform of natural resource management. This reform refined the roles and mandates of the Ministry of Environment and the Ministry of Agriculture, Forestry and Fisheries. The Ministry of Environment now takes on primary responsibility for the protection and conservation of

forests and ecosystems, while the Ministry of Agriculture, Forestry and Fisheries focuses on the development aspects of natural resource management, including economic land concessions. This reform resulted in the creation of protected landscapes that cover 40 percent of the country (see map above).

Development of an environment and natural resources code

A proposed environment and natural resources code outlines overarching principles and provides guidance on implementing laws on natural resource management and biodiversity conservation, aimed at sustainable management. Important new stipulations include conducting strategic environmental and social assessments to avoid, mitigate and minimize adverse impacts on the environment and development. A proposal for collaborative management would support the rights and interests of communities in natural resource management.

Decentralization of natural resource management

Government Circular no. 5 on decentralizing authority to subnational governments enables district and provincial authorities to play more prominent roles in natural resource management, particularly law enforcement. Other resource management responsibilities may be devolved to subnational entities in line with Ministry of Environment regulations (*prakas*). These delegate key functions of protected area management to local government, such as community engagement, environmental education and the mainstreaming of climate resilience measures in development planning.

Decentralization has strong potential to enhance human development through improved ecosystem management, particularly in Cambodia's remote forested provinces. Yet it comes with potential risks that need to be managed. Indonesia, for example, decentralized power and authority to manage natural resources to the local level, but this initially resulted in significant confusion among stakeholders and a notable increase in deforestation. [27]

These measures are intended to transform the current mode of economic development into one that is more sustainable, and better equipped to simultaneously ensure the needs of people and ecosystems, recognizing the two are not mutually exclusive. However, the country still faces several challenges in fully attaining this ambition.

The first challenge relates to the low productivity of natural resources. While Cambodia has dramatically advanced its national agenda for conservation, areas zoned for production have decreased from 6 million to 1.4 million hectares. Current levels of production are unlikely to meet rapidly growing demands for fuel and construction timber. This will likely increase pressure on other forests, leading to a spiral of degradation. There is thus a critical need to boost the productivity of forests reserved for production.

Improved productivity of natural resources is also important to secure the support of rural communities for resource management measures by increasing the benefits they receive. People's commitment to sustainable management will be largely shaped by what they can draw out of it. At present, however, the economic potentials of sustainably managed products have yet to be fully realized.

The second challenge relates to limited human resources for conserving ecosystems and community involvement. At present, according to the Ministry of Environment, more than 7 million hectares of protected landscapes are managed by just 1,260 rangers. This means that each ranger is responsible for more than 5,000 hectares of land, an area obviously too large for effective management. While Cambodia has made some progress towards engaging communities in managing natural resources, less than 10 percent of Cambodia's forests and protected areas are under community management (see Box 0.5).

A third challenge concerns limited financial resources for managing the large area of protected landscapes. The current budget allocation for the Ministry of Environment is minimal, comprising less than 0.4 percent of the annual Government budget in 2017.[29] This is insufficient for governing 40 percent of the total land of Cambodia.

A related challenge concerns market failures, where undervaluation of ecosystem goods and

Cambodia has remaining challenges in sustaining natural resources such as the low productivity of natural resources, limited human resources, market failures and unclear and overwrapping land uses

services leads to overexploitation or loss. Under the global REDD+ initiative, for example, the environmental values of forests to store and sequestrate carbon has not been fully considered by users of forests because storage and sequestration have had no market value. Rural communities therefore exploit or clear forests for agriculture and other purposes that they see as generating tangible economic benefits. The conversion to cashew nut plantations in Kulen Mountain, which led to the loss of environmental services such as carbon sequestration is a stark example. In order to prevent such market failures and promote conservation, payments may be needed to compensate people for preserving the forests.

A final challenge concerns unclear and overlapping land uses. The Ministry of Environment has the challenging task of sustainably managing a very large protected area system. This requires recognizing the needs of communities living within it. According to the Protected Area Law, all areas must be categorized into four zones (core, conservation, sustainable use and community zones) depending on conservation priorities (Boxes 0.6 and 0.7). Yet, only a handful of protected areas have actually been categorized. Accordingly, it is uncertain which areas are prioritized for conservation and which for human development.

Box 0.5.

National provisions for community-based natural resource management

The Government has initiated the following measures to foster community management of natural resources and strengthen resource rights for indigenous communities. Each measure is intended to improve livelihoods while safeguarding ecosystems.

- *Community forestry:* 604 sites established by 2018, comprising 470,970 hectares.[30]
- *Community protected areas:* 168 areas with 39, 452 households, comprising 272,110 hectares.
- *Community fisheries:* 516 sites established, concentrated mostly around Tonle Sap.[31]
- *Indigenous communal land titles:* 11 indigenous communities have received legal recognition of communal land titles.[32]
- *Customary user rights:* Stipulated in the Forestry Law and applying to forests managed by the Ministry of Agriculture, Forestry and Fisheries, these rights allow communities to maintain traditional livelihood practices, although they have been hard for communities to establish and defend.

Box 0.6.

Preserving culture with community involvement while improving livelihoods

Kulen Mountain, nestled just a short distance from Cambodia's famed Angkor temples, was the birthplace of the 9th century Khmer Empire. Just a generation ago, Kulen was still home to a rich jungle.

Veng, a 72-year-old retired farmer and former park ranger, who has lived atop Kulen Mountain all of his life, says, "When I was growing up, Kulen used to have tigers and rhinos. But now, when you travel from the north to the south, there aren't even elephants in the area anymore".

Like Veng, many of the elders living on the Kulen Plateau have witnessed the forest changing and its animals disappearing. Forest cover on the plateau decreased from 42 percent in 2003 to around 25 percent today. If this trend continues, the forests could disappear altogether in the coming decade.

The consequences for the town of Siem Reap and its tourism industry are potentially devastating, including declining water quantity and quality, and loss of a remarkable cultural heritage.

"We know when forests disappear, so does the rainfall. With less rain fall, it will impact the thousands of people living in the region," says Dr. Jean-Baptiste Chevance, the Programme Director of the Archaeology and Development Foundation. "With less rain, it will also have an impact on the tourism and the overall economy."

Despite pressures on the plateau, there are still some reasons for optimism. The Government has developed a number of laws, policies and regulations for the conservation and sustainable use of ecosystems.

Veng says. "Now we have good laws and regulations to protect the forests. Now everywhere that is protected, I don't touch," he says.

The Archaeology and Development Foundation is also helping the Government explore innovative ways to protect the forests on the plateau, while offering alternatives to destructive agricultural practices.

"In 2015, the Government recognized five Archaeological Protected Areas, covering 800 hectares and encompassing dozens of archaeological sites," to protect cultural treasures while benefitting local people by allowing them to collect non-timber forest products within the areas.

Moving forward, many more similar solutions will be imperative to protect existing forests and rehabilitate those already degraded. But the will to do so is in the hearts of many people. As Veng says, "I love the forests because I live and depend on the forests. I wish we could keep it all."

Box 0.7.

Protected area zones

The 2008 Protected Area Law states that there are eight categories of areas: national parks, wildlife sanctuaries, protected landscapes, multiple use areas, Ramsar sites,[33] biosphere reserves, natural heritage sites and marine parks.

The zoning system applies to the first five categories.

Core zone	A high conservation value area that contains threatened, endangered or critically endangered species and fragile ecosystems. Access is allowed only for park rangers and researchers with prior permission from the Ministry of Environment.
Conservation zone	A management area for natural resources, ecosystems, watersheds and natural landscapes adjacent to the core zone. Entry is restricted. Small-scale harvesting of non-timber forest products is permitted under strict control.
Sustainable use zone	A management area for national economic development, including in protected areas and community protected areas. Shifting cultivation is permitted in accordance with management plans; development and investment activities are allowed with the approval of the Ministry of Environment
Community development zone	Land ownership is granted to local villages and community protected area members. The zone may contain existing residential land, rice paddies and swidden agriculture.

Towards a better balance: key questions of this National Human Development Report

This report explores how to better capture synergies between environmental sustainability and human development in Cambodia

In light of the key role played by ecosystems in human development and present policy challenges, this report explores how to better capture synergies between environmental sustainability and human development in Cambodia. It delves into several questions of central importance today.

What is the state of human development in Cambodia compared to neighbouring countries? And how are different Cambodian communities faring? Crucially, what are the links with the quality of natural resources?

Chapter 1 provides an overview of the status of human development in Cambodia today, and analyzes the connections between the quality of natural resources and human well-being. It reports on the key human development metrics at national and provincial levels, and examines Cambodia's performance compared to that of other countries in South-east Asia.

How can Cambodia promote natural resource use and production that is sustainable, economically viable and supportive of human development?

A number of economically viable and sustainable production models could be further explored in Cambodia. The report considers ways to promote natural resource use and production that are simultaneously sustainable, economically viable, and supportive of human development.

Chapter 2 focuses on sustainable timber production, presenting economic analyses of seven timber production models to identify the most economically viable scenarios. These findings are used to gauge possible alternatives to destructive models of forestry, including cooperative management and commercial forestry.

Chapter 3 analyses the consumption and production of fuelwood and charcoal, and proposes ways to enable rural communities to engage in sustainable consumption and production. It focuses on charcoal as a major activity with environmental concerns for Cambodia, given the ongoing dependency on woodfuel for cooking.

Chapter 4 examines how to add value to non-timber forest products for local communities. It details the value chains of five key products commonly harvested by rural communities—bamboo, rattan, resin, honey and medicinal plants—and identifies opportunities for value addition. These sectors offer viable alternatives to unsustainable practices, and provide possibilities for building family livelihoods and local community economies, and enhancing human development

How can Cambodia empower communities to manage natural resources for improved well-being, resilience and human development?

Since active engagement of local communities in natural resource management can have positive impacts on livelihoods and ecosystems, the report examines the possibilities and challenges of securing resource rights and access. This would enable communities to achieve their development aspirations, while becoming more resilient and maintaining essential safety nets for their livelihoods.

Chapter 5 explores community-based natural resource management as a governance tool to ensure that the management of ecosystems and protected areas is effective and inclusive. The chapter reviews current thinking and experiences and provides policy recommendations for unlocking the potential of community-based natural resource management in Cambodia.

How can Cambodia balance conservation and development to maximize human development benefits?

With Cambodia's recent jurisdictional reform resulting in 40 percent of the country's territory being placed under some form of protection, there is a critical need to mobilize financial resources for conservation. Key to this is overcoming common problems that local communities have faced. This report argues that it is possible to develop management structures and governance arrangements that allow for effective management of common pool resources, like forests. The report takes a detailed look at two policy instruments, payments for ecosystems services (PES) and spatial planning, as means of maximizing conservation and human development benefits.

Chapter 6 presents PES as a tool for conservation financing in Cambodia, based on two feasibility studies. PES attempts to rectify market failures where ecosystem services are undervalued. It establishes contractual mechanisms whereby users pay for ecosystem services delivered by providers, typically rural communities who manage natural resources. The chapter reviews design options for two pilot sites: Kulen Mountain in Siem Reap province and Kbal Chay in Sihanoukville.

Chapter 7 elaborates spatial planning as a tool for natural resources management and explores the potential of the decision support system. As a platform for data-sharing, it could assist decision-makers in visualizing and identifying areas suitable for specific land uses, such as conservation and protection, development activities and zones dedicated to community development.

Chapter 1

Human development in Cambodia today

1. Human development in Cambodia today

Natural resources, Cambodia's extensive forests and hydrology, remain central to the livelihoods and well-being of many communities

Cambodia has made major human development gains since the foundation of the modern Khmer nation in the early 1990s, after a long period of conflict. The economy has changed dramatically with sustained growth of over 7 percent per year and the emergence of higher value added industrial and service sectors. Social changes, including through urbanization, migration and evolving lifestyles, have accompanied and supported a shared prosperity.

The vitality and resilience of ecosystems, and their management, are important for human development in the near and longer terms

Against that backdrop, natural resources, specifically Cambodia's extensive forests and complex hydrology, remain developmentally important. These are central to the livelihoods and well-being of many, often vulnerable rural communities. They provide key environmental goods and services in both urban and rural areas, including through the regulation of climatic and ecological systems, and the preservation of biodiversity.

In the longer run, natural resource stocks act as a buffer to risks, boosting resilience to environmental and other shocks. This occurs both systemically, via their ability to rebalance ecosystems and moderate severe weather events, and by providing fallback options to communities where savings and asset holdings are weak. There is also an intergenerational dimension to the preservation of these resources, enabling the maximization of human development over time. And with Khmer culture steeped in a connection to the land and especially to Cambodia's ancient forests, the preservation of natural resources has other intangible long-run benefits (see Box 1.1).

In sum, the vitality and resilience of ecosystems, and their management, are important for human development in the near and longer terms. Taking stock of the current state of human development, in addition to providing a barometer on well-being, provides a baseline for understanding risks and opportunities, and the policy priorities and actions discussed in the following chapters.

Box 1.1.

Cambodia's spirit forests

Cambodia's ancient forests have a central position within the culture and traditions of its peoples. For indigenous groups, forests are revered as sacred places where supernatural spirits serve as custodians, ensuring nature remains in balance and supportive of human life. Their significance is underlined by maintenance of cultural and religious taboos—rules that limit the exploitation of certain plants and animals, and guide behaviour in the forest as well as worship and burial practices. These are widespread and deeply embedded in groups as diverse as the Souy people in south-west, the Kuy in the north-west and the Bunong in the north-east.

For the Khmer people, the forest has become part of folklore, stories and cultural forms, including dance and music, that connect current generations with those of Angkorian times. The forest is therefore, a powerful facet of national identity, and its degradation represents a major cultural, and in turn, a human development loss, felt across Khmer society.

Putting people at the centre of development

"People are the real wealth of a nation. The basic objective of development is to create an enabling environment for people to enjoy long, healthy and creative lives."

—Opening of the first global Human Development Report, published in 1990

Human development reflects the broad richness of human life, extending beyond simple notions of economic output. Grounded in the work of Nobel laureate Amartya Sen,[34] the concept defines progress as the expansion of people's choices to live valuable and fulfilling lives. Sen described human development as the ability *(the capability)* to choose and access states of being and doing (termed *functionings*) that are intrinsically valuable, such as being educated, healthy and enjoying a decent standard of living. Freedom of action and choice (*agency*) and equity are core elements, since all people must be free of constraints and have an equal opportunity to pursue the things they value.

While it is important to recall that human development is a way of thinking about progress and development rather than a measurement approach alone , it includes a core set of metrics that track well-being not through a macroeconomic proxy, such as Gross National Income (GNI) or GDP per capita, but through attributes that human beings value directly. Debates have raged on variable choices, but since the launch of the first *Human Development Report* by UNDP in 1990, a set of multidimensional indexes, including the Human Development Index (HDI), have been estimated and published for all UN Member States (see Box 1.3 for more details).

As the years have passed, human development thinking has enlarged to recognize that real progress calls for navigating trade-offs and synergies between environmental sustainability and equitable development. Also critical is the extent to which conditions are in place to mitigate against shocks.

In a pathbreaking contribution, and pertinent to the topic of natural resource management, Sen and Anand argued that the human development approach secures both *inter*generational and *intra*generational equity, which entail "recognition of a shared claim of all, to the basic capability to lead worthwhile lives."[36] Among other issues, this approach requires taking full account of the impact of environmental damage on the human development of current and future generations. This does not mean that policy responses and investment choices should prioritize the environment over all other dimensions, but only that policymakers should account for the full costs and benefits over the long term, and bring environmental externalities into consideration.

Contemporary human development thinking places particular emphasis on the capability and agency of disadvantaged people, such as women, the poor and ethnic minorities. This entails efforts to ensure universal access to health care, education and basic services, and affirmative action to address structural inequalities. These types of actions are now hardwired in the 17 Sustainable Development Goals (SDGs), adopted by the global community in 2015 to provide ambitious targets for people, planet and prosperity through 2030.

The concepts of vulnerability and resilience place human development in the context of risk and change, especially where human-environment relationships are concerned. Vulnerability is the susceptibility of people or communities to negative changes in circumstances.[37] Such circumstances can be triggered by environmental changes such as climate shifts, floods, droughts and ecosystem degradation, or by economic and political changes such as commodity price fluctuations, global recessions or destabilizing political events. Resilience refers to the adaptive capacities of communities, which enable them to cope in stressed environments and changing circumstances.[38] Many factors, from social relations and cultural traditions, to governance, and environmental practices and the quality of resource management, can contribute to either building or eroding resilience.

Human development is a way of thinking about progress and development rather than a measurement approach

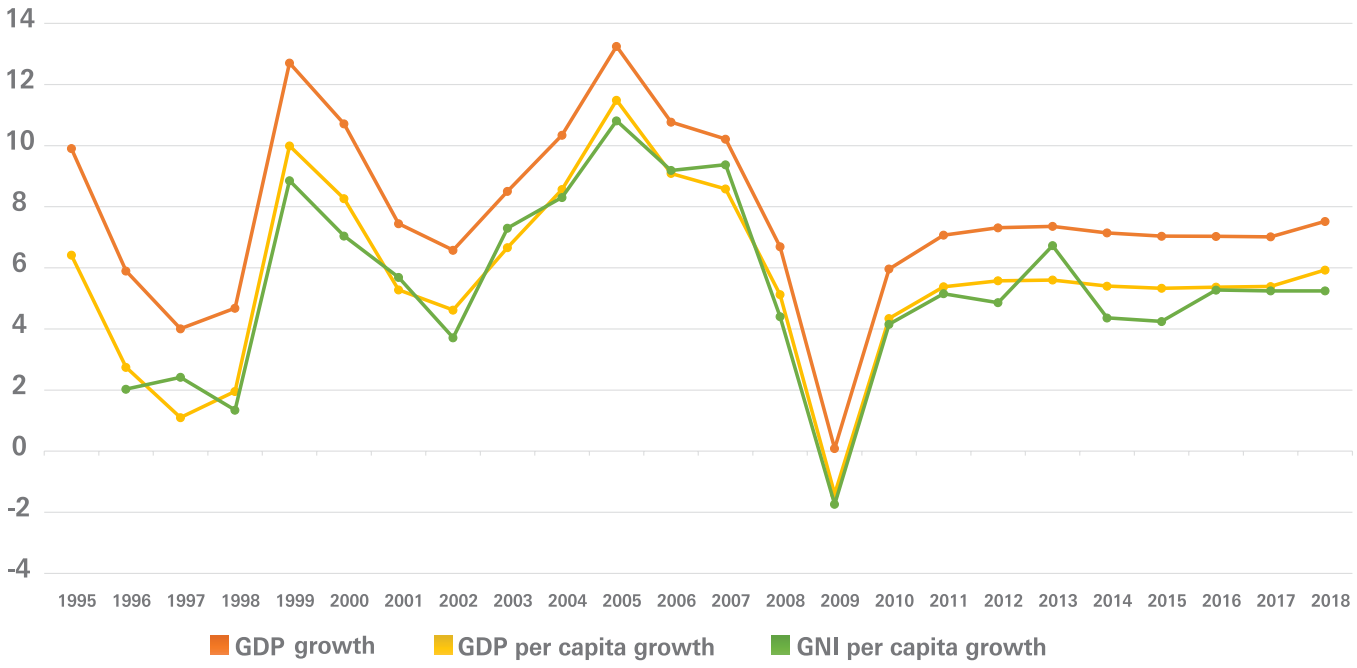
A record of substantial and inclusive growth

Cambodia's very rapid development since the establishment of the modern Cambodian state has built on annual economic growth averaging 7.7 percent since 1994 and growth was an estimated 7.5 percent in 2018 (Figure 1.1). Progressive economic liberalization and ongoing public and private investment, have transformed a country once ravaged by a decade of domestic conflict, preceded by the desperate years of Khmer Rouge rule.

A hallmark of Cambodia's development has been macroeconomic stability, with low levels of inflation and balance of payments equilibrium, despite the political stresses of a nascent democracy and instability in the global economy.[39] Government borrowing has remained in check, and revenues have grown strongly in recent years, with domestic taxes now accounting for over 20 percent of GDP.[40] The economy is highly open and has few capital controls, and as a result trade and foreign investment have flourished. Cambodia's economy remains highly dollarized, with around 80 percent of transactions by value conducted in the US currency. [41]

Figure 1.1.

Economic growth (%) has been exceptional over the last three decades



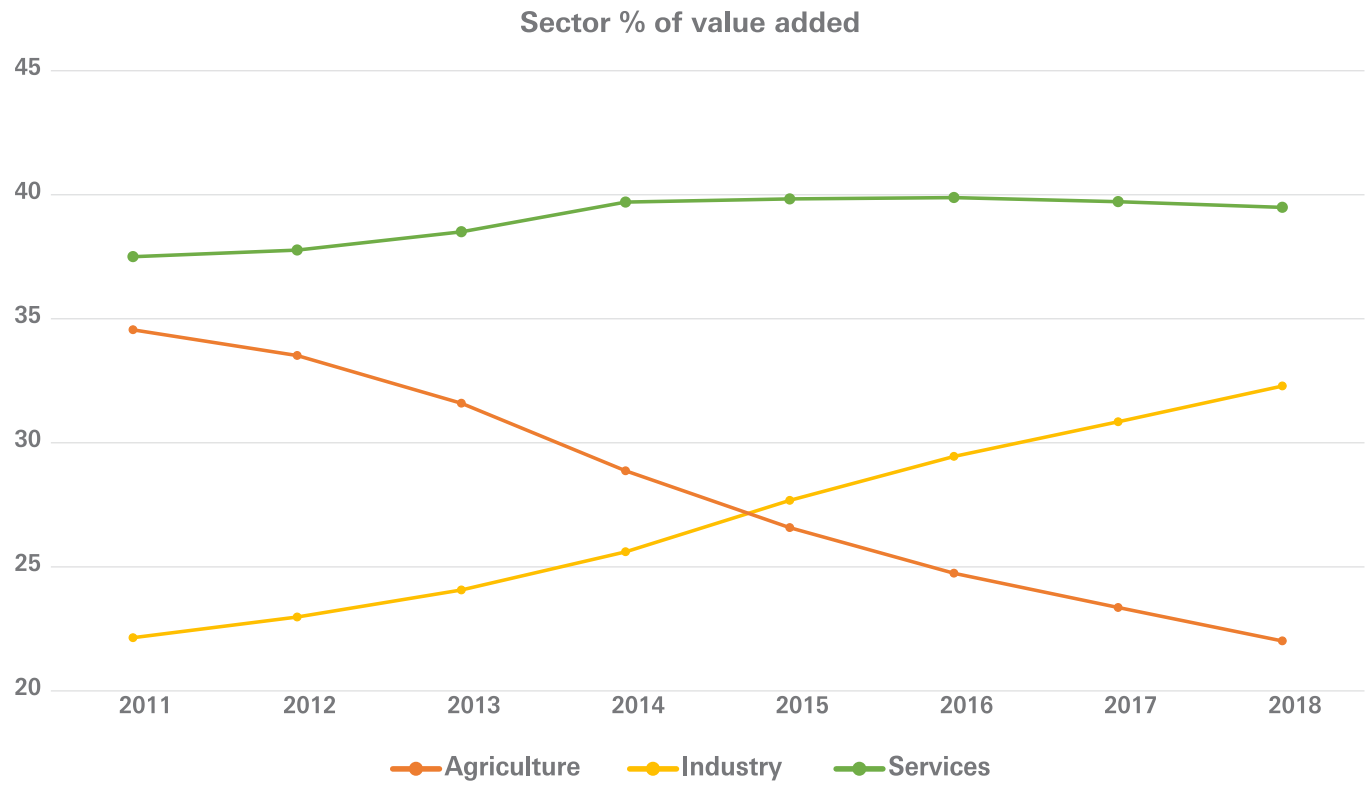
Source: World Bank, World Development Indicators.

Cambodia's economy has also seen ongoing structural changes

Cambodia's economy has also seen ongoing structural changes (Figure 1.2). Agriculture has declined, falling from almost 35 percent to 22 percent of value added, and industry and services have risen from 22 percent to 32 percent, and from 38 percent to 39 percent, respectively by 2018. Nevertheless, there are questions about the extent and quality of these changes, and the degree of underlying improvements in productivity. Employment has lagged structural shifts, with agriculture's share holding at 41.5 percent of total jobs.[42] Workers displaced from agriculture have largely been absorbed by the new economy, specifically by the garment and construction industries.

Figure 1.2.

Structural change in Cambodia is substantial and ongoing



Source: World Bank, World Development Indicators; authors' calculations.

Cambodia's population had grown to over 16 million people by 2018, and although the rate of increase has slowed, the population continues to expand at 1.65 percent per year. This has fed a bulge in the working-age population, delivering a demographic dividend. A dynamic economy together with migration abroad, much of it to Thailand, have kept labour market participation high at 82.7 percent, or 88.5 percent for men and 77.2 percent for women in 2016.[43]

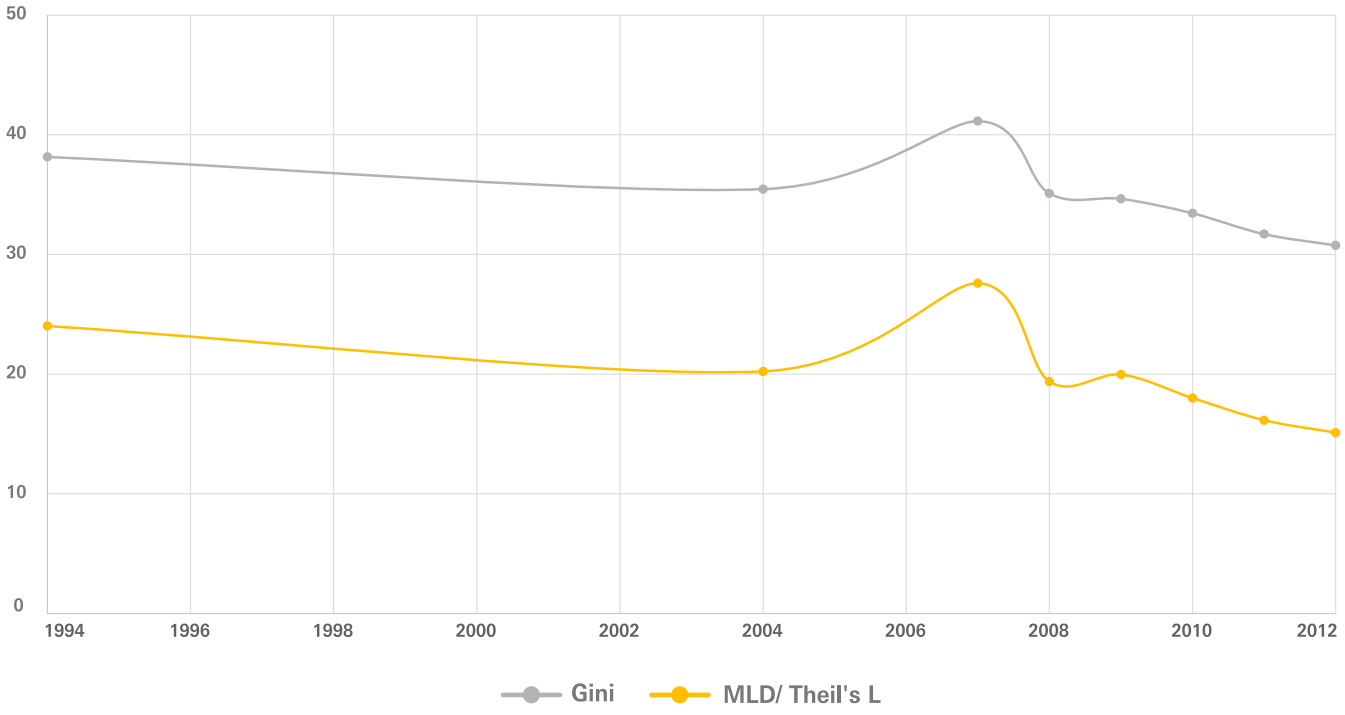
Growth has been accompanied by declining and comparatively low levels of inequality, with a Gini coefficient of 0.31 in 2012 compared to 0.38 in 1994 (Figure 1.3). Alongside high economic growth rates, economic inclusion, reflected in high labour market participation and convergence in incomes at the subnational level, has driven very dramatic falls in poverty. The national poverty headcount ratio declined from close to 50 percent in 2007 to 13.5 percent in 2014 (Figure 1.4). The international dollar-based poverty line follows a similar pattern. Cambodia has rightly earned global plaudits for these accomplishments, which enabled it to achieve the primary poverty target of the Millennium Development Goals ahead of time. The trend slowed after 2009, however, and is likely to continue to do so, as people still living in poverty are often located in remote and marginal areas, where they are harder to reach.

Although inequality has declined, many disparities persist, largely between core and peripheral areas of the country, and may even have grown in recent years (see Box 1.2). A sizeable proportion of people remain highly vulnerable to economic and other shocks. Analysis undertaken in 2014 suggested a reduction of just 70 cents in daily income would more than double the poverty headcount ratio to around 40 percent.[44]

A sizeable proportion of people remain highly vulnerable to economic and other shocks.

Figure 1.3.

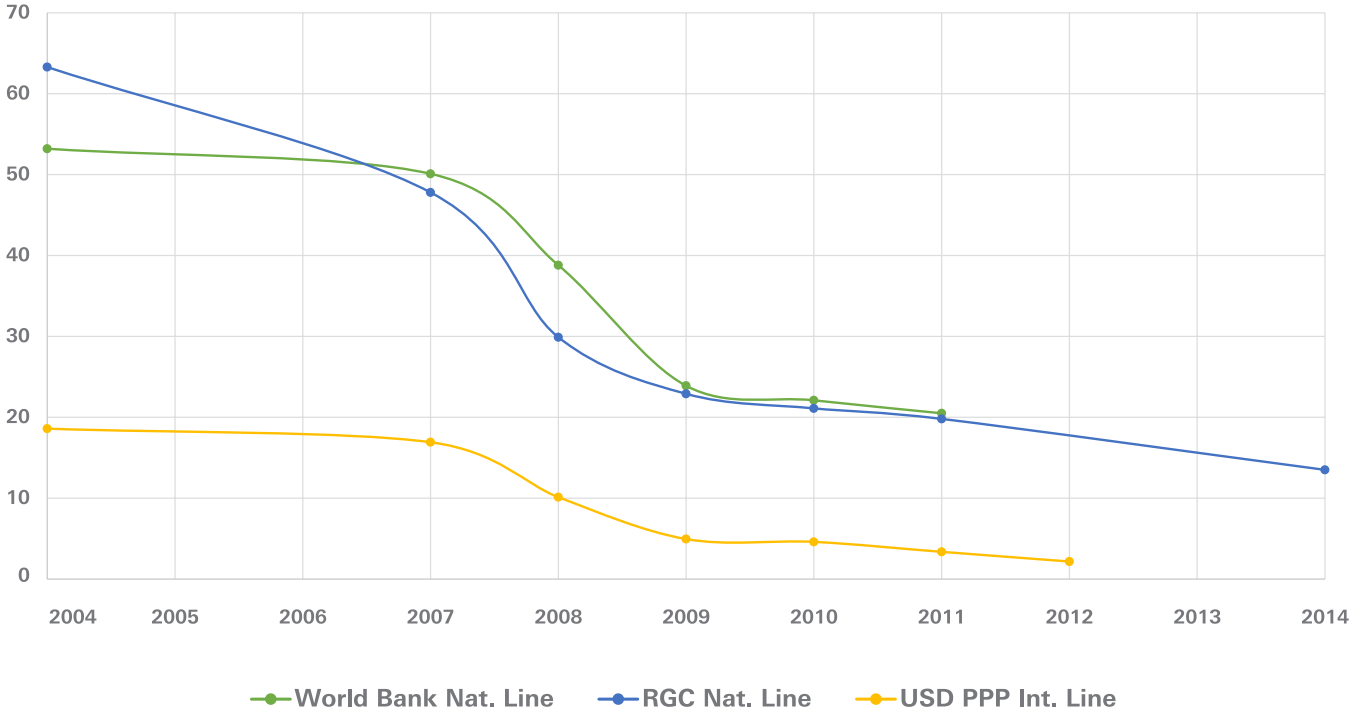
Measures of inequality show progressive improvement



Source: Povcalnet; authors' calculations.

Figure 1.4.

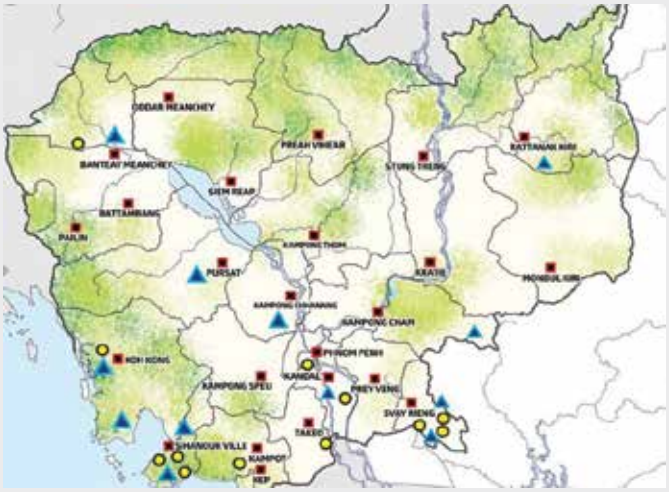
Poverty (headcount %), regardless of measurement, continues to fall



Source: World Bank 2017; Asian Development Bank 2014; Povcalnet; authors' calculations.

Box 1.2.

Cambodia's provinces and its socioeconomic geography



Special economic zones encourage new businesses and industries

Cambodia has 25 provinces, including Phnom Penh municipality, with varying population distribution and socioeconomic conditions. Provinces in the far north-east (Ratanakiri, Mondulkiri, Preah Vihear and Stung Treng) and south-west (Koh Kong) are remote, and either forested or mountainous. Most people live along two major river systems, the Mekong and Tonle Sap. Cambodia's primary economic corridor runs from the far south-east to the midpoint of the western border with Thailand.

It is difficult to be precise about the relative economic performance of regions, due to a lack of subnational data, but Cambodia's peripheral regions, which lack access to markets, generally lag behind others. Phnom Penh and its neighbouring core provinces are the most economically vibrant areas by some margin. Provinces with high trade potential and an ability to benefit from Cambodia's laissez faire economy—such as those on the south-east Vietnamese border, those close to the Sihanoukville port and others on the Thai border—have also grown rapidly in recent years.

The Government has responded to regional disparities with a regional economic policy rooted in the creation of around 30 special economic zones, where businesses enjoy more favourable operating conditions. The zones enable the development of industrial clusters, and in turn, new and better-quality employment opportunities for local populations. Cambodia is also experiencing growing internal migration, predominantly to its economic core.

Source: National Institute of Statistics 2015.[45]

Steady advances in human development

Against a favourable economic backdrop, Cambodia has achieved steady advances in human development as measured by the human development indices. On the 2018 global HDI, Cambodia ranked 146 out of 189 reporting countries, placing it in the medium human development category (see Box 1.3 on measuring human development). Many diverse factors, ranging from social relations and cultural traditions, to governance, and environmental practices and the quality of resource management, can contribute to either building or eroding resilience.

From 1990 to 2017, Cambodia achieved the seventh fastest rate of improvement in HDI globally, and the second fastest in Asia, although its score remains one of the lowest in South-east Asia, below close neighbours such as Lao People's Democratic Republic and Viet Nam, not to mention the subregion's best performers, Malaysia and Thailand (Figure 1.5).[46] Progress in Cambodia was strongest between 2000 and 2010, tapering off before accelerating again from 2016. While Cambodia is still considered a Least Developed Country, even as it has reached middle-income stage, its human development performance is now well-ahead of the average for the least developed group.

Box 1.3.

Measuring human development

The Human Development Index or HDI integrates three basic dimensions of human development: life expectancy at birth, which reflects the ability to lead a long and healthy life; mean years of schooling and expected years of schooling, indicating the ability to acquire knowledge; and gross national income per capita, capturing the ability to achieve a decent standard of living. These dimensions are benchmarked between the strongest and weakest global performances and aggregated with an equal weight to produce the final index.

To measure human development comprehensively, there are four further composite indices, three of which are used in this report. The Inequality-adjusted Human Development Index discounts the headline HDI according to the extent of inequality in each component. The Gender Development Index compares female and male performance on the HDI, while the Gender Inequality Index highlights women's empowerment.

Finally, the Multidimensional Poverty Index seeks to measure non-income dimensions of poverty in health, education and living standards using an aggregation method proposed by Alkire and Foster (2011). This index is not included in this report as underlying survey data are out of date (the most recent are from 2014). Moreover, this is not an official measure in Cambodia.

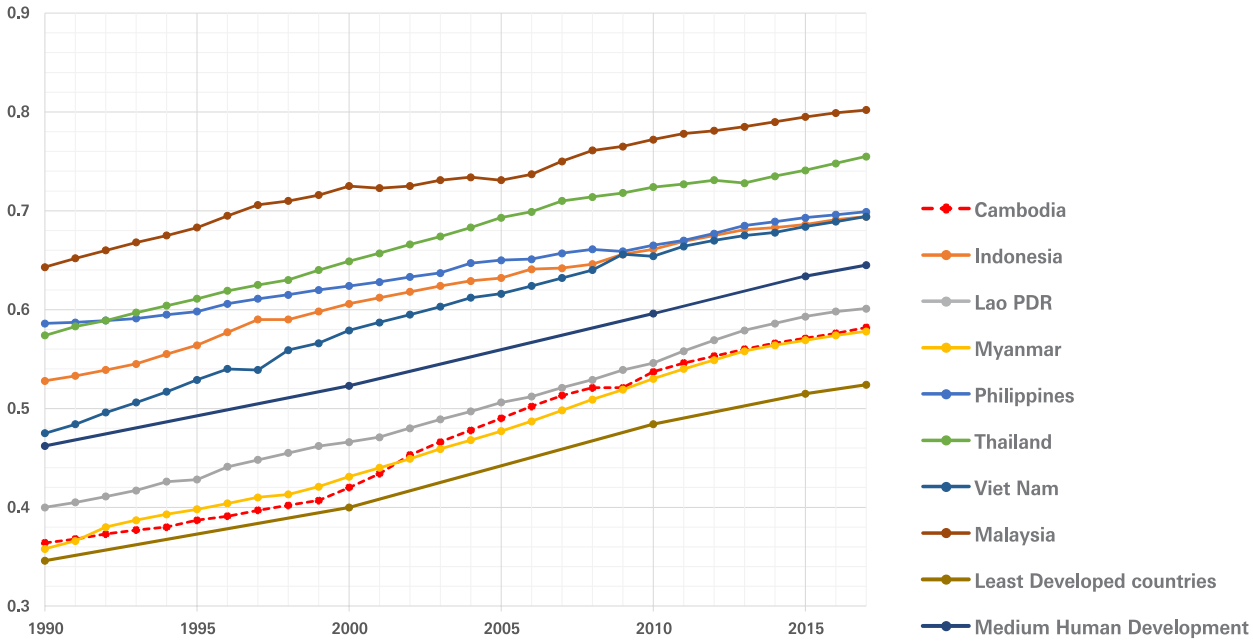
Index values for Cambodia appear on the following pages, with fuller details on the basis of calculation available in a series of technical notes published by UNDP. For more details, see the human development indices technical notes at hdr.undp.org

The main driver of Cambodia's striking rate of improvement has been dramatic rises in life expectancy (Figure 1.6), especially in remote and highly challenged areas.

The main driver of Cambodia's striking rate of improvement has been dramatic rises in life expectancy (Figure 1.6), especially in remote and highly challenged areas. Here Cambodia has surpassed Lao People's Democratic Republic and Myanmar, and is close to overtaking Philippines and Indonesia. Rising income has also contributed, reflecting ongoing economic growth. Education has seen continued improvements but weaker relative and absolute performance.[47,48]

Figure 1.5.

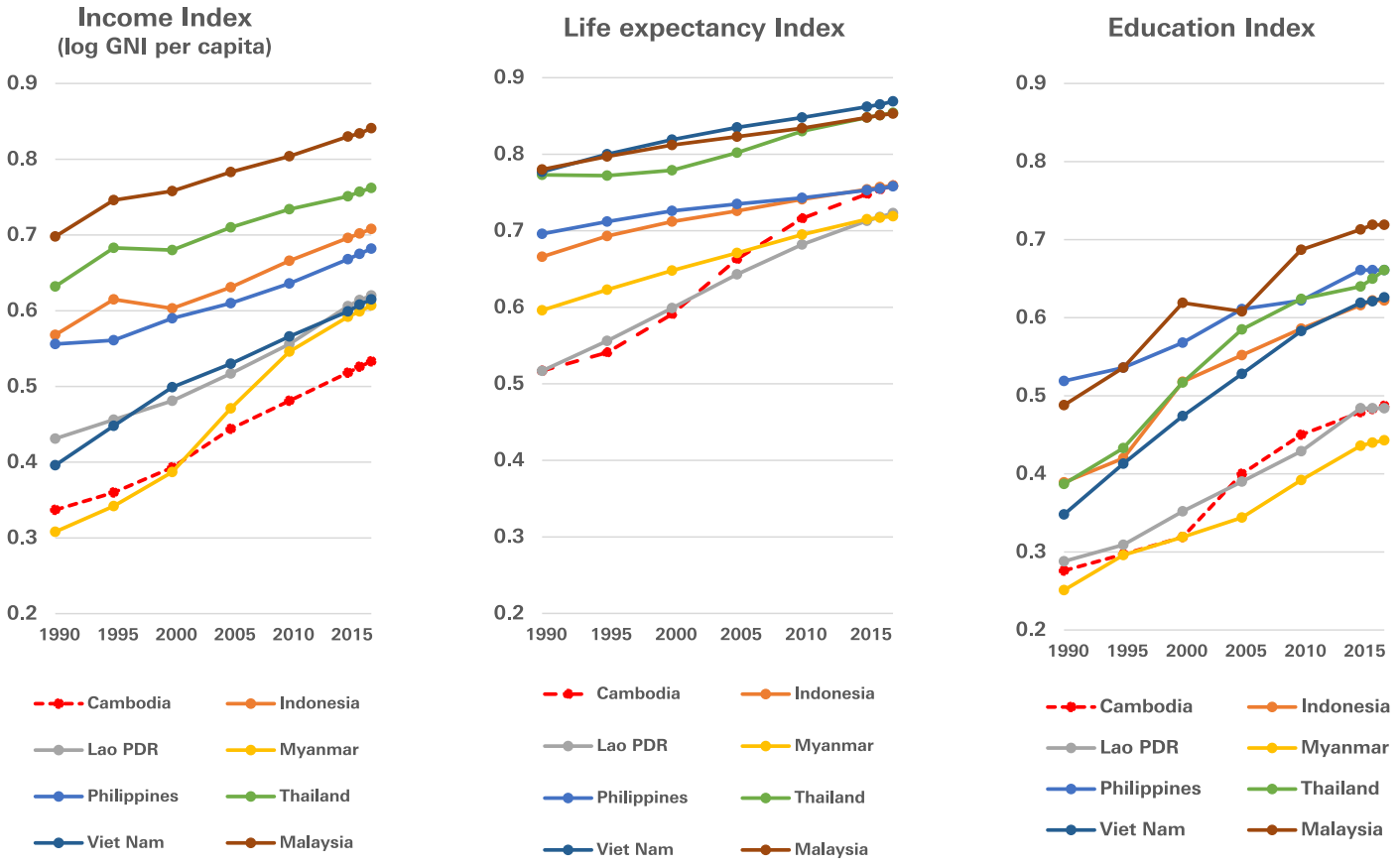
Rapid improvements in the Human Development Index (HDI), but further catch-up is required



Source: UNDP 2018.

Figure 1.6.

Exceptional improvements in longevity have driven advances in HDI components



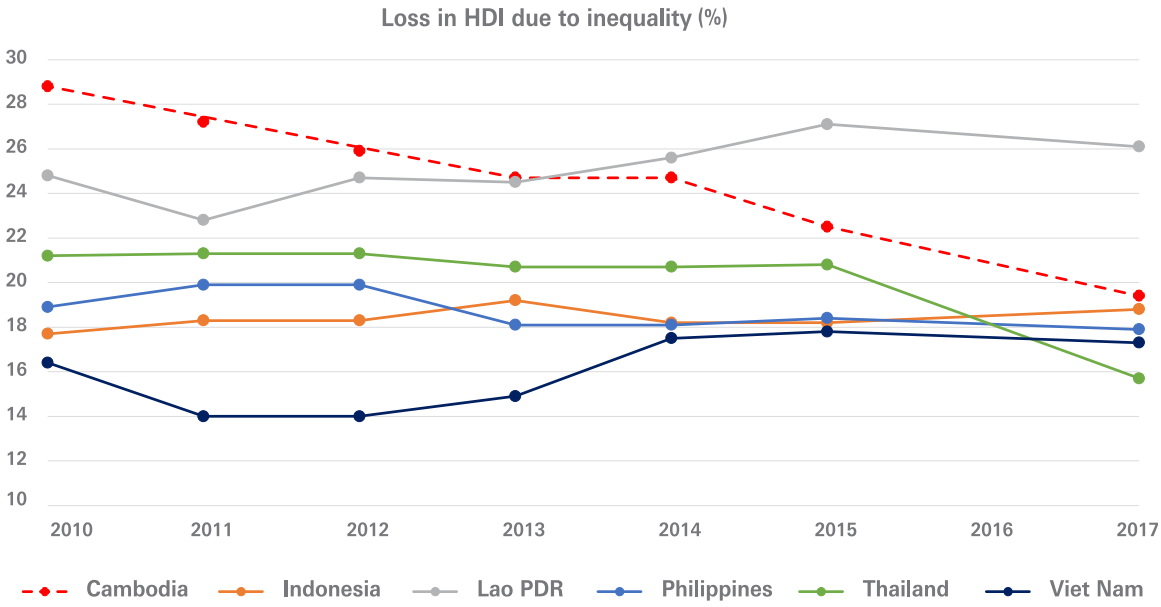
Source: Authors' calculations.

Inequality in human development (as shown by the Inequality-adjusted HDI), has declined somewhat in Cambodia, mirroring changes in income distribution (Figure 1.7). Losses in human development due to inequality, given by the divergence between the HDI and the inequality-adjusted index, fell from close to 29 percent in 1990 to 19 percent in 2017. This was due mainly to a more equitable distribution of income, but also to wider access to health and education. While Cambodia still faces higher levels of inequality than many of its neighbours, its positive trajectory suggests its position will improve further. It already suffers lower losses due to inequality than Lao People's Democratic Republic, and its performance is converging on that of Indonesia.

While Cambodia still faces higher levels of HDI inequality than many of its neighbours, its positive trajectory suggests its position will improve further

Figure 1.7.

Human development losses due to inequality have fallen



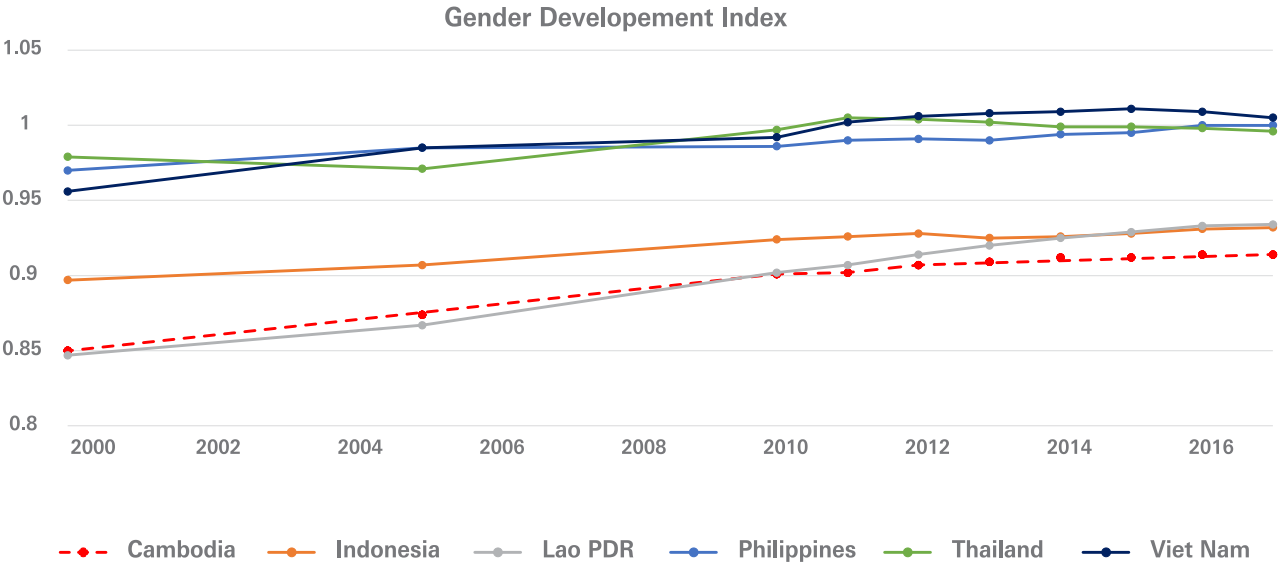
A positive trend has returned, with a narrowing of average gender gaps in income, education and life expectancy

Note and source: The loss in HDI due to inequality is given by the difference between the Inequality-adjusted HDI and HDI scores. UNDP 2018 and authors' calculations.

Over the long run, as measured by the Gender Development Index, which is the gender-adjusted form of the HDI,[49] Cambodia has moved forward on gender equality (Figure 1.8). After several years of levelling off, a positive trend has returned, with a narrowing of average gender gaps in income, education and life expectancy. Cambodia's score on the index remains weaker than some of its neighbours, however.

Figure 1.8.

Gender differences in human development are falling, but not fast enough

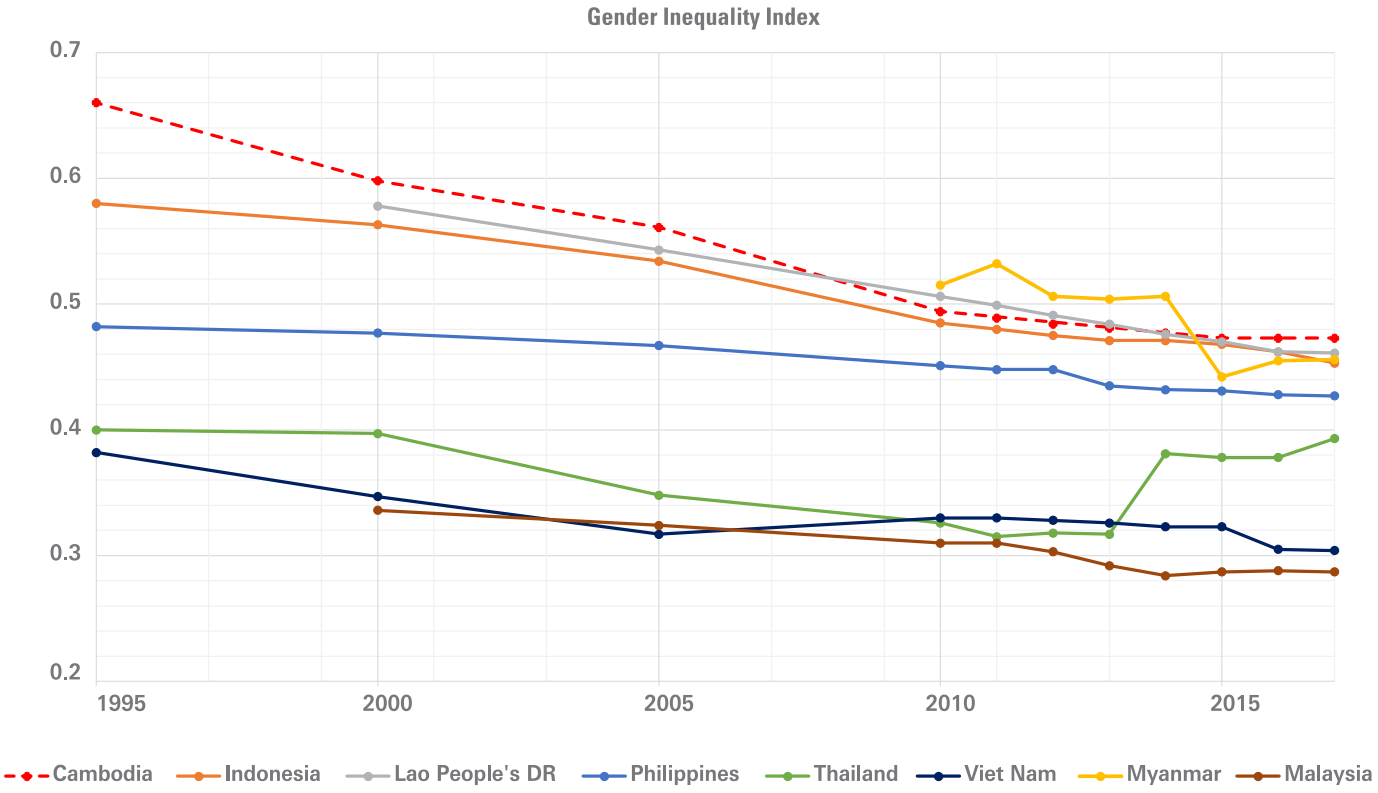


Source: Gender Development Index from UNDP 2018 and authors' calculations.

The Gender Inequality Index offers a wider and more demanding metric, measuring the balance of men and women in political life and in the economy, along with progress on the specific health challenges faced by women. Despite major improvements over time, Cambodia's progress has decelerated in recent years. It has the weakest score within the comparator group of countries in Figure 1.9.

Figure 1.9.

Despite long-run improvements in women's empowerment, performance has levelled off



Source: Gender Inequality Index from UNDP 2018 and authors' calculations.

While these trends are somewhat disappointing, other metrics paint a more favourable picture. An example is the Global Gender Gap Index compiled by the World Economic Forum, which covers ground similar to the human development indexes but employs a wider number of indicators. In 2017, Cambodia gained 13 places to rank at 99 out of 144 countries.[50] Underpinning this change were women's rising shares in decision-making and executive positions, and higher levels of participation in higher education.[51]

Variations at the subnational level

Examination of the dynamics of human development at the subnational level provides key insights, and allows, in the next section, some exploration of the possible importance of natural resources. Given constraints on data availability, three points in time-2005, 2010 and 2015-were selected as the basis of analysis. Human development indexes were estimated for each of Cambodia's 25 provinces using various secondary data sources and estimation approaches (Box 1.4).[52]

Box 1.4.

Estimating subnational HDIs

Calculating HDIs for each province was demanding and required making several assumptions. The results are therefore estimates, rather than definitive measures of human development in cities and provinces.

Data came from three sources: the Cambodia Demographic and Health Survey (CDHS) for mean years of schooling, the Cambodia Social and Economic Survey (CSES) for income, and the population census for life expectancy. Given mismatches in reporting cycles, waypoints could only be approximately aligned. CSES data for 2009, 2011 and 2015 were matched to DHS data for 2005, 2010 and 2014, and to census data for 2007, 2011 and 2017, respectively. Scaling used the appropriate United Nations data for 2005, 2010 and 2015.

Several data weaknesses-imposed constraints on the quality of the sub-indexes:

- Estimation of the GNI index required two stages. First, per capita GNIs for Phnom Penh and other urban and rural areas were estimated using CSES per capita income data, then scaled to the national GNI. Second, provincial values (other than for Phnom Penh) were estimated by taking ratios of urban to rural incomes based on their population shares (sourced from the census) then scaled to GNI.
- The life expectancy index was sourced from census update data, albeit with some realignment.
- For the educational index, it was only possible to source mean years of schooling (from the DHS); expected years of schooling relied on the published national estimates.

In addition, many boundary changes took place within the 10-year period. For new provinces, past data used the *parent* provincial record; for established provinces, published data were used. Where provincial data were aggregated (mainly in the CDHS data), the same value was used for each province.

The final compilation relied on the standard HDI specifications. Provincial data are provided in Appendix A.

The results reveal considerable variations between provinces over the last decade (Figure 1.10). Phnom Penh remains well ahead of others, and in 2015 was approaching the lower bound of the high human development category (a value of 0.7 and above). A cluster of remote rural provinces occupies the lowest places, yet these areas have shown the highest rates of improvement in recent years, and there has been considerable convergence. While the index for Phnom Penh was some 73 percent higher than the lowest-ranking province in 2005 (Mondulkiri), this gap declined to 67 percent in 2010 (when the lowest was Prey Vihear) and was only 30 percent in 2015 (when Modulkiri returned to the lowest position).

Figure 1.10.

Provincial HDIs vary considerably but have converged over the last 10 years

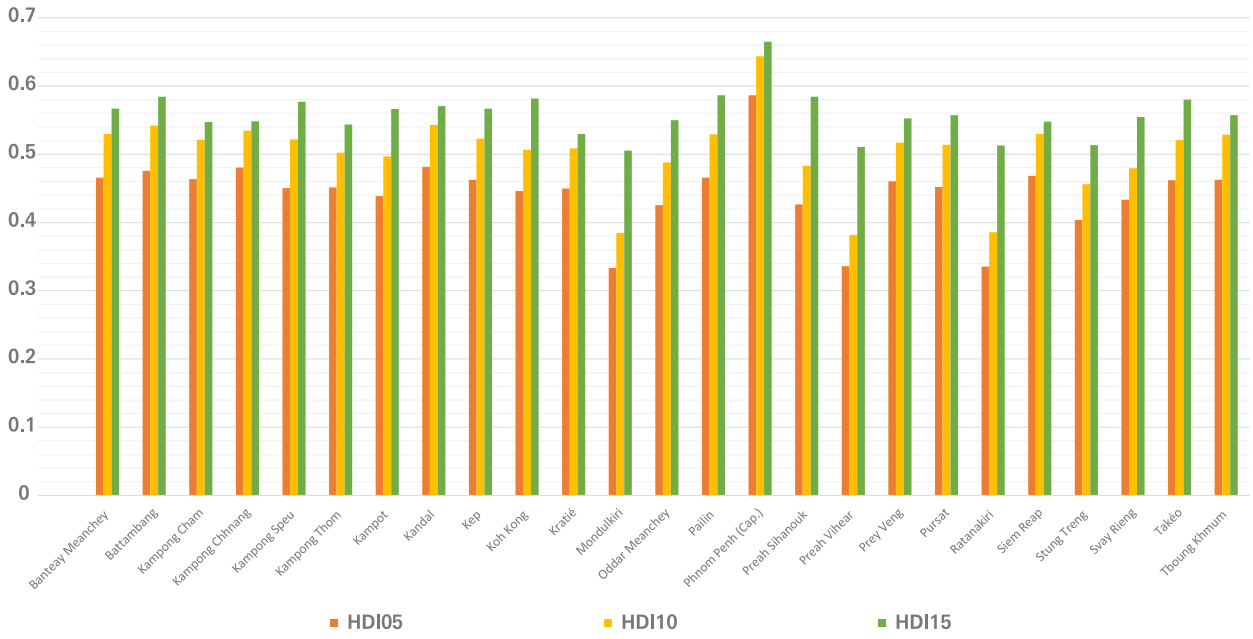
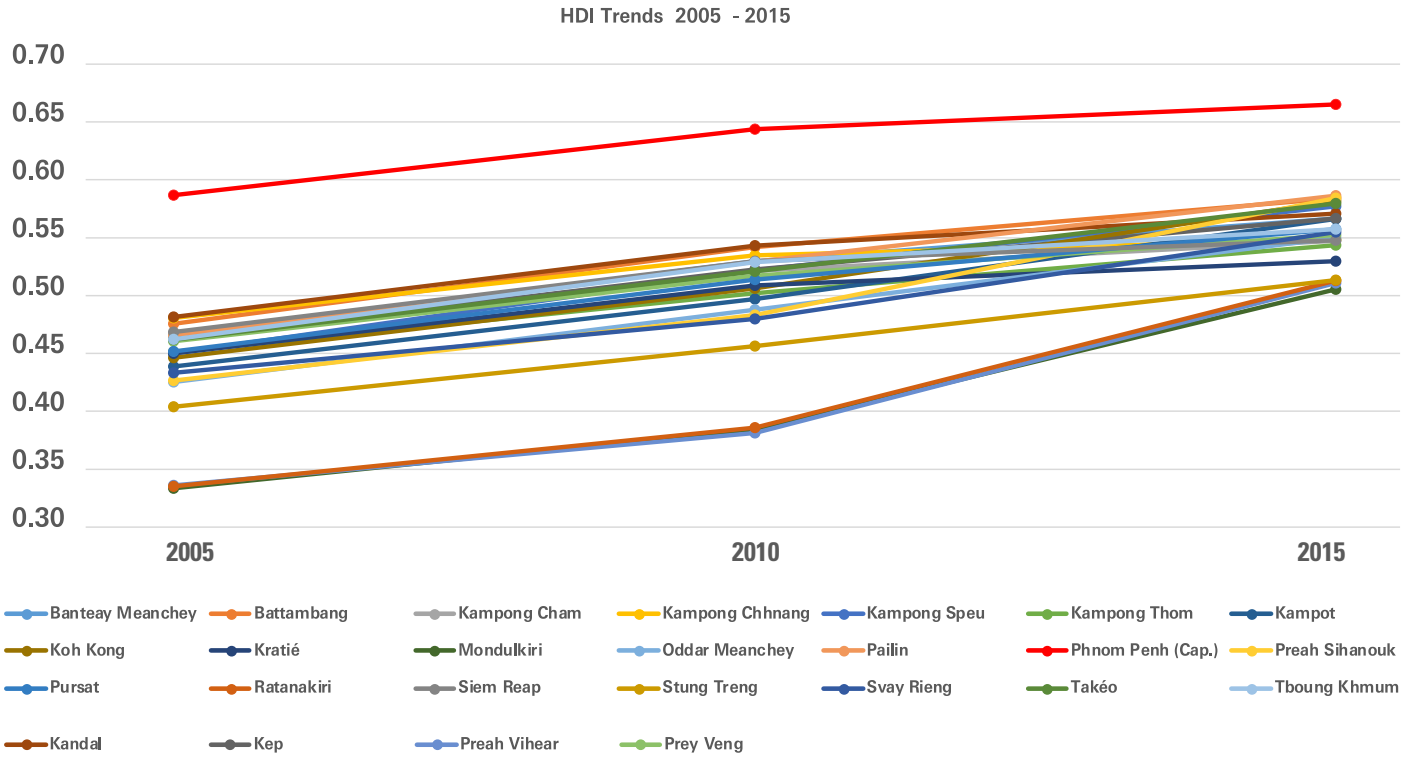


Figure 1.11 underlines the level of catch-up by the most deprived areas, notably Mondulkiri, Preah Vihear and Ratanakiri. A three-group pattern in 2005—Phnom Penh at the top, a cluster of provinces around the average and a persistently lagging group—had by 2015 become a pattern of only two groups, namely, Phnom Penh and the rest.

Figure 1.11.

Lagging areas are rapidly catching up



The level of variation among localities is clearer when rates of change are differentiated from the average level of improvement and average starting position (as in Figure 1.12). This also enables a four-way classification by starting position and performance: (Q1) those places with weaker initial human development position but stronger performance, labelled "*strivers*"; (Q2) those with stronger initial positions and stronger performances, the "*steady and strong*" group; (Q3) those with weaker initial positions and weak performance, a "*laggard*" group; and (Q4) those with strong initial positions but weak performance, the "*strong but slow*" improvers.

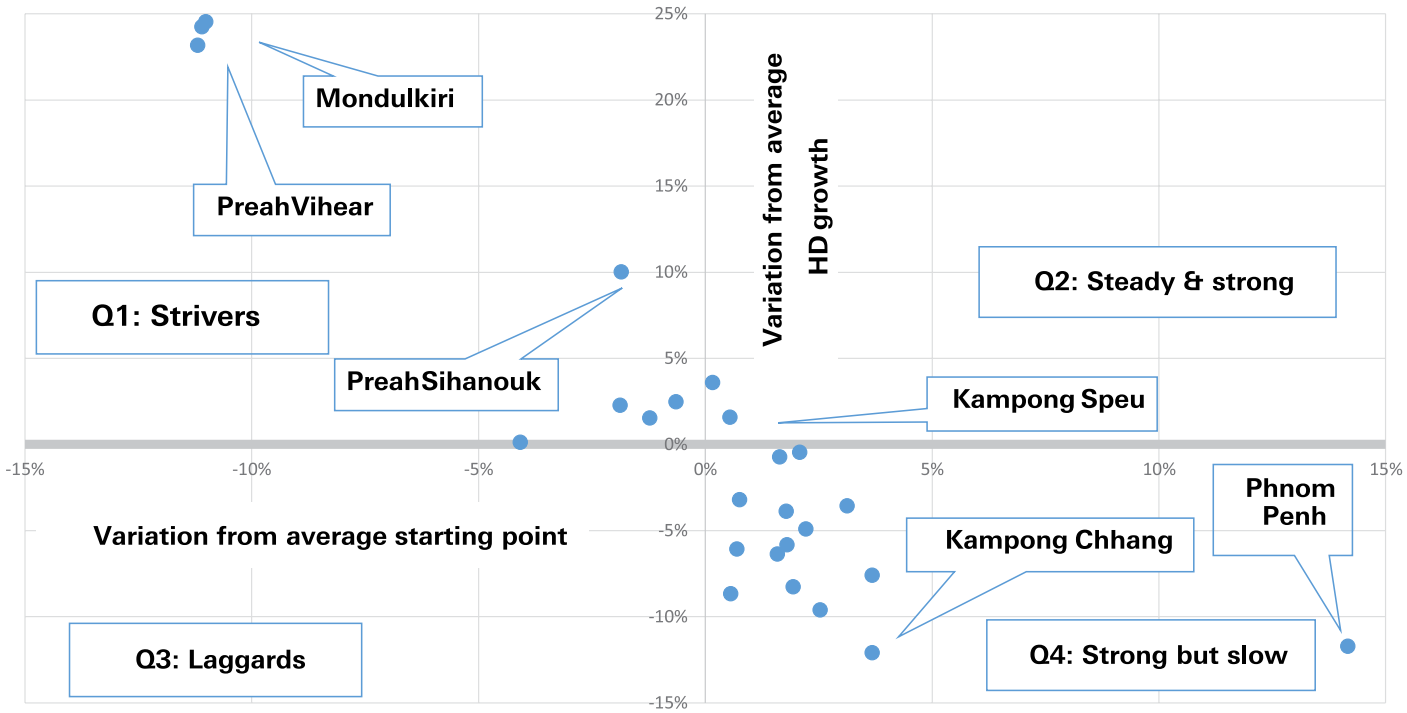
Cambodian provinces fall largely into two categories: traditionally lagging areas, that are quickly catching up; and stronger provinces, with slower levels of improvement.

Cambodian provinces fall largely into two categories: the first, comprising traditionally lagging areas, like Modulkiri and Preah Vihear, that are quickly catching up; and the fourth category of stronger provinces, most notably, Phnom Penh, with slower levels of improvement. A few provinces fall in the second "*steady and strong*" category, such as Kampong Speu, but none fall in the third category of "*laggards*". A large number are clustered around the two average values. To some extent this pattern, with lagging rural areas improving at a higher rate than urban core areas, is predictable, with more developed provinces exhibiting diminishing returns as they reach higher values of the index.

HDI scores are likely to be affected by migration flows from rural to urban and core to non-core provinces during this period. The differential improvement of peripheral versus core areas on life expectancy and education components may be a result of population increases in urban areas and decreases in rural ones, and hence over/under pressure on services. Economic data also suggest a tightening of the agricultural sector's relative productivity, and in turn, an oversupply of labour in core areas that may be depressing income levels somewhat. Nevertheless, the difference between rates of HDI improvement in core and peripheral areas is sizeable.

Figure 1.12.

Starting point is no barrier to improvement in provincial HDIs, but also no guarantee of ongoing improvement



Source: Authors' calculations.

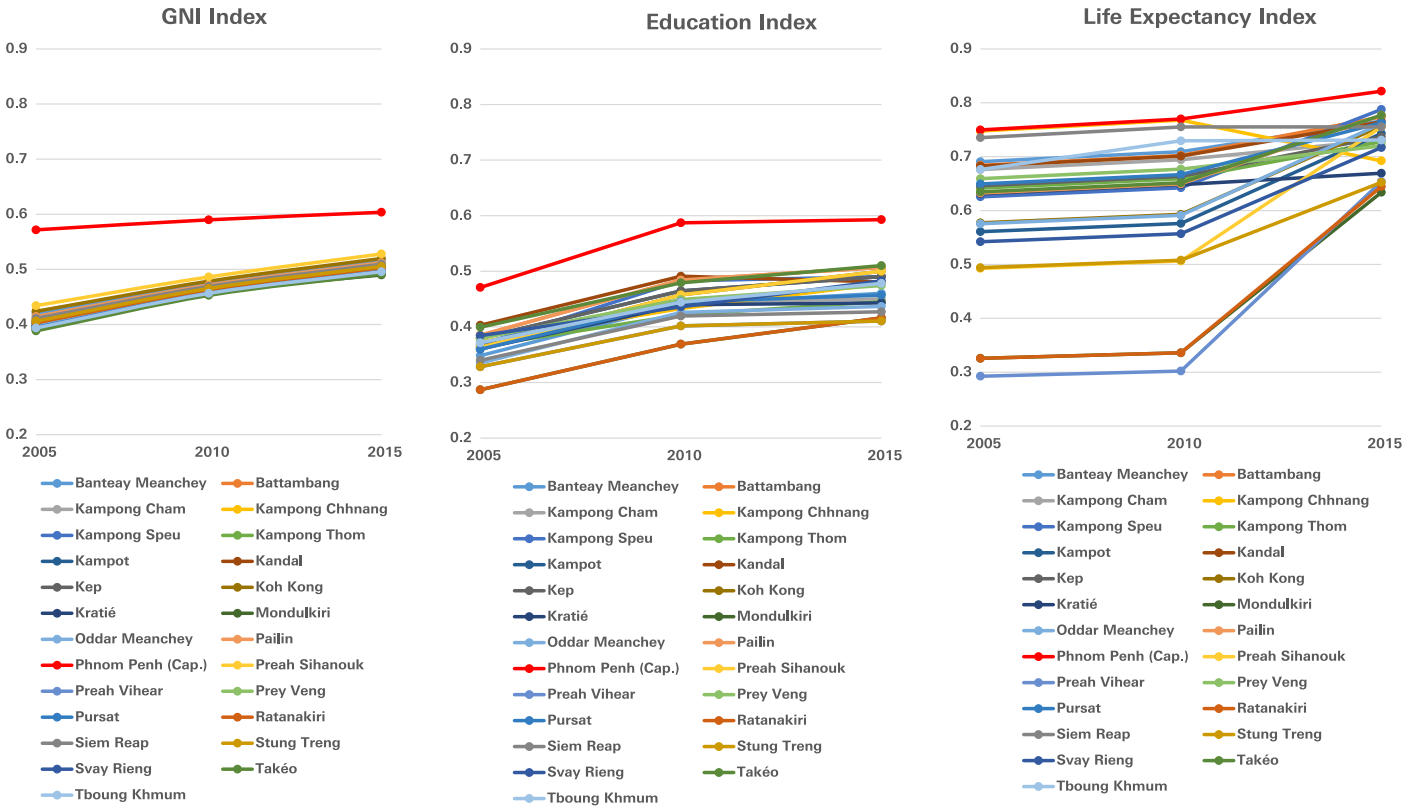
Analysis of the components of the HDI at the provincial level reveals the mix of factors at work (Figure 1.13). As is the case nationally, rapid improvements in life expectancy have been a primary driver of overall human development gains as well as the rapid catch-up in "striving" provinces. Underpinning this have been big improvements in child and infant mortality, particularly at remote locations. Yet this also suggests that diminishing returns will set in as these gaps close.

Educational outcomes generally remain weaker than the other components for all provinces, although there is evidence of higher rates of improvement in areas that were furthest behind. Nevertheless, improved educational outcomes represent an obvious means of boosting future human development, particularly in lagging localities.

Despite continuing improvements in income, the economy's contribution to human development is below what might be expected given Cambodia's strong year-on-year growth. This is largely explained by how the income dimension of the HDI is calculated and Cambodia's ongoing population growth. The variability between areas is also much lower. As noted, migration, which is often driven by differential income levels,[53] could play a role here.

Figure 1.13.

Greater longevity is driving improvements and subnational convergence in human development



Source: Authors' calculations.

Exploring links to natural resource management

The connections between natural resource stocks (including forests) and development are complex and subject to ongoing debates

The connections between natural resource stocks (including forests) and development are complex and subject to ongoing debates. A common theme is the so-called *resource* and also *forest transition*, whereby it is argued that natural resource stocks fall dramatically at the early stages of economic development, with progressively slowing exploitation, followed by recovery at high levels of development. These arguments parallel the concept of the so-called *environmental Kuznets curve*, with environmental damage in nations worsening at low income levels, peaking at middle income before falling back at high levels of income (drawing an analogy with the claimed inverted U-shape relationship between inequality and GNI levels).[54] Yet, like the original Kuznets relation, these claims have been disputed on empirical grounds.

A team at the Helsinki Institute of Sustainability Science has shown that this relationship with regard to forests has a stronger basis if human development data are used. It found a better conditional correlation between forest cover and HDI than GNI or GDP per capita.[55] Specifically, lower HDI countries are associated with rapidly declining forest cover, whereas very high HDI countries tend to have recovering rates. While the team's supporting arguments remain economic—that rural development and improved farming techniques allow forests to find a market rationale (on marginal lands)—the research does demonstrate an independent connection between forest cover and human development. It stops short of claiming a causal link, however.

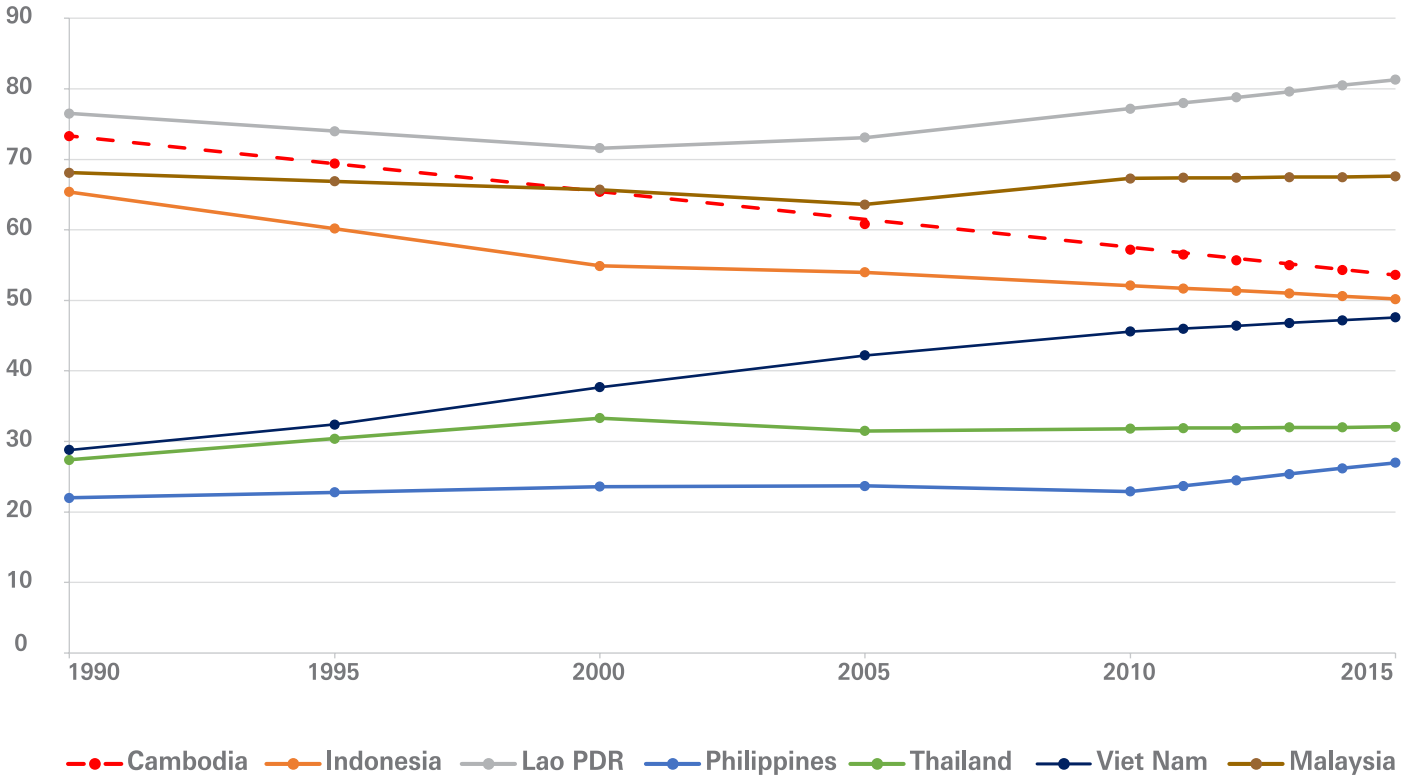
Although this account is somewhat problematic for this report, as it reverses the possible causal path (i.e. that human development influences forest cover, as opposed to cover driving development), it does implicitly acknowledge that the links may be bi-directional. Moreover, for countries where forest cover (or other natural resources) is an especially significant feature of the economy and environment, natural resource management is likely to be developmentally important. The rationale for this is set out at the opening of this chapter in terms of both the short-run connections (the supply of goods and services, including amenities, and the impacts on livelihoods, nutrition and health) and the long-run ones (the contributions of forests to ecosystems and the regulation of the climate). The latter, given contributions to resilience and human security through combating risks such as floods and droughts, especially within forest communities, would be the more significant.

Effective resource management must be developmentally salient, and beyond its narrow contribution to economic growth, or even potentially, the variables given within human development metrics

For Cambodia, with medium human development levels and lower middle-income country status, this study implies a transition should be taking place. Global data (given in Figure 1.14) tentatively support this, with some slowing in the rate of decline of forest cover. Later data for 2018 (see Figure 0.2) show that Cambodia retains a large forested area (46.86 percent of Cambodia's territory in 2018). Therefore, effective resource management must be developmentally salient, beyond its narrow contribution to economic growth, or even potentially the variables given within human development metrics.

Figure 1.14.

Forest cover in Cambodia is still high, and the rate of decline is slowing



Source: UNDP Human Development Report Office calculations based on data on forest and total land area from FAO 2018.

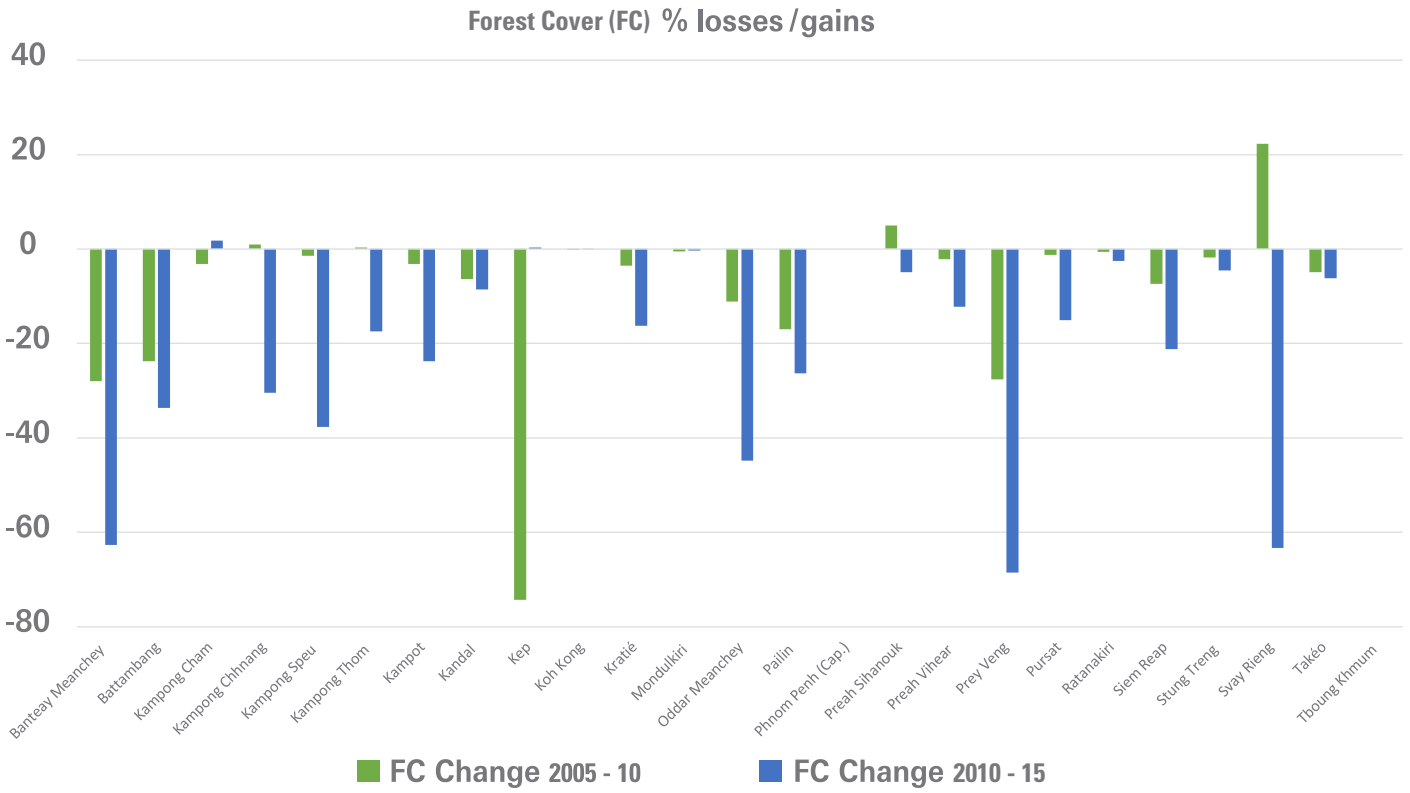
This does not mean that natural resource management should be simply focused on ensuring the preservation of traditional subsistence livelihoods in forested areas, and somehow arrest their development. Rather, viable strategies should include managing structural change in the economy, alongside sustaining the environment and delivering a model of development able to promote resilience over the long run. Moreover, more productive local economies could build on the effective use of forests as a modern resource to drive higher value-added activities ranging from commercial forestry to high-end furniture to eco-tourism.

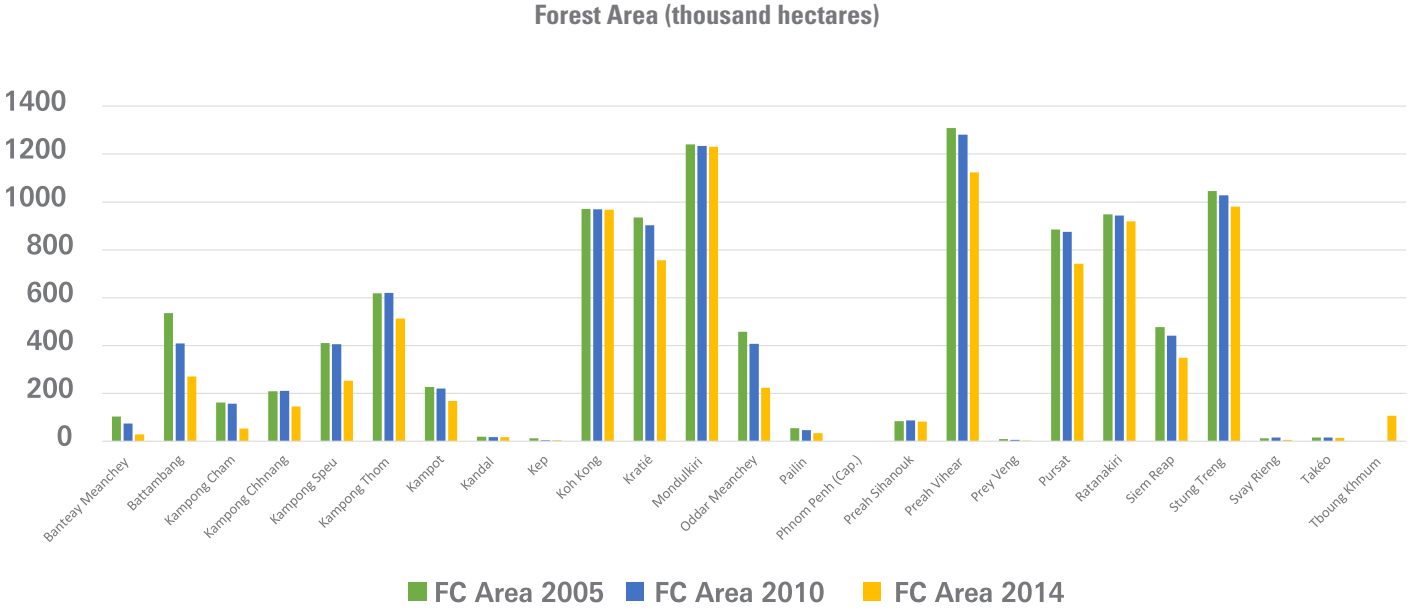
The core argument of UNDP's global *Human Development Report* in 2011 was that while there are trade-offs between economic and environmental objectives, these are not fundamental and complementarities exist. The challenge therefore, is to manage the former and maximize the latter, securing win-win outcomes. This is especially true when taking a longer-term view and accounting for all externalities.[56]

Finding evidence to make these connections in Cambodia is statistically difficult. Data are limited in scope and period, and human development metrics are potentially too narrow to capture the full contribution made to human development more broadly. Nevertheless, quantitative methods can help explore the connections, including through using provincial forest cover data over a 10-year period from 2005 and the HDI data provided above. At the subnational level, as Figure 1.15 shows, while some provinces have seen major losses in forests, others have experienced little change. The largest reductions have taken place in the least forested areas, such as Kep and Svey Rieng. In many heavily forested areas, such as Koh Kong, Mondulkiri and Ratanakiri, coverage remains largely intact.

Figure 1.15.

Patterns of forest loses vary: the most forested areas often see smaller declines





Source: Royal Government of Cambodia 2018; also see Appendix B.

Comparing forest cover and HDI data with basic correlation analysis, as reported in Table 1.1, shows that highly forested areas tend to have lower levels of HDI, with relatively high negative correlation coefficients (Product Moment or Spearman's Rank, and regardless of whether forest cover is measured in absolute or percentage terms).[57] Nevertheless, there is some variation between measures and a decline in the strength of the correlation in 2015.

This is not a causal relationship per se. It simply reflects the reality that forested areas are often also the most remote and poorest, and by extension, their peripheral location and lower level of infrastructure drives their underdevelopment. But it does suggest that forest cover is important for human development and that change is underway. Two findings arise from these data.

First, for lagging areas, forests matter for human development. They are a key natural resource that local people currently rely on, and have relied on for generations, for basic needs and livelihoods. While this may change over time, as the economy evolves, and new opportunities arise, natural resources will remain core to these areas' comparative advantages, and should therefore be managed for developmental gains.

Forests matter for human development, they are a key natural resource that local people have relied on for generations for basic needs and livelihoods

Second, while it is clear that the strength of this correlation has declined over time, as lagging (and hence forested) areas have caught up with other areas in Cambodia (again Table 1.1), much potential remains for further catch-up. Given the size and populations of these areas, this dynamic has driven national improvements in HDI. Efficient management of these resources is likely to be central therefore to Cambodia's overall developmental performance.

Table 1.1.

Forest cover correlates negatively with human development

	2005	2010	2015
HDI/forest cover in hectares			
Correlation coefficient	-0.6834	-0.6897	-0.6174
Rank correlation coefficient	-0.5676	-0.5672	-0.5808
HDI/forest cover as percentage of area			
Correlation coefficient	-0.6558	-0.6829	-0.5429
Rank correlation coefficient	-0.6842	-0.6977	-0.4261

Source: Authors' calculations.

Limited data prevent a prediction about the possible long-term contributions to human development through improved resilience. While some basic regression analysis using change variables was undertaken with provincial forest cover and HDI data, the results were far from compelling, suggesting only a very tentative connection over time.[58] This underlines the need for further research and for caution in claiming causal connections. As always, correlation is not proof of causation.

Conclusions: Building on gains to accelerate progress

Improvement in the HDI has consistently ranked in the global top 10, human development in Cambodia still lags behind its neighbours. Acceleration is needed if Cambodia is to realize its potential

Human development in Cambodia has progressed rapidly over the last two to three decades. The national rate of improvement in the HDI has consistently ranked in the global top 10. But the level of human development in Cambodia still lags behind that of its neighbours, and acceleration is needed if it is to catch up and realize its potential. Key to strong performance has been steady progress on income, and exceptional gains in life expectancy. On the latter component of human development, Cambodia has overtaken several comparable countries. Problematically, going forward, it will begin to reach ceiling levels of longevity, and diminishing returns may set in. This underscores the need to address weaker components of human development, specifically education, which may also drive gains in the income component and mitigate diminishing returns via longer term improvements in productivity.

Trends in human development measures of inequality have been very positive, but again Cambodia still lags neighbouring countries. Efforts are needed to ensure outcomes match strong performance on income inequality, where Cambodia's Gini coefficient is one of the lowest in the comparator group. All sections of society need to benefit from the expansion of human development. This depends greatly on improved public service provision, specifically access to decent quality schooling and health care, but additionally, comprehensive social protection and improved public infrastructure are important. A similar case can be made for gender equality and women's empowerment, where despite long-term improvements, Cambodia still lags comparable countries, and more vigorous action is required to tackle disparities.

As in many countries, subnational patterns of human development vary considerably. Core regions and most clearly the capital city, enjoy higher levels of human development, while peripheral areas do not fare as well. Although there has been convergence, disparities remain. However, there has been significant change in how human development gains are distributed across provinces. A three-group pattern, with Phnom Penh as a high performer, a cluster of provinces around average performance and a group of remote lagging areas, has transitioned into two groups, with the lagging areas absorbed into the average performers. Underpinning this achievement has been remarkable progress in life expectancy and years of schooling in provinces like Mondulkiri, Ratanakiri and Prey Vihear.

Finally, in line with established connections between natural resource stocks and development, evidence shows that forest management in Cambodia is an important consideration for lagging and poorer provinces where forest cover is significant. Given the high populations of these areas and their potential for further catch-up, human development levels overall will depend on how forest resources are leveraged to deliver wide socioeconomic development.

Given the sheer size and scale of Cambodia's forests, it is clear that they will continue to play a vital role in regulating ecosystems and the climate, and in supporting the material needs of local communities

It has not been possible to provide empirical evidence to demonstrate the long-term human development gains accruing from improved resilience as a result of better natural resources management. Yet given the sheer size and scale of Cambodia's forests, it is clear that they will continue to play a vital role in regulating ecosystems and the climate, and in supporting the material needs of local communities. Thus, in turn, better forest management must be supportive of improved human development.

Chapter 2

Sustainable timber production

Photo credit: Grandis Timber

2. Sustainable timber production

Cambodia's forests are extensive, yet under serious pressure. In 1975, forests stretched over 73 percent of the country, but by 2018, they had shrunk to 46.84 percent.[59] As the forests disappear, so do essential resources that many people need for energy, food, medicine and livelihoods.

While reasons for the losses vary, one of the most significant ones relates to constantly rising demand for wood for construction, firewood, and charcoal. Meeting this demand mostly involves unsustainable supplies, such as from economic land concessions, hydropower and mining projects, imports, and confiscated illegal timber, leading to a spiral of degradation for people and ecosystems.

There is an urgent need to move towards sustainable management of forests, while enhancing forest productivity

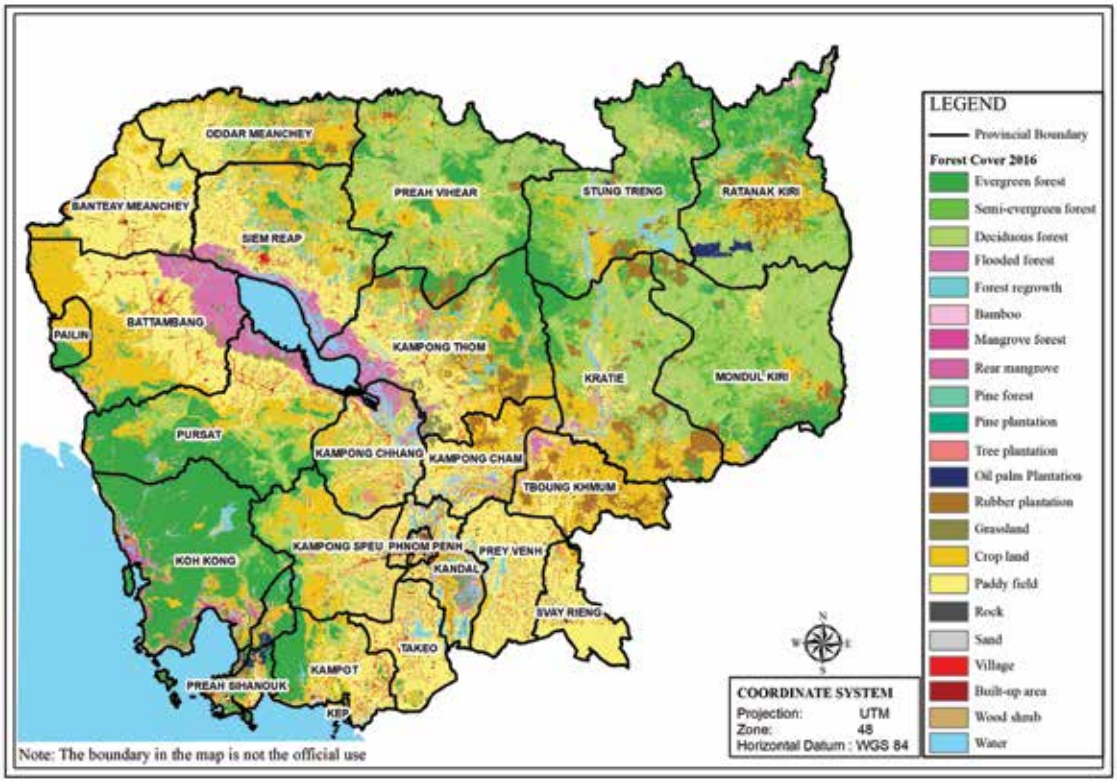
There is an increasingly urgent need to move towards sustainable management of forests, oriented around enhanced productivity and the careful stewardship of ecosystem resources. Equally, sustainably managed forests contribute to human development and build resilience to climate and other risks through healthier ecosystems and more options for livelihoods.

The state of forests today

Cambodia's forests cover 8.7 million hectares according to data from 2016 (Figure 2.1). There are five major types: evergreen (15.8 percent); semi-evergreen (5.9 percent); deciduous, including dry dipterocarp forests (18.4 percent); flooded forest (2.6 percent) and others. The last comprises regeneration and regrowth forests; mangroves; rubber, tree and oil palm plantations; and bamboo.[60]

Figure 2.1.

Forest cover map 2016



Source: Royal Government of Cambodia 2018

In 2002, the Government introduced a moratorium on logging permits to arrest deforestation. Most production forestry concession agreements were cancelled by 2006. Today, because there are no active forest concessions harvesting timber, some wood is supplied through unauthorized logging and harvesting, and through residual wood produced through clearing forests for economic land concessions for large-scale commercial agriculture. Given the 2012 moratorium on economic land concessions and rapidly growing demand for fuel and construction timber, pressure on protected areas and other forest areas is likely to escalate.

Towards sustainable forest management

Mitigating this pressure and moving towards sustainable forest management starts with restoring degraded forests and bolstering productive capacity in the 15 percent of forests currently reserved for timber harvesting (1.3 million hectares out of 8.7 million hectares of forests overall).[61]

Sustainable forest management is a financially viable and socially responsible strategy to make sure that ecosystems and ecosystem services function well over the long term. It integrates the social, economic and ecological dimensions of resource use, and supports human development through different channels. These can include providing timber to rural communities who depend on these resources for a living and safeguarding a clean water supply.[62]

Cambodia's Forest Law builds on sustainable forest management principles.[63] Various initiatives have been piloted through community forestry, partnership forest restoration, rehabilitation, fuelwood production and REDD+.[64] However, concrete steps to promote the sustainable management of production forests and guarantee the long-term provision of timber to meet rising demands are still in early stages.

Considering the options: seven sustainable forest management models

Cambodia faces a dearth of knowledge on alternative timber production strategies that are economically viable as well as oriented around sustainable forest management and human development. To provide a sense of the options, seven sustainable forest management models were assessed, mainly along financial parameters, but broader ecological and social dimensions, including human development gains, were also emphasized.

Two different forest categories, planted and natural forests, were modelled. Different management regimes were applied, namely: the private sector, concessions, community forestry and regulation by the Forest Administration. For planted forests, the assessment focused on the most common species such as acacia, eucalyptus and teak. It compared the models with a Baseline Model (a) of degraded land with frequent bush fires. For the natural forests, lowland and upland forests were represented and compared with a Baseline Model (b) of illegal logging.

The seven cases, summarized in Table 2.1, were grounded in practice and experience in Cambodia, and based on representative examples of existing forest management (when available) or on hypothetical but feasible cases. They thus offer realistic options for sustainable forest management. Assessing the models entailed a definition of biological and economic production models; the identification of two cash flow streams (costs/outputs and benefits/inputs); a calculation of net cash flows and carbon storage benefits; and a summary of results by forest stocks, carbon stocks (at beginning and end) and investment requirements. These steps are further described in Annex 1.

Sustainable forest management is a financially viable and socially responsible strategy to make sure that ecosystems and ecosystem services function well over the long term.

Table 2.1.

Examples of potential sustainable and human development gains modelled in the assessment

Type	Planted Forest				Natural Forest		
Baseline	Baseline Model (a) Degraded land with frequent bush fires; no timber or carbon storage				Baseline Model (b) Illegal logging; no management and no timber left		
Case	**Case 1**	**Case 2**	**Case 3**	**Case 4**	**Case 5**	**Case 6**	**Case 7**
Species/ types	*Acacia mangium*	*Tectona grandis*	*Tectona grandis*	*Eucalyptus sp.*	Lowland forest	Upland dry dipterocarp forest	Lowland forest
Forest Manager	**Private**	**Private**	**Forestry Administration**	**Forestry Administration**	**Community**	**Forestry Administration**	**Concession**
Production objectives	Commercial timber mix	High-value timber	High-value timber	Industrial wood (fire/ pulp wood)	Timber and non-timber forest products	Carbon stock increase, later timber	Timber

Group 1

Sustainable forest management in planted forests

Case Study 1: *Acacia mangium* by a private company

There are private commercial afforestation/reforestation companies such as Think Biotec LLP that afforest degraded land mainly with *Acacia mangium*, which could play a major role in such activities in Cambodia. The company is planting acacia for climate change mitigation (mentioned in the Climate Change Memorandum of Understanding between the Royal Government of Cambodia and the Government of the Republic of Korea), while promoting the sustainable supply of wood. As the company's production data were not available, a theoretical case was constructed.

Case Study 2: *Tectona grandis* (Teak) by a private sector operator

Grandis Timber Limited is a commercial reforestation company certified by the Forestry Stewardship Council. It focuses on the establishment of timber plantations on previously deforested land. The company signed a contract with the Ministry of Agriculture, Forestry and Fisheries for a land lease period of 50 years on an economic land concession in Kampong Speu province. It employs 150 permanent staff and up to 750 seasonal labourers. As production data were unavailable, the appraisal is based on estimates from the available certification reports, and assumed costs and benefits based on field experience.

Case Study 3: *Tectona grandis* (Teak) by the Forestry Administration

A theoretical example was assessed, where the Forestry Administration manages a high-value timber plantation, i.e., *Tectona grandis*. The example is based on a plantation legally owned and closely monitored by the Forestry Administration. It covers an area of 60 hectares. The plantation was established in 2001 in Kampong Cham province, Dam Bay commune. It is intended to promote commercial forestry and increase national income through the forestry sector.

Case Study 4: *Eucalyptus* by the Forestry Administration

Industrial wood plantation for firewood and/or pulp wood production plantation with eucalyptus. The sample plantation was established in 2002 in Takeo province. The site covers an area of 357 hectares (divided into four different blocks). Growth data for the example were taken from literature.

Group 2

Sustainable forest management in natural forests

Case Study 5: Community forestry in Kampong Thom

Prey Kbak Ou Kra Nheak Community Forest was selected as a representative example of a dry dipterocarp species forest. It consists of semi-evergreen and deciduous forest and covers an area of 1,593 hectares. The area is legally managed by the community under a contract signed between the community and the Forestry Administration with a 15-year management mandate. The contract will be renewed every 15 years according to the results of the management by the community, as stated in a clause of the agreement.

Case Study 6: Rehabilitation of degraded dry dipterocarp forest by the Forestry Administration

The area is in the process of becoming a community managed forest, and is currently affected by heavy degradation, illegal logging, seasonal fires and uncontrolled firewood collection. Currently, the area is under restoration to increase forest cover and increase timber stock, while promoting the sustainable use of non-timber forest products and firewood supply to the local community.

Case Study 7: Mondulkiri concession

This sustainable forestry model is similar to Model 5 (community forestry), but the forest concession model is applied by the community, which acts as a concession. The community-based production forestry demonstration project in the Buffer Area of Seima Protection Forest is testing a new modality of implementation for the 2003 Community Forestry Sub-decree. The work is part of the long-term collaborative Forestry Administration/World Conservation Society programme to manage the Seima Protection Forest for environmental and social benefits. Currently, the area is part of the Seima Wildlife Sanctuary, which is under the jurisdictional management of the Ministry of Environment.

- The Phase 1 target forest area is around 12,750 hectares of logged evergreen, semi-evergreen and mixed-deciduous forest, with a high percentage of trees from the genus *Lagerstroemia*.
- The Phase 2 area covers about 29,000 hectares of similar forest in Sre Chhuk commune, Mondulkiri province and Khseum commune, Kratie province.

Modelling approach and key indicators

Key financial indicators were used to compare the financial and overall viability of the models and combined with a risk assessment of each model.

- *Internal rate of return* shows the annual percentage return on capital. It measures the potential profitability of the models.
- *Net present value* measures projected profitability over time. It is calculated by discounting future values of expenses and incomes back to the present to show today's value.
- *Cash break-even* indicates the point in time when revenues equal investments (costs) and thus evaluates financial performance.

Several assumptions were used related to desired (or target) forest growing stock, species, wood density, biomass expansion, forest produce and timber harvesting. Specific assumptions on baselines, forest growth, silviculture, costs and benefits included:

- The proposed forest manager has full, legal and unlimited access to land and forest resources during model periods of 20, 50 or 100 years.
- The scenario can be implemented by trained, motivated and fully dedicated staff, according to a forest management plan.
- Development costs, which might be substantial, are borne by organizations outside the model.
- There is market access for legal forest products.

Economic estimates covered forestry activities, timber and non-timber forestry product sales prices, lease and labour costs, and development costs. Assumptions were based on existing data (when available), field assessments, extensive literature review, and standard or average conversion factors and rates.

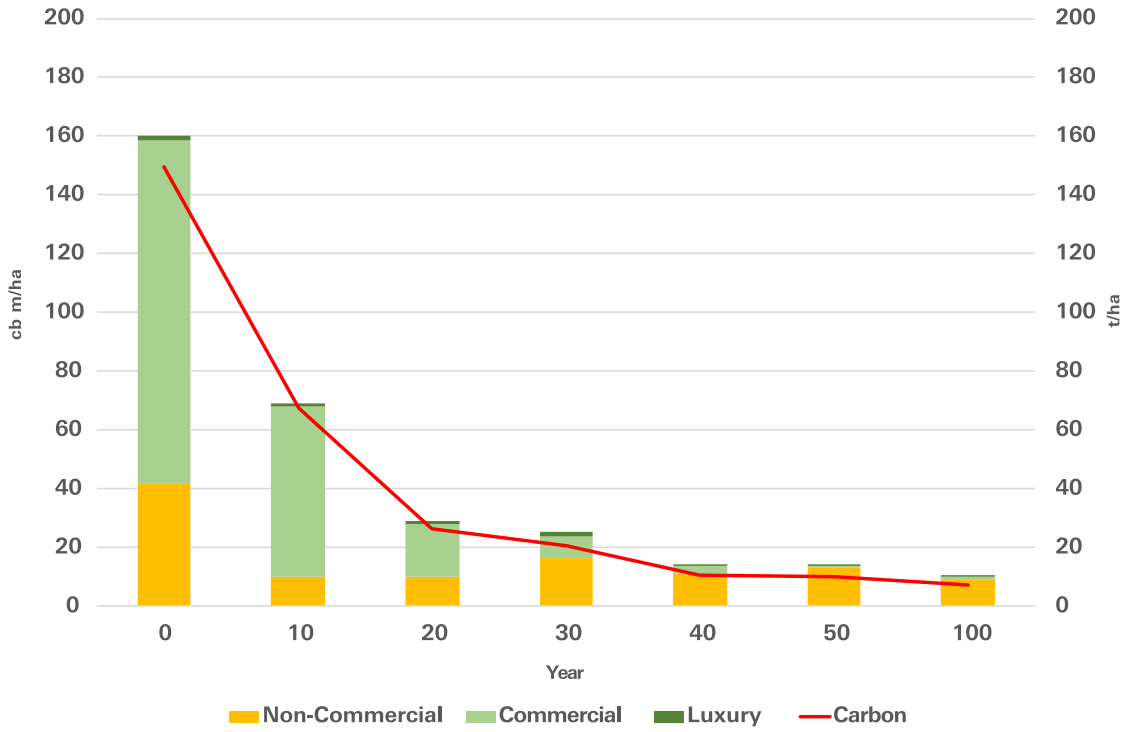
A wide range of costs and benefits

The modelling showed that Case 2 (planted teak) performs well on all indicators, followed by Case 1 (planted acacia). Case 5 (natural forest managed by the community) also stands out as financially attractive, especially with carbon investments. Case 6 (rehabilitation by the Forestry Administration) and Case 7 (concession) perform poorly.

Results across the individual models were further compared with the baseline scenarios. Only Baseline Model (b), the illegal cutting of natural forests, was assessed economically. This demonstrated that although illegal logging activities have highly lucrative internal rates of return of more than 80 percent and a net present value of $3,182, they are neither sustainable nor beneficial for human development (Figure 2.2).

Figure 2.2.

Baseline Model (b) on the hypothetical illegal cutting of natural forests



100 years of illegal logging was modelled, based on the following scenario:

- Forests consist of luxury timber (1 percent), commercial timber (74 percent) and non-commercial timber (25 percent);
- In the first illegal activity, about 100 cubic metres per hectare are stolen; and
- The average growing stock is only 19 cubic metres per hectare (33.2 tons of biomass), but in total, 1,881 cubic metres per hectare are harvested.

Key results:

- Internal rate of return: 81 percent over the entire period
- Net present value: $3,182
- Benefit-cost ratio: 2.01

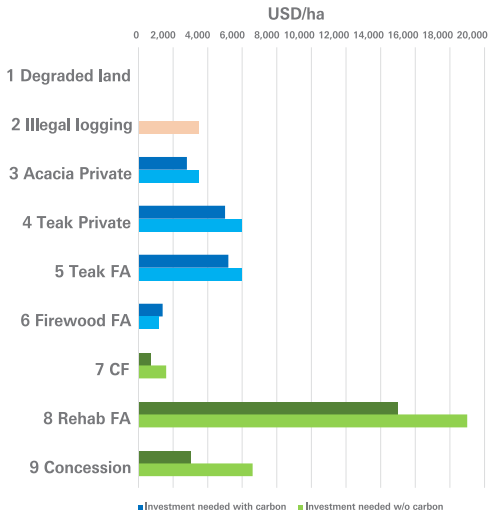
Compared with Baseline Model (b), the seven sustainable forest management models are less financially attractive (Figure 2.3). Some stand out as both financially viable and beneficial for human development, however, even keeping in mind that all seven are based on sustainability principles and the goal of increasing direct benefits to local livelihoods.

Overall, privately managed teak and community forestry perform well, while rehabilitation by the Forestry Administration and concession perform poorly. This is based on comparisons across investment need, internal rate of return, net present value with a 12 percent discount rate, and benefit-cost-ratios with a 12 percent discount rate. On Figure 2.3, the darker shading represents the cases with carbon funding, the lighter shading those without carbon funding.

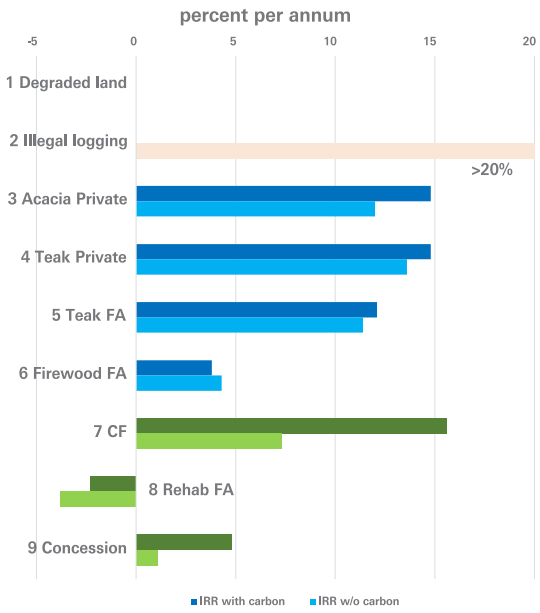
Figure 2.3.

A summary of results for the seven cases and Baseline Model (b)

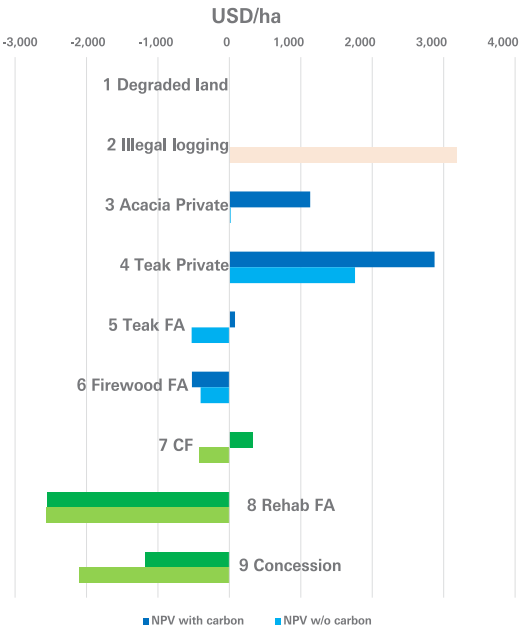
(A) Investment needs



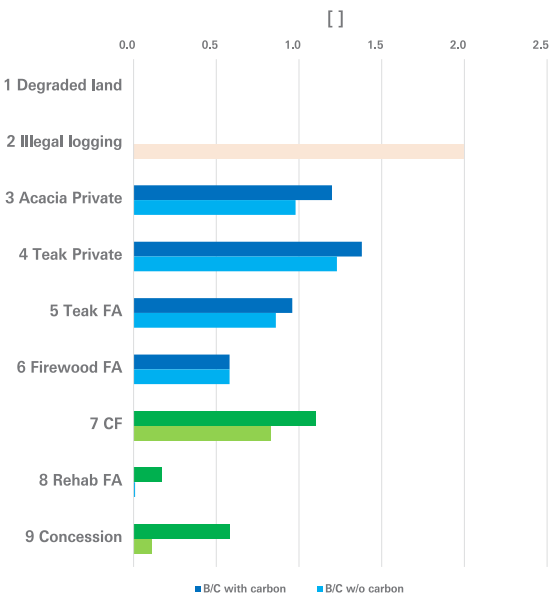
(B) Internal rate of return



(C) Net present value



(D) Benefit-cost ratio



Of the seven cases, Case 2 (privately managed teak plantations) is the most attractive for investment (Table 2.2). But it shows a cash break-even period of 20 years. Shorter periods are only possible through acacia and eucalyptus management (15 years) or community forestry with carbon revenues (10 years). The last yields very attractive internal rates of return of between 11 percent and 16 percent per year in relation to the model period (10 years and 100 years, respectively).

Community forestry has the lowest investment requirements and includes the extraction of non-timber forest products by communities. The same forest managed by a concession would need 75 years (without carbon money) or 25 years (with carbon money) to reach cash break-even. Concession management produces low returns of only 1 percent to 5 percent per year, although it promises other environmental and social benefits.

The cases revealed that artificial rehabilitation of degraded forests takes time spans of more than 100 years to break even. Investment costs are very high and do not pay back in monetary terms within the modelling period.

Table 2.2.

Only community forestry shows acceptable returns within 10 years

	Planted Forest				Natural Forest		
Parameter	Case 1, acacia, private	Case 2, teak, private	Case 3, teak, Forestry Administration	Case 4, eucalyptus firewood	Case 5, community forestry	Case 6, Forestry Administration rehabilitation	Case 7, concession
Internal rate of return first 10 years (percentage per year)	**./.**	**./.**	**./.**	-8.8	-0.8	**./.**	**./.**
Internal rate of return entire period (percentage per year)	12.0	13.6	11.4	4.3	7.3	-3.8	1.1
Cash break-even	15	20	20	15	20	**./.**	75
With carbon investments$_{(-C)}$							
Internal rate of return$_{10\text{-}C}$ (percentage per year)	-13	**./.**	**./.**	-9.0	10.5	**./.**	**./.**
Internal rate of return$_{n\text{-}C}$ (percentage per year)	14.8	14.8	12.1	3.8	15.6	-2.3	48
Cash break-even$_{\text{-}C}$	15	20	20	15	10	**./.**	25

Notes: Internal rate of return over the entire modelling period in percentage per year. Net present value over the entire modelling period. Cash break-even point in years, when revenues equal investment costs. Carbon credits (-C) of $1 per ton included in appraisal. ./. not available, not computable. Red indicates negative indicators.

Assessing potential risks

Risk analyses of each of the seven models assessed feasibility, potentially negative impacts and the likelihood of success. They covered information availability, environmental impact, the probability of model occurrence and the mitigation of negative impacts (Table 2.3). This exercise yielded mixed results. Teak and natural forests managed by communities perform best, together with rehabilitation by the Forestry Administration, which does, however, include high risk mitigation measures. The concession model has the highest overall risk.

For planted forest management, risks related to information availability are low to moderate. Environmental impacts due to pests and disease are at least moderate, and high for eucalyptus (Case 4). The probabilities of negative impacts are at least moderate to high, and high for eucalyptus. Mitigation measures are available, but need proper enforcement.

For natural forest management, risks related to information availability are moderate to high given that models are based on relatively weak evidence. Expected negative environmental impacts are low except for the concession model, where unattractive financials will trigger cost-savings by concessionaires. Mitigation measures are available, but due to the high cost in the Forestry Administration rehabilitation case, inappropriate implementation can be predicted.

If the scoring system is applied across the models, the community forestry approach scores best, while the concession approach scores worst. Acacia and privately managed teak show similar risk scores. Surprisingly, Forestry Administration-managed rehabilitation and teak management score identically, and are even one score better than acacia and private teak. The scoring also reveals that eucalyptus/firewood management is the second most risky management approach.

The lack of information is the most striking risk factor. In this respect, mitigation measures show the lowest risks. Environmental impacts and their probability of occurrence score identically and are close to mitigation measures.

An example of information shortage concerns forest growth and associated harvests, which are the biological value drivers in forest appraisals. Systematic forest growth assessments are not available, and existing studies draw a blurred picture of species performance, concluding that Cambodia is not yet maximizing growth potential.

With one exception (Case 5, community forestry), all cases and parameters score over 50 percent and up to 80 percent on risk scores, indicating high overall uncertainty for sustainable forestry management in Cambodia.

Table 2.3.

Risks vary, with teak and community-managed natural forests scoring best

	Planted forest				Natural forest			
	Case 1 acacia, private	**Case 2 teak, private**	**Case 3 teak,Forestry Administration**	**Case 4 eucalyptus firewood**	**Case 5 community forestry**	**Case 6 Forestry Administration rehabilitation**	**Case 7 concession**	**Total (score)**
Information availability	Moderate(3)	Moderate(3)	Moderate(3)	Low Moderate(2)	Moderate(3)	Moderate High(4)	High(5)	**23 of 35**
Environ-mental impact	Moderate(3)	Moderate(3)	Moderate(3)	High(5)	Low Moderate(2)	Low(1)	Moderate High(4)	**21 of 35**
Probability of model occurrence	Moderate High(4)	Moderate High(4)	Moderate(3)	High(5)	Low(1)	Low(1)	Moderate(3)	**21 of 35**
Mitigation measures	Low Moderate(2)	Low Moderate(2)	Low Moderate(2)	Low Moderate(2)	Moderate(3)	High(5)	Moderate High(4)	**20 of 35**
Total (scoring)	**12 of 20**	**12 of 20**	**11 of 20**	**14 of 20**	**9 of 20**	**11 of 20**	**16 of 20**	

Varying assumptions

Private teak plantations and natural forest managed by communities not only perform best but also are less risky

To highlight various external factors, the assessment changed some fixed assumptions. This process highlighted, for example, that timber prices affect return rates, based on Case 4, eucalyptus managed by the Forestry Administration. Timber and firewood markets tend to normalize when the illegal timber supply is cut off. If the sales price increases, then the internal rate of return over 10 years would improve significantly, making firewood production financially attractive.

For Case 7, concession, cost reductions from land lease and overheads (to $10 per hectare per year) and an income increase from subsidies (of $20 per hectare per year) did not significantly improve financial attractiveness. This confirms that the main value driver is the timber price.

Change in the discount rate had little effect for the natural forest models. A modified discount rate (10 percent or 15 percent as opposed to 12 percent) still produced negative net present values, except for a 15 percent discount rate in the community forestry case with carbon funds. Higher discount rates mean lower present values for future cash flows. Increased carbon returns (of $2 and $4 per ton compared to $1 per ton) showed positive internal rates of return, with the exception of rehabilitation at $2 per ton.

Rehabilitation of natural forests through communities gives mixed outcomes, based on case 6, rehabilitation by the Forestry Administration. This variant led to lower growing stock at the end of the modelling period and lower carbon stock. But investment requirements were more than halved, and the cash break-even was achieved in year 100 with carbon funding of $1.46 per ton.

Two top performers: private teak and community forests

Overall, the assessment of different models under various forestry management regimes showed that private teak plantations and natural forest managed by communities not only perform best but also are less risky. The fact that the hypothetical illegal logging Baseline Model (b) outperforms all seven models financially partly explains why illegal logging prevails. Yet this finding should be seen in the light of potential human development benefits offered by sustainable management, such as increased living standards and resilience, and climate change mitigation.

Sustainable forestry management is economically viable, although several challenges must be addressed. These include limited information on different types of forests, their locations and current status; tenure insecurity and limited authority of forest managers; outside pressure on forest resources through illegal logging; and the limited capacity of forest managers.

Planted forests (cases 1-4): All models are promising and financially attractive with positive internal rates of return. Suitable species (e.g., acacia and teak) are well established and easy to manage from a silvicultural point of view. Acacia species are more prone to pests and diseases, a risk that should be taken into consideration.

Production of high-value timber (teak) through a private sector management approach is one of the most economically attractive models, with a higher internal rate of return over the entire modelling period, at 14.8 percent, than the other six models.

Eucalyptus, if planted for firewood production, is financially viable, with an internal rate of return over the modelling period of 4.3 percent, but still has a negative net present value. This is due to very low timber prices as cheaper timber is available from illegal logging. The timber price is likely to increase in the future once illegal logging is controlled, however. This would make short rotation forestry more financially attractive in addition to the expected gains in human development and sustainability.

Natural forests (cases 5-7): Among natural forest models, a community-based management approach is the most attractive in terms of biological and financial sustainability, with an internal rate of return over the modelling period of 7.3 percent. To achieve this result, however, communities must have full resource management rights, going beyond mere rights of use and sale of non-timber forest products. This will support human development through strengthened capabilities and increased autonomy in decision-making, among other gains.

Rehabilitation of natural forests by the Forestry Administration is not financially viable, with a negative 3.8 percent internal rate of return over the modelling period. A pure rehabilitation approach to heavily degraded natural forests in areas with extensive illegal logging is very expensive with a high investment requirement of $18,752. Cash break-even through timber harvests and carbon funding alone will not be realized within 100 years. Rehabilitation by communities with carbon funds is less expensive, and achieves greater local empowerment and higher incomes.

Frequent low-volume harvesting in natural forests as practised, for example, by communities shows better economic performance than standard concession approaches. In addition, it promises greater and more sustainable development benefits by promoting resilience in both forests and local communities through healthy ecosystem services, and more diversity in nature and livelihoods.

Economic indicators may change depending on the growth rate in planted and natural forests, the availability of marketable timber in natural forests, carbon prices, and, in particular, timber prices, which stand out as the main value driver in forestry. When timber prices increase as illegal logging is minimized, sustainable forestry management will become more profitable and potentially better positioned to deliver human development gains.

Recommendations

Sustainable forestry management can stop the unchecked loss of forests and the degradation of ecosystems, improve human development prospects and reduce vulnerability

Sustainable forestry management shows great promise. It can stop the unchecked loss of forests and the degradation of ecosystems, improve human development prospects and reduce vulnerability . There are several ways for Cambodia to move in this direction.

First, accurate and adequate data on forests are key to formulating effective management strategies and making timely interventions addressing local conditions. Cambodia needs to conduct a national forest inventory. This should include field surveys, remote sensing and GIS technology. A forest resource management information system should be established to supplement the existing National Forest Monitoring System. It could provide data on the condition of forest resources (e.g., production forest areas, species composition, annual allowable cuts, growth and yield, silvicultural treatment, and areas under natural and artificial rehabilitation); concessionaires and the forest industry (e.g., investment, installed capacities, operating capacities, production of logs and forest products, employees, equipment inventory and trade); and market intelligence (domestic and international trends in supply, demand and prices).

New strategies for managing planted forests should aim to minimize timber losses at all production levels and to maximize benefits to local populations. High-quality species such as teak and other local species should be promoted as a priority while low-value acacia and eucalyptus plantings can be promoted for supplying woodfuel.

Strategies for natural forest management should be rooted in communities, providing full legal authority and responsibility for sustainable use. They could consider alternative harvesting scenarios based on low but frequent harvesting, as this may provide better financial returns and stabilize community income.

Promoting comprehensive sustainable forestry management at all levels can deliver multiple gains. For instance, practical training on silviculture for local communities could lead to livelihood diversification and greater resilience. Government staff need full capacities to implement sustainable management, including data on the type, growth and status of a forest under their oversight.

Community members could be engaged in monitoring and collecting data, including through the use of modern communication technology. Financial and technical support should be provided to communities so that more community forestry areas are approved, and to rehabilitate degraded forest and protect healthy forests from exploitation by local and external stakeholders.

A robust and supportive environment for sustainable forestry management would help avert further degradation of valuable and unique forest resources. This entails clarifying and establishing secure tenure and boundaries, and defining full responsibilities for forest managers (governments, communities and the private sector) to manage forests. Effective law enforcement is critical, and a formal timber legality assurance system should be in place to ensure the legality and traceability of wood supplies.

Strengthened forest governance would be based on clear management strategies with short-, moderate- and long-term scenarios, and improved transparency. Guidelines and guidance could be developed to encourage the spread of best practices for implementation, monitoring and control.

Chapter 3

Sustainable consumption and production of woodfuel

Photo credit: GERES.

3. Sustainable consumption and production of woodfuel

In Cambodia, woodfuel such as fuelwood and charcoal play major roles in meeting energy needs, and generating income for many rural communities

It is fundamental to human development for poor households and small businesses to have energy to cook, run machines and light homes and shops. In Cambodia, woodfuel such as fuelwood and charcoal play major roles in meeting these and other energy needs, while charcoal production is an essential source of income for many rural communities. These uses persist despite serious health risks from the burning of biomass, which releases significant amounts of particulate matter and carbon monoxide. Deforestation and forest degradation are other concerns, resulting in losses to ecosystems and contributing to the greenhouse gas emissions that feed climate change.

In some sense, woodfuel rests at the nexus between human development and sustainable ecosystem management. To meet energy and development needs in the near term and into the future, Cambodia needs to sustain vital forest resources, giving careful consideration to woodfuel demand and supply, and to management strategies for consumption, production and alternatives. Achieving sustainable production and consumption would maintain forests, contribute to climate change mitigation, support better public health outcomes and provide energy security.[65,66]

In the longer term, an energy transition will be essential, drawing on alternative energy sources that are cleaner and more reliable, such as solar and wind power. For now, the sustainable management of woodfuel is an important step in this transition.

Charcoal production in rural Cambodia.

Photo credit: GERES.

Growing demand

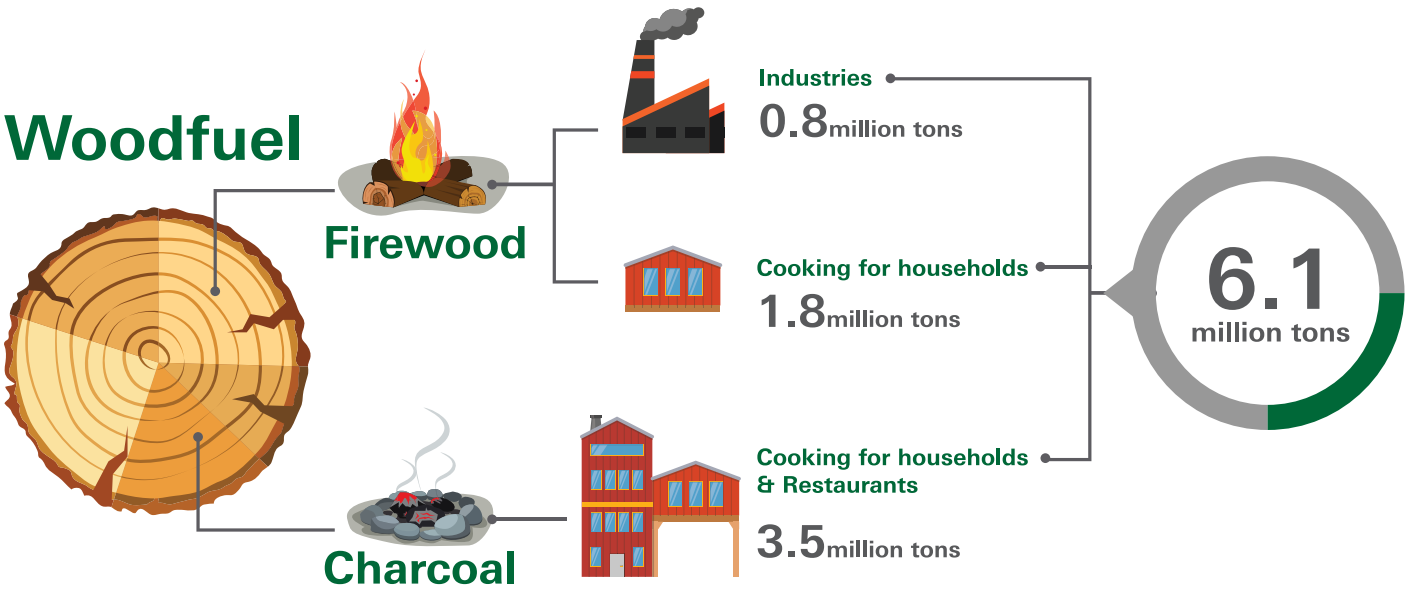
Woodfuel demand has grown rapidly in recent years, with annual consumption now reaching over 6 million tons, equivalent to clearing 71,600 hectares of deciduous forests each year. In 2014, woodfuel accounted for more than 64 percent of Cambodia's total energy mix, followed by oil products (30 percent) and electricity (6 percent).[67] Firewood is used for industries (0.8 million tons) and for household cooking (1.8 million tons). Charcoal is used for cooking in households and restaurants (3.5 million tons)[68]. See Figure 3.1.

Demand for woodfuel is shaped by factors that also act as barriers to more sustainable use. There is limited awareness of the benefits of more efficient technologies and alternative energy sources, and concern around safety and convenient access to alternatives. Both households and industries maintain customs and preferences for conventional uses of charcoal and fuelwood. With most wood sourced almost free of cost, wood collectors and consumers have few incentives to invest in alternatives.

Woodfuel demand has grown rapidly in recent years, with annual consumption now reaching over 6 million tons

Figure 3.1.

Both businesses and households depend on woodfuel



Business use

Around 80 percent of households still rely on woodfuel as the main fuel for cooking

The garment sector consumes 0.4 million tons of firewood annually. Factories generally use it to generate steam for ironing and washing processes, whereas electricity provides energy for lighting or sewing equipment. Some factories use up to 30,000 square metres of firewood per year. In factories surveyed, firewood represented the main source of primary energy, at up to 80 percent of the final energy consumed, but only 12 percent of the costs. Considering an average total energy cost of 16 percent of total costs, firewood would represent 2 percent of overall garment production costs.[70]

Brick-making consumes 0.4 million tons of firewood annually as part of producing more than 500 million bricks for construction, a rapidly growing industry.[71] The production process, requiring a temperature of more than 850°C, entails significant energy consumption.[72]

Restaurants in homes and traditional markets and street food vendors are major consumers of charcoal; there are more than 63,000 restaurants around the country. Fuel choice is linked to the type of dish that is cooked, as well as the quantity cooked; charcoal is preferred to keep food warm for a long time.

Domestic cooking

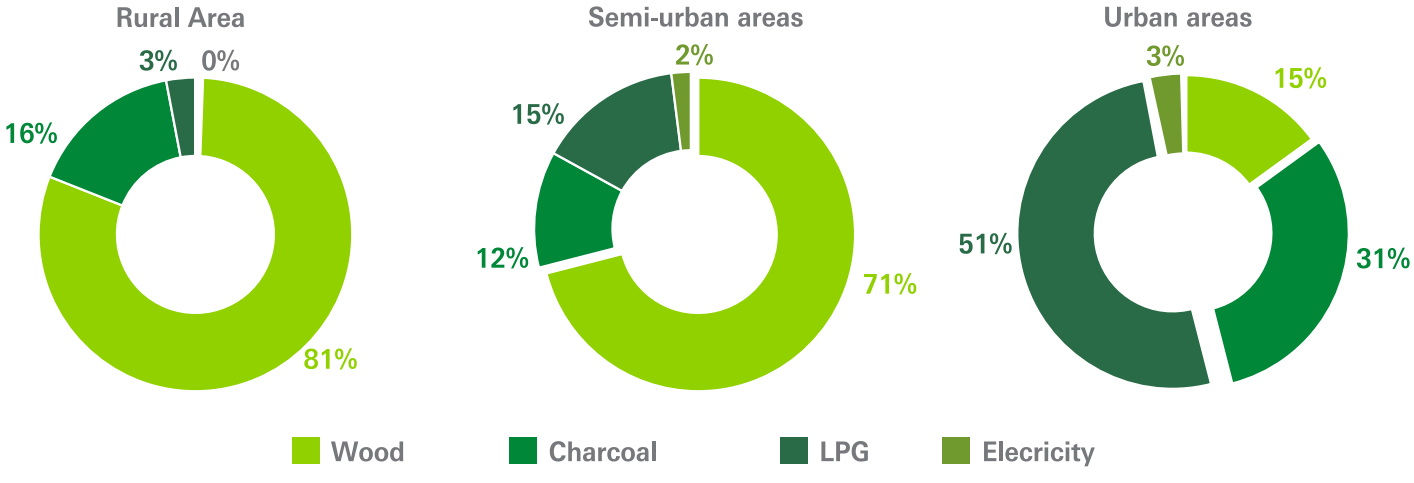
Around 80 percent of households still rely on woodfuel as the main fuel for cooking (Figure 3.2). About 2.1 million use firewood and 0.5 million use charcoal as the main fuel, consuming 1.8 million tons of firewood and 0.4 million tons of charcoal (equivalent to 3.5 million tons of fuelwood) per year.[73]

Urbanization has increased the use of more advanced types of energy for cooking, such as liquefied petroleum gas (LPG) and electricity. Even so, LPG is generally a secondary fuel, as many households still rely on woodfuel as their main fuel for cooking. Electricity is mainly used for rice cookers, making it a significant but not the main source of energy for cooking. Phnom Penh and Sihanoukville likely have higher rates of use of LPG and electricity than other urban areas, as they are well supplied with both.

Rising household income does not automatically lead to a switch to more advanced fuels. Choices are influenced by factors including price, safety, health, convenience and cooking traditions (Box 3.1).

Figure 3.2.

Share of households using firewood, charcoal, LPG and electricity



Source: GERES 2015.

Box 3.1.

Factors affecting households' choice of types of energy

Price: A comparison of three types of cooking devices showed that 15 kilogrammes of LPG is the cheapest cooking option, in addition to providing other benefits such as safety and a lack of particulate matter or carbon emissions. Double burners produce little emissions and are safer than portable LPG. The initial cost is US$80 plus other costs for renewing the tank, which can be a barrier for poor households.

Safety: Many households have safety concerns about LPG, another major barrier for use. Past accidents related to the use of small canisters that are refilled many times without any control have resulted in some households' reluctance to use LPG. Originally used in China and the Republic of Korea, mostly for picnics, these canisters are then imported to Cambodia to be refilled several times.

Health: Households are generally aware of the adverse impacts of cooking pollutants on health. Reducing exposure to smoke and creating a cleaner cooking environment are important elements driving cooking strategies.

Convenience and cooking traditions: Households use different fuel for different types of dishes. A typical Cambodian meal comprises several dishes, including rice as well as a fried dish, soup and a grilled dish. In urban areas, LPG is preferred to cook fried dishes, while an electric rice cooker is used to cook rice. Charcoal might be the preferred fuel for grilling or cooking soups in big pots that require a long simmering time, however. Installing LPG and a rice cooker, therefore, may not automatically result in a complete switch from using wood or charcoal.

Sources: Kong and Handley 2017, Biney et al. 2015.

A mix of sustainable and non-sustainable supplies

Woodfuel comes from sustainable and non-sustainable sources across Cambodia

Woodfuel comes from sustainable and non-sustainable sources across Cambodia. The former include firewood supplied from areas with management plans, which ensures the sustainability of biomass stock and long-term availability. Unsustainable sources include by-products of forest clearing for agricultural production, such as economic land concessions, and direct harvesting of firewood. Non-sustainable sourcing can be legal, especially in the case of concessions, if all necessary permits are obtained.

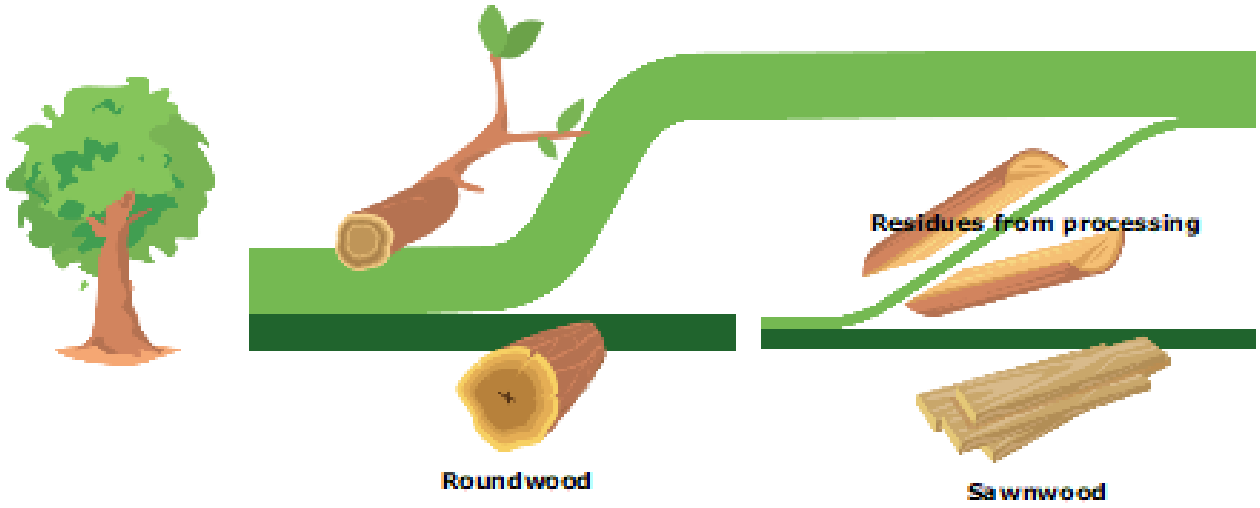
An estimated 77 percent of woodfuel consumed in Cambodia emanates from unsustainable sources, with 48 percent from forest conversion for agriculture, including economic land concession conversion, and 29 percent from overharvesting of firewood in forest areas.[74]

Among sustainable sources, one example is community forestry, a legally approved management arrangement allowing forest-dependent communities to participate in the sustainable management and use of forests. The amount of wood supplied from community forestry is limited, however, as many community forests are highly degraded with limited productivity. Community forestry also faces the challenge of competing against illegal woodfuel suppliers, whose prices are low. Moreover, despite official registration and the use of community forestry management plans, many community forestry initiatives lack necessary permits to produce and distribute charcoal legally.

Woodfuel also comes from replacing rubber or cashew plantations (Figure 3.3). While roundwood such as sawnwood from old rubber plantation replacement is mainly exported, residues have value as firewood and are sold to local distributors.[75] But currently, few plantations are old enough to be harvested. Most existing rubber plantations were planted after 2000 and likely will not be ready for use within the next 10 to 15 years. Further, the charcoal from rubber and cashew plantations is of a significantly lower quality than charcoal currently sold on the market.

Figure 3.3.

Woodfuel, mainly residues, comes from replacing plantations



Source: GERES.

In general, fuelwood collection by households have limited impacts on forests and ecosystems

Unstainable sources include natural forests, protected areas and economic land concessions. Some woodfuel comes from natural forests and protected areas reserved for conservation, although extracting wood from these areas is illegal.

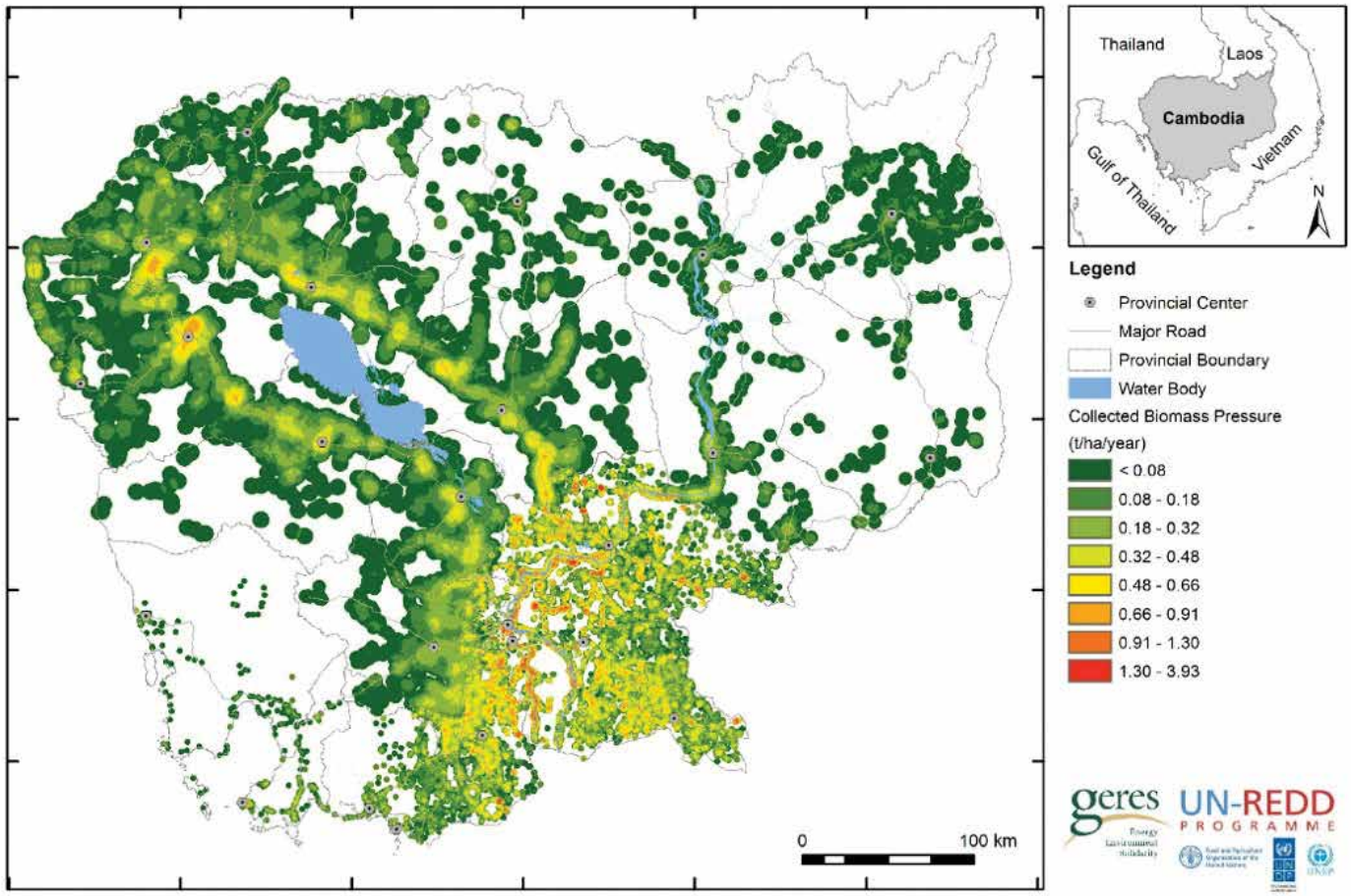
After the introduction of economic land concessions in 2005, many previously forested areas were converted to large-scale agriculture. As a result, ample wood became available. But this situation is gradually changing due to the moratorium on concessions introduced in 2012 to conserve the remaining forests. As concession areas no longer supply wood products in high demand, there could be a shift in sourcing, resulting in mounting pressure on surrounding natural forests.

Limited impacts of fuelwood collection by households

In general, households collect firewood for cooking from within 5 kilometres of their homes in varying locations . Households in the Tonle Sap and coastal regions source more than 50 percent of firewood from flooded forests or forests, while households in the plains, plateau and mountains source their firewood mainly from around their own homes and agricultural lands.[76] Firewood collection for household cooking is generally not a major threat to the forest ecosystem, except in the Tonle Sap and coastal areas (Figure 3.4). There it is likely to have negative environmental impacts due to overharvesting and the presence of important ecosystems for fish reproduction.

Figure 3.4.

Pressure from household firewood collection for domestic cooking is relatively limited



Source: GERES 2015

A proliferation of charcoal production and impacts of concern

Charcoal production businesses have recently proliferated in rural areas as a key income generation activity and have concerning impacts on forests

Charcoal production businesses have recently proliferated in rural areas as a key income generation activity. More than 80,000 households produce charcoal for income. With a national average retail price of 1,000 riels per kilogramme, the sector is worth more than $100 million.

While many charcoal producers in Kampong Speu initiated their businesses after the late 1990s, most producers in other provinces, such as Kampong Chhnang, Banteay Meanchey, Battambang and Kampong Thom, have started their businesses within the last five years (Figure 3.5).

A field survey in the five main charcoal production provinces showed that charcoal represented the majority of household income, ranging from 34 percent to 57 percent of the total. Charcoal is mostly a dry season activity to gain supplemental income, although some producers in Kampong Thom produce charcoal all year long as a main source of income.

Producers source different wood species for charcoal of high and normal quality. Common sources are natural forests, where wood is typically collected for free. In Kampong Speu, producers source most of their wood from Phnom Aural, which is under high pressure from their activities. In Kampong Thom and Kratie,

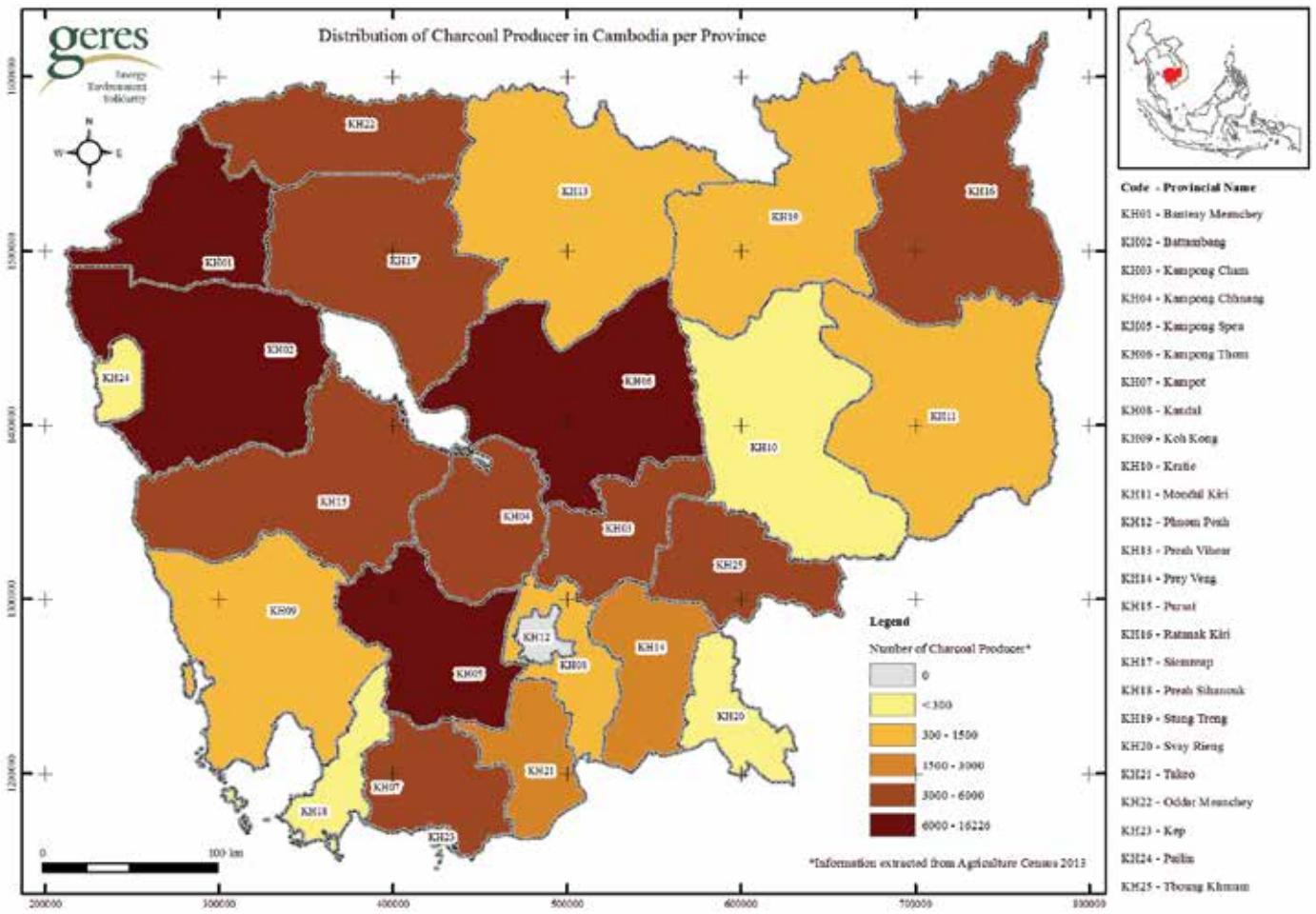
large-scale conversions of forest for agriculture, especially through economic land concessions, have made wood readily available. Most producers purchase wood from traders who supply specific wood species. A few charcoal producers harvest wood in the forest. In Battambang and Banteay Meanchey, most wood originates from non-forest areas. Trees are cleared from small degraded areas to expand existing fields or roads for agriculture.

On average, charcoal producers have two fixed kilns made of mud and clay; some have a metal chimney. The kilns normally require low investment and limited maintenance, and have a long life span. Very few producers take extra care to improve charcoal quality. On average, they produce 25 tons of charcoal per year, but it is possible to produce more than 140 tons using multiple kilns in constant operation.[77]

Charcoal producers generally sell to distributors, who provide charcoal to households, restaurants and retailers. Among all actors in the supply chain for charcoal, distributors derive the most significant part of added value. Figures 3.6 and 3.7 show value chains for charcoal supplies that reach Phnom Penh from Phnom Aural and Kampong Thom.

Figure 3.5.

Location of charcoal producers



Sources: GERES 2015, Agricultural Census 2013, National Institute of Statistics 2015.

Figure 3.6.

Value chain of charcoal from Phnom Aural supplying Phnom Penh

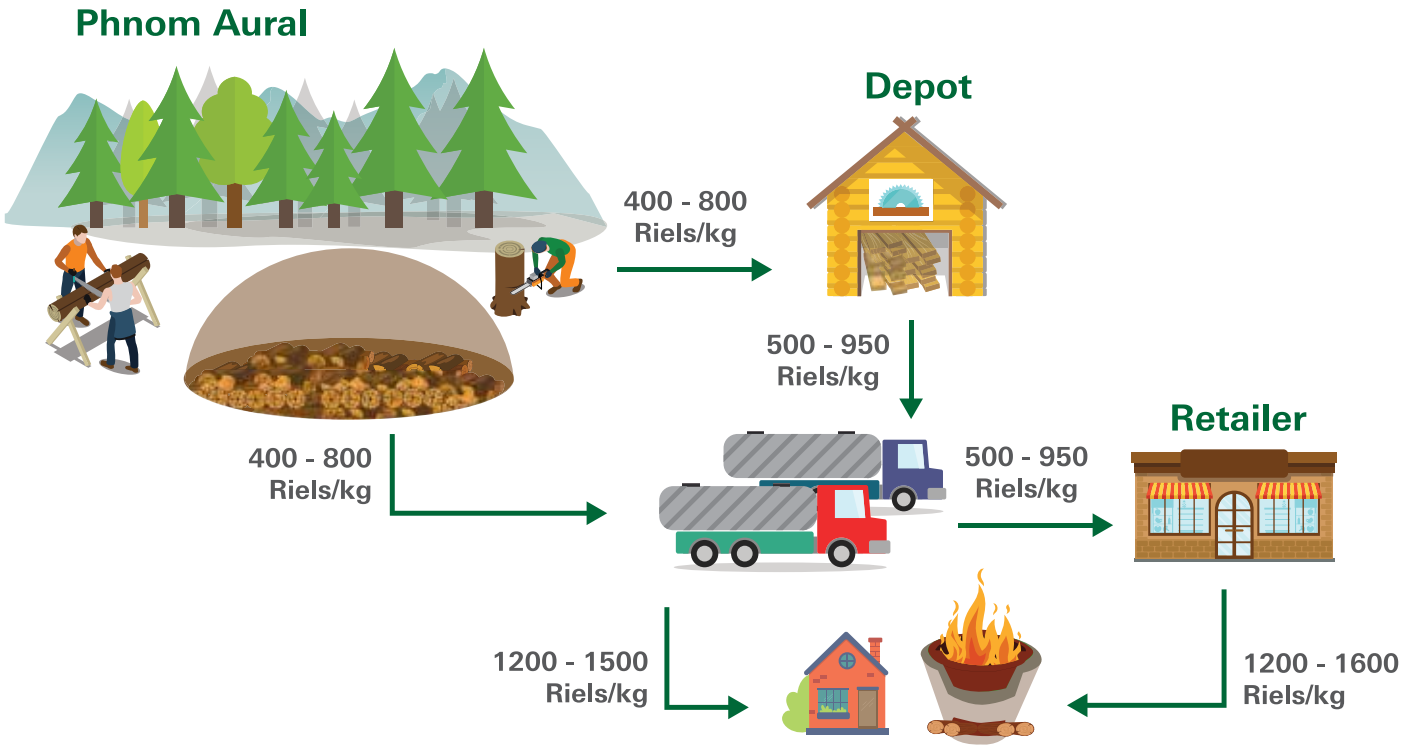
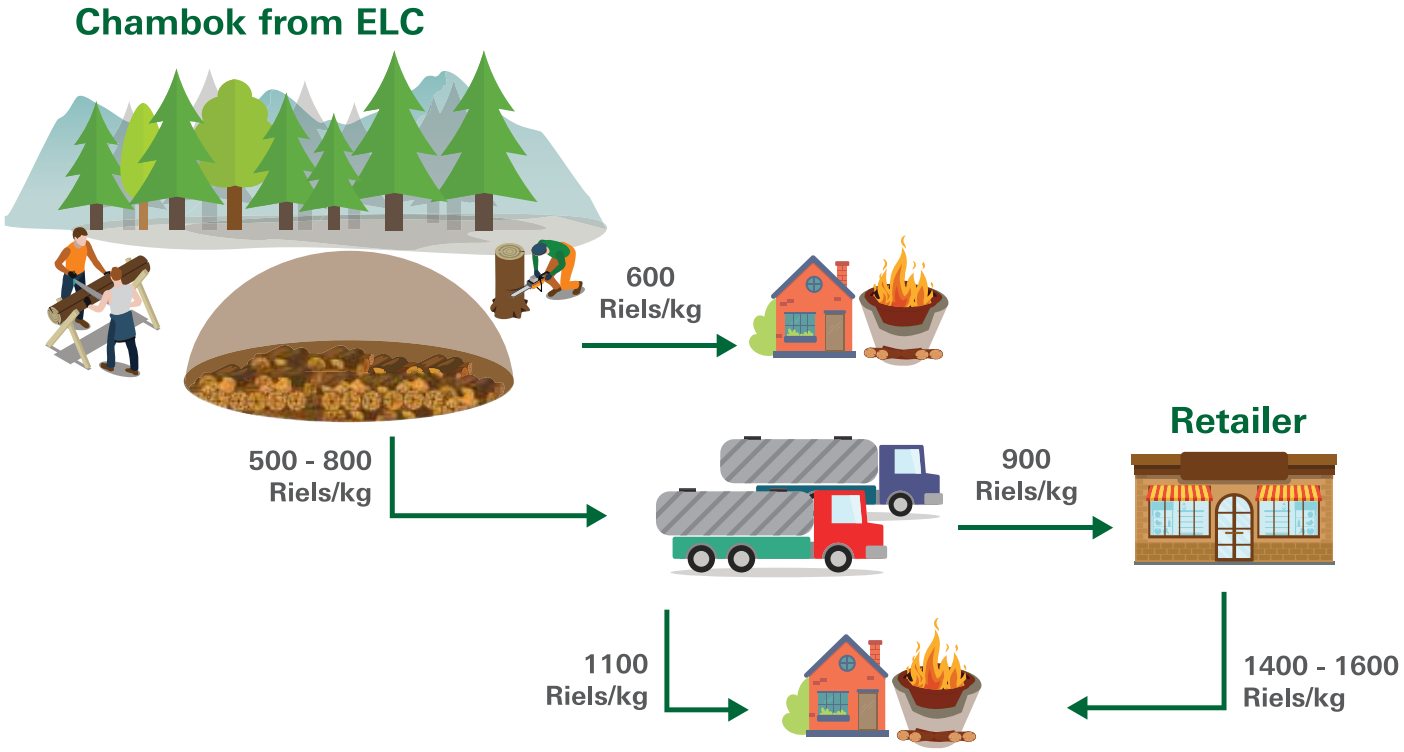


Figure 3.7.

Value chain of charcoal from Chambok from ELC



Source: VANDYROS

Many options to move towards sustainable energy

Cambodia has many options in improving the efficiency of woodfuel production and consumption, and switching to alternative energy as part of moving towards sustainable energy

Cambodia has many options in improving the efficiency of woodfuel production and consumption, and switching to alternative energy as part of moving towards more sustainable production and consumption.

Improving production efficiency for charcoal production

In producing charcoal, traditional and widely used practices are often associated with low yield and high energy losses, with a conversion rate of 6 to 7 kilogrammes of wood to 1 kilogramme of charcoal. Production efficiency can increase, however, through improvements in wood drying, kiln construction and kiln operations.

Improved charcoal kilns can raise efficiency through internal and external heating, and heating with recirculated gas. One example is the Adam Retort, which achieves yields closer to more highly efficient brick kilns while cutting methane emissions in half.[78] The GreenMad Dome Retort is a larger and more efficient version with higher volume and better insulation.

Improvements for traditional charcoal kilns can enhance production and energy efficiency

Photo credit: GERES.

A higher efficiency Adam Retort charcoal kiln in Strung Treng province.

Photo credits: GERES (left) and GreenMad Dome Retort, GIZ (right).

Improving energy efficiency for the garment and brick sectors

Improved energy efficiency is critical in the garment and brick sectors as the main consumers of 0.8 million tons of fuelwood used by industries each year. In garment businesses, existing boilers could be replaced with energy-efficient ones, but given the cost of a new boiler, which is more than $60,000, and a cheap supply of woodfuel, many garment businesses do not prioritize such an investment. New boilers combined with a switch to agricultural residues, such as rice husk briquettes, could offer returns with a better business case.

Another measure would be the insulation of steam pipes and regular monitoring to reinsulate as leaks occur. Poor insulation can significantly increase water condensation and energy consumption. Regular monitoring through thermal cameras could help identify pipes with high-temperatures for rapid reinsulation. Further, by recovering condensate water, the temperature of boiler feed water could be significantly increased.

Among brick businesses, rising wood prices pose an increasing incentive to switch to improved kiln technologies. Considering the required investment and the current difficulties for brick businesses to get loans, support to commercial banks to devise tailored financing solutions could be one way forward (see Table 3.1).

Table 3.1.

The main brick kilns currently in use in Cambodia

Intermittent or tunnel kiln (boat kiln)	**Traditional batch kiln** (square/ elephant/ round kiln)	**Hoffman or continuous kiln** (rotary kiln)
		
Fuel used		
Firewood	Rice husk	Both firewood and rice husk
Specific energy consumption		
8.41	5.53	2.52
Share of the brick production		
72%	10%	18%

Source: GERES.

Improved cooking stoves to improve efficiency

Greater efficiency and the transition to more sustainable energy will largely depend on changes in households, where more than 5 million cook stoves are in use. In rural areas, more than a quarter of households still cook with highly inefficient basic cooking stoves referred to as three-stones or Siam/Mong stoves.

Some progress has been made in introducing improved stoves (Table 3.2). With better insulation and a smaller combustion chamber, the New Laos Stove allows significant fuel savings of around 20 percent compared to traditional stoves, for example. The Neang Kongrey Stove shows similar savings. Both are designed around local cooking habits. Support for their production and distribution has already resulted in the New Laos Stove and Neang Kongrey Stove capturing 25 percent and 14 percent of the woodfuel cook stove market, respectively, a significant success. Over the decade to the end of 2014, more than 3.6 million improved cook stoves were sold. Production and distribution provide employment to more than 550 workers, especially in Kampong Chhnang.

Table 3.2.

Main improved cook stoves currently in use in Cambodia[79]

New Lao Stove

Neang Kongrey Stove

New Lao Stove	Neang Kongrey Stove
Retail price	
$3.5	$1.6
Manufacturing country	
Cambodia	Cambodia
High power efficiency	
24.1% (wood), 29.1% (charcoal)	25.5%
Low power specific fuel consumption (MJ/min/l)	
0.036 (wood), 0.028 (charcoal)	0.035

Source: GERES.

Switching from woodfuel to alternative energy

An example of moving away from charcoal use altogether involves the industrial and community production of char-briquettes. These can be made from several types of widely available biomass. In Phnom Penh, Khmer Green Charcoal produces and sells char-briquettes made from coconut shells and charcoal wastes. Some entrepreneurs are working to develop bamboo pellets and briquettes to replace wood for industrial use.

Rice husk can replace fuelwood use for the industrial sector.[80] Rick husk generates fuel, heat or electricity through thermal, chemical or bio processes, and is in ready supply, with more than 8 million tons of paddy milled in 2014.[81] With no agricultural use, rice husk could become a key source of energy. National production potential could be more than 2 million tons, corresponding to 1.7 million tons of wood. A significant share of paddy is exported to neighbouring countries such as Thailand or processed locally, however, which diminishes the potential for rice husk to become a more broadly used energy source.

Brick and cement factories absorb a significant share of what is produced, as do some food-processing industries located close to rice mills. In the garment industry, the use of rice husk briquettes instead of firewood has already been a major climate change mitigation action. Actual available residues are unknown and depend on many different factors, including distance to markets, distance from neighbouring countries and other primary users.

Coconut shells

Rice husk briquettes

Photo credits: GERES

Challenges in promoting sustainable woodfuel options

Cambodia's Forestry Law requires permits to use, produce, transport and trade forest and non-timber forest products.[82] The Protected Area Law prohibits commercial extraction of forest products, non-timber forest products and fuelwood.[83]

Procedures for obtaining permits for woodfuel are complex and expensive, lowering incentives to apply. Fines for violations are very high, at a level that most producers and distributors cannot afford to pay. As a result, regulations are rarely followed, and very few permits are obtained for legal firewood harvesting and charcoal production.

Illegal production and trade of woodfuels creates several notable challenges. There is little incentive for producers to invest in sustainable production or improve energy efficiency, as most wood is readily available at very low cost. Similarly, industrial users have limited motivation to switch to other energy sources such as briquettes from rice husk or bamboo, as these cost at least 50 percent more. Sustainably produced charcoal and firewood cannot compete in the market given higher prices related to ensuring sustainability on top of formal taxation, among other issues.

Recommendations

Ecosystem sustainability, human development and Cambodia's longer-term energy transition hinge in large part on the sustainable production and consumption of woodfuel

Ecosystem sustainability, human development and Cambodia's longer-term energy transition hinge in large part on the sustainable production and consumption of woodfuel.

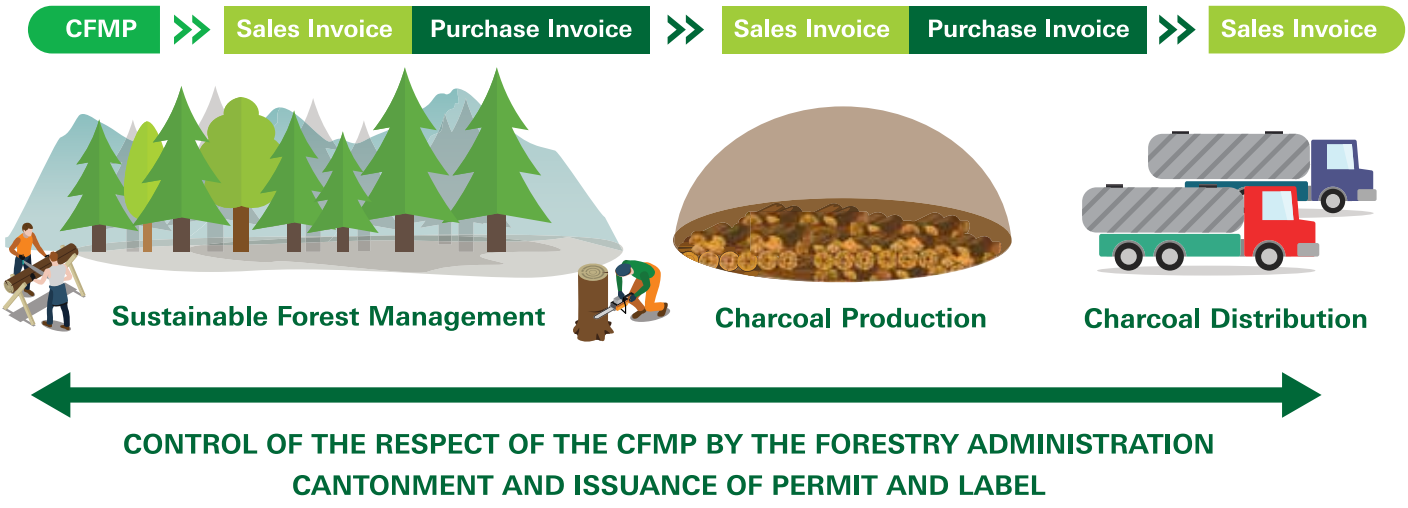
Extend law enforcement: Moving in that direction could begin by recognizing that it is inefficient and ineffective to regulate charcoal production mainly through fines leveraged at production sites. To apply regulations more comprehensively, the Government could build "charcoal checkpoints" into existing police traffic control systems. This would boost regulation as well as taxation, which could then be directed towards incentivizing sustainable production and preventing illegal production.

Enable fuelwood production through plantations and sustainable forest management. Few commercial timber operations or plantations provide woodfuel, which is a missed opportunity. Residues from timber production[84] are significant, and could supply many charcoal and fuelwood operations. Integrated production models that combine co-production of roundwood and fuelwood could yield a significant amount of woodfuel. This can generate short-term income from woodfuel production and long-term higher value income from roundwood production.

Introduce a low-cost sustainable woodfuel certification scheme. This could encourage sustainable production. It would entail standards and labelling to regulate the entire fuelwood and charcoal production chain, making it possible to ensure that certified charcoal is not mixed with non-sustainable charcoal. Certification schemes could target wood producers for sustainable forest management, and charcoal producers and distributors for chain of custody.[85] See Figure 3.8.

Figure 3.8.

Chain of Custody Certification Scheme



Source: GERES.

Introduce differentiated taxation to incentivize sustainable woodfuel production. This would tax non-sustainable woodfuels that originate from free firewood collection in forest areas at higher rates than sustainably sourced woodfuels. Table 3.3 presents a model inspired by a scheme implemented in Chad. Effectiveness requires chain of custody certification schemes as well as an efficient law enforcement system. If well designed, the system could generate funds for local law enforcement, and support the development of local livelihoods and community forestry activities. A value added tax exemption for sustainable woodfuel and alternative sustainable energy sources could be applied across the market, making these options more competitive.

Table 3.3.

Differential taxation for incentivizing community-based firewood harvesting

Beneficiaries	Sustainably managed	Open access	Illegal exploitation
Household Energy and Environment Agency	100 riels	2,000 riels	4,000 riels
Ministry of Finance	100 riels	2,000 riels	4,000 riels
Local management structures	1,000 riels		
Community	800 riels		
Total	**2,000 riels**	**4,000 riels**	**8,000 riels**

Source: GERES.

Create producer and consumer networks for community forestry-sourced woodfuel. The marketing and distribution of sustainable woodfuel, including that sourced from community forestry, faces the significant challenge of competing with illegally sourced and much cheaper woodfuel. Furthermore, community forestry products have limited market differentiation and access. To improve this situation, producer and consumer networks for community forestry-sourced woodfuel could be established.

On the production side, cooperatives could form, linking registered community forests, traditional charcoal producers and distributors. They could aid production, processing, distribution and marketing. Cooperatives could also provide assistance with technology and knowledge transfer, and make investments in enrichment planting and assisted natural regeneration of trees with high potential for charcoal. Complementary regulatory support would help community forestry groups remain competitive through operating small chainsaws and moto-trailers for fuelwood harvesting and transport.

On the consumer side, modern technology such as a smartphone app to order sustainable charcoal could be introduced to develop a base of regular consumers, such as among households and restaurants. This would enable producers to reduce transaction costs associated with marketing.

Provide technical and financial assistance for energy efficiency and fuel switching. This should initially be targeted to charcoal producers with the smallest investment capacity, as a way to improve their current practices and kiln-building, before promoting new technologies. Transformational change will need to be driven by campaigns targeting factories and clients to increase awareness of the benefits of legal and sustainable charcoal for forest ecosystems and human well-being.

Provide initial financing support: Even if the above interventions are achieved, some sustainable woodfuel initiatives will not be fully competitive in the market in the short term. Initial financing will be necessary to catalyse and accelerate transformation of the sector.

Chapter 4

Upgrading value chains for non-timber forest products

4. Upgrading value chains for non-timber forest products

Beyond timber and woodfuel, Cambodia's forests provide a wealth of other resources including plants and wildlife.[86] Properly managed and regulated harvesting and marketing of these non-timber products can deliver significant contributions both to forests and people in rural communities.

Around 3 million households in Cambodia depend on non-timber forest products for their livelihoods

Around 3 million households in Cambodia depend on non-timber forest products for their livelihoods.[87] Many are rural and poor. They turn to forests to build homes and boats, and to make baskets and other household items. Honey, vegetables, fruits and fish are among many sources of food, and a range of plants supply medicines. Some products, such as resin, provide important cash incomes, especially in indigenous communities.[88]

Long-term benefits for human health and nutrition, household income and livelihood diversification are clear. But much depends on the sustainable management of local resources and the ability of local communities to draw on them.[89] So far, these ends have largely not been achieved, even as the forest resource base is steadily eroding. Rural communities are losing potential benefits while their traditional safety net is being undermined. Market links for some products are underdeveloped, and current regulations are not fully aligned behind sustainable harvesting and local livelihoods.[90]

Better support could come through upgrading the value chains of non-timber forest products. This depends on developing products and markets that open new commercial and livelihood opportunities, under a framework of enhancing human development and the sustainable management of forests and ecosystems.

Tracing value chains for five products

Our value chain analysis focuses on five non-timber forest products, bamboo, rattan, resin, forest honey and medicinal plants

To start defining what this support might look like, this report applied value chain analysis to five non-timber forest products, bamboo, rattan, resin, forest honey and medicinal plants. All of these are commonly harvested for household use, and for trade and income. Value chain analysis examines how a product or commodity is harvested, processed and sold. It focuses on who is involved, and how each actor benefits or profits.[91] The results can help identify opportunities and challenges for upgrading value chains, given factors such as resource access, regulatory frameworks, power relations and environmental change.[92]





Photo credit: NTFP-EP

Bamboo: Potential in domestic and international markets

Collection and transport: Bamboo is available in at least 12 provinces and mainly collected for household use, and for fisheries and construction. It is rarely traded due to low market demand; collection for trade only takes place when there are sure buyers. Demand for poles and culms has declined over the years, and collection is physically demanding, relying on handsaws. Those with alternative livelihoods tend to avoid bamboo collection. Transport is generally by raft, ox carts or tractors.

Processing: The main bamboo products include baskets, incense sticks and food sticks. These products are generally basic, labour intensive and low in value.

- Baskets: The production of seasonal, functional, low-value baskets is mainly by women at the household level, using simple tools. Production has declined due to low interest and scant benefits.
- Incense sticks: Production capacity for incense sticks is low at 7 to 10 kilogrammes of sticks per day, compared with India, where hand-operated machines allow a production capacity of 20 to 30 kilogrammes a day.
- Food sticks: Domestic production only meets about 10 to 15 percent of local demand. Locally made sticks are of low quality compared to imports from China.

Wholesale/export/retail: A limited number of bamboo retailers and wholesalers are mainly small in size. Bamboo poles are mostly sold in depots and construction shops. Some basket producers with access to markets sell their products directly to users. Low-value baskets are exported to Thailand but export is highly vulnerable to economic shifts

Key findings from the value chain analysis

The bamboo sector is characterized by labour-intensive production, and rudimentary and low-cost product alternatives. Bamboo culm collection and processing contributes a household daily net income ranging from less than $2 to $34, depending on the proximity of resources and markets, available physical capital (i.e., tools, transport), market demand and productivity level.

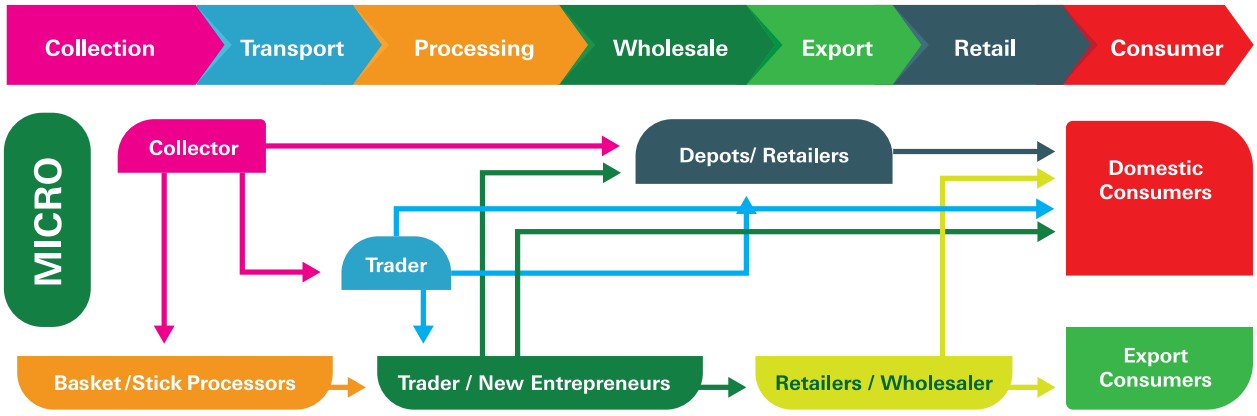
Greater benefits for local bamboo producers of incense and food sticks and woven bamboo products can be achieved through enhanced production efficiency, increased volume, improved quality and designs, and expanded market reach. These advances depend on ready access to bamboo resources, tools and equipment, and transportation, which can increase value and income. Other factors are appropriate technology and guarantees of sales volume through market access support, such as through links with traders or buyers.

Greater benefits for local bamboo producers can be achieved through enhanced production efficiency, increased volume, improved quality and designs, and expanded market reach

Market shares could also be expanded for woven bamboo handicrafts if more export is enabled—for example, to Thailand—as these products create the highest number of jobs and level of value addition among the bamboo processing industries.

Figure 4.1.

The value chain for bamboo



Sources: Khou 2015; National Institute of Statistics 2013; NTFP-EP 2015; NTFP 2016; Oxfam 2006; PMIC 2011.

Rattan: Improved competitiveness aimed at exports

Collection/aggregation: An estimated 290,000 households[94] collect rattan, mainly from wild growth outside community-managed forests. There are no rattan plantations except for enrichment plantings supported by non-governmental organizations (NGOs). By one estimate 1,500 tons of rattan can be sourced across the country from 8,000 hectares that are under sustainable resource management.[95]

Increased benefits would come through resource management oriented around sustainable harvesting, enrichment planting or cultivation in community-managed forests, and selective collection mainly of higher value rattan

Semi-processing/production: Post-harvest treatment and processing of rattan requires boilers and space to dry. Machines used for splitting and sizing are mostly obsolete, producing copious waste and low-quality products.

Wholesale/export/retail: Quotas, transport and export permits, and royalty payments are required for semi-finished and finished products at commercial scale. Most harvested rattan is sold unprocessed to intermediaries/traders partly due to regulatory requirements and partly due to convenience. There are 65 rattan furniture retailers who source directly from manufacturers. Exports are weak, mainly focused on less than 1,000 tons of low-value products per year since 2009.[96] Some collectors with motorbikes transport supplies directly across borders for informal trade.

Key findings from the value chain analysis

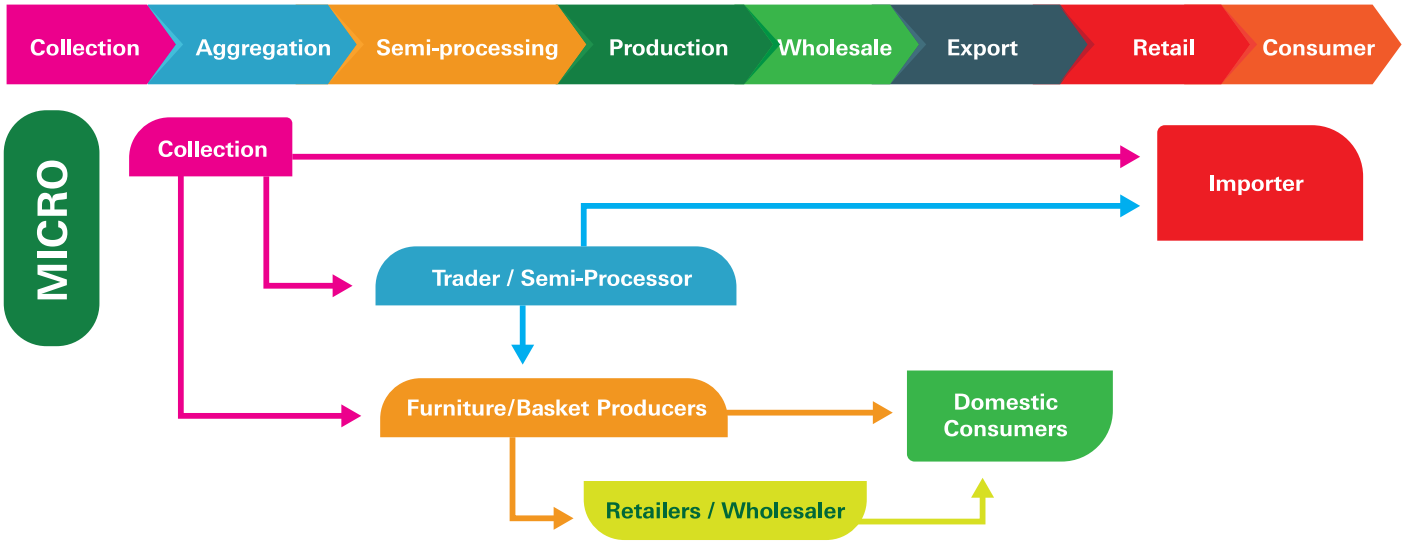
The net household income from rattan collection per season can range from a low of $60 to a high of $575. The processing of rattan contributes from $315 to $1,575 per year to a household.[97]

For collectors, value is derived through volume. Yet unsustainable harvesting and management will diminish income in the long term and weaken the rattan value chain. Increased benefits would come through resource management oriented around sustainable harvesting, enrichment planting or cultivation in community-managed forests, and selective collection mainly of higher value rattan.

In rattan processing, more could be done to improve product design and increase productivity. An export strategy is key to develop the processed rattan industry once competitiveness and capacity are strengthened.

Figure 4.2.

The value chain for rattan



Sources: National Institute of Statistics 2014; Chey et al. 2015; International Trade Centre 2016; Khou and Vuthy 2006; Rattan Association of Cambodia 2017; Val 2009; WWF 2010, 2011, 2013.

Resin: Investments beyond the raw value chain

Collection/aggregation: Resin has traditionally been harvested for income in at least 10 provinces. Major activities in the north and north-east take place especially in the Prey Lang Landscape and the Eastern Plains Landscape, where an estimated 28 to 43 percent of households engaged in resin tapping in 2014.[98] Changes in land use and illegal logging threaten the volume and stability of resin supplies, however.

Semi-processing/wholesale/export/processing: Permits and royalty payments are required for semi-processing of resin,[99] which includes storage and additional activities considered beyond customary rights. Processing capacity is very weak and limited to low-value products for local markets. Finished products include traditional torches made by resin collectors or local households for lighting, fire starters and wood finishes.

Retail: A few long-established enterprises in Phnom Penh and provincial capital markets sell raw and filtered resin. Boat and house owners purchase raw resin as a cheap varnish. Wholesalers are usually the main retailers but there are also microretailers. About 20 wholesalers and exporters source from 17,800 resin tappers around the country.[100]

Key findings from the value chain analysis

Collecting resin can provide a household with income of $340 to over $1,700 per year, depending on the number and age of traditionally owned trees and market demand.[101] The estimated value of the sector is at $4.7 million to $15 million.

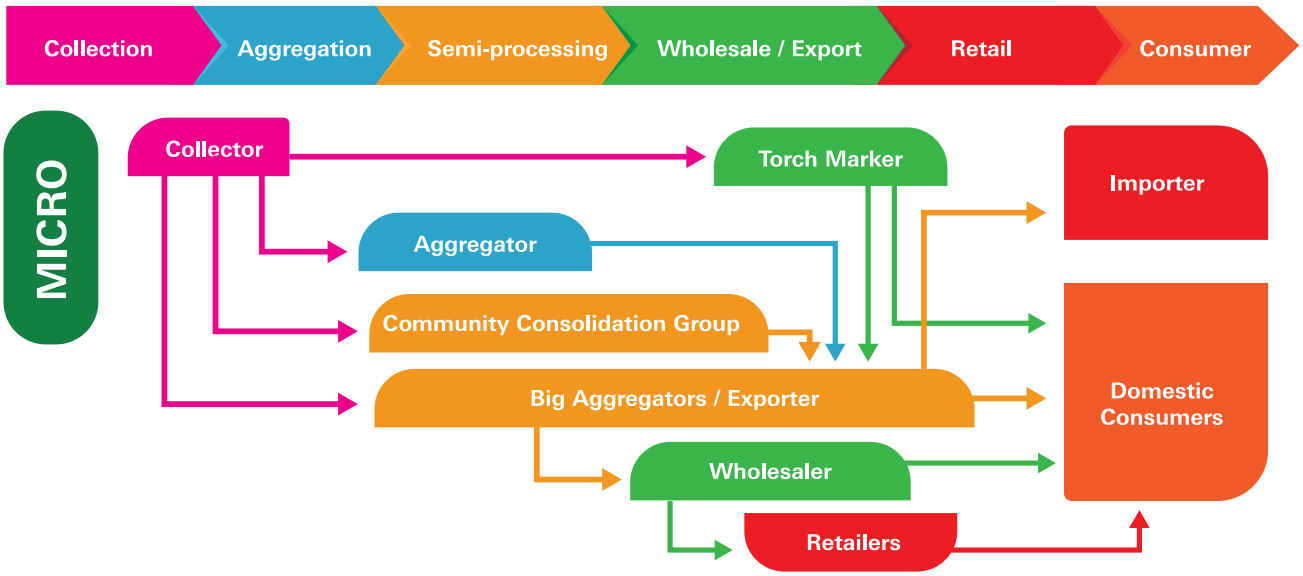
The resin value chain has only marginal value addition and is highly vulnerable to limited markets. Currently, there is little room to increase benefits in the raw value chain except through semi-processing, increased volumes and streamlining the value chain .

Protecting resin trees from illegal logging and enhancing production through plantings are important measures to secure and increase supplies. Limited domestic and export markets call for investments in new and high-value products, and the development of new value chains. Diversifying to products such as varnish and paint can offer benefits when market prices for raw resin are low. Investment in research and development, entrepreneurship promotion and strengthened support services could develop the value chain, and foster new products and markets.

Protecting resin trees from illegal logging and enhancing production through plantings are important measures to secure and increase supplies

Figure 4.3.

The value chain for resin



Sources: NTFP-EP 2011; Prom 2011, 2017; SFB 2015; Winrock 2015.

Forest honey: Strong prospects for growth and value

Collection/aggregation: Forest honey used to be collected only for household consumption but is now an important source of supplementary income in 10 provinces. In villages near forested areas, between 15 and 30 percent of households depend on honey.[102] In 2014, 31,000 households were involved in forest honey collection.[103]

Forest honey from native species, mainly A*pis dorsata* and *Apis cerana*, is collected primarily from wild sources by households with traditional honey-hunting skills. Production was small at an estimated 40 to 50 tons in 2009. Forest honey is harvested based on customary rights in state forests for only about three to four months a year. Roving and village traders collect and transport honey that has been harvested.

Enhanced production, inputs for improved quality and perceived value, specialty honey positioning and market access can increase benefits

Processing: For local markets, honey processing is rudimentary, composed of comb squeezing, filtering and bottling. Some honey collectors and traders use makeshift tools and recycled bottles for processing, usually not meeting standards of quality and hygiene. Competition for the limited wild honey supply is very high.

Wholesale/retail: A mix of enterprises and NGO-initiated social enterprises package and sell forest honey, including Café Mondulkiri, CEDAC, Nature Wild and Bee Unlimited. The retail sale of honey includes direct sale to consumers, small market kiosks, organic shops and high-end tourist boutiques. Efforts have been made to penetrate the export market, but export is still negligible.

Key findings from the value chain analysis

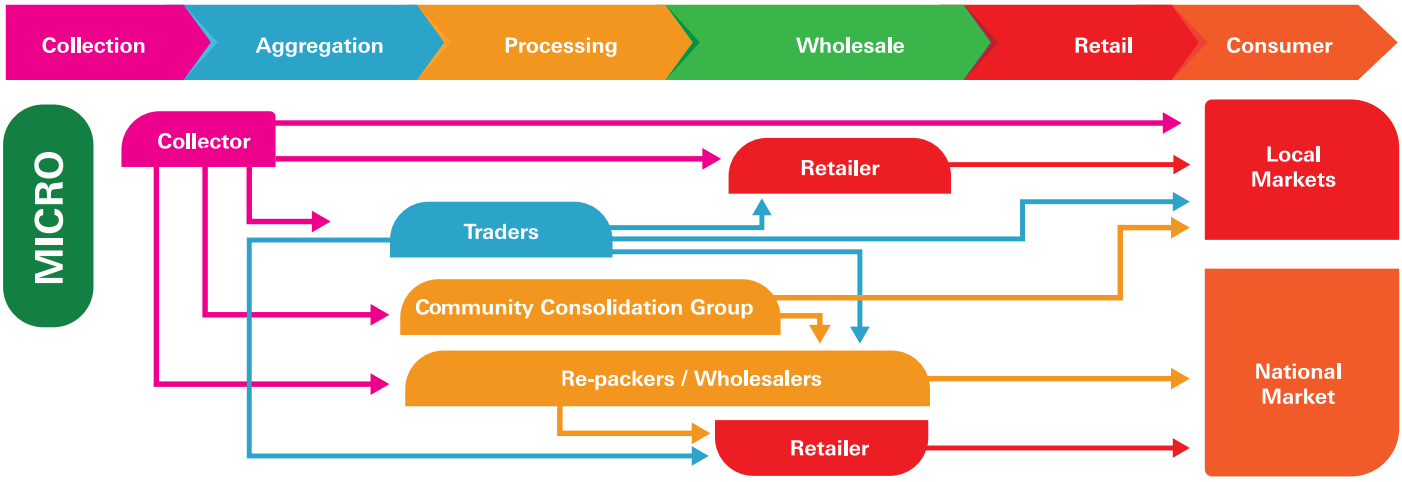
While a small sector, forest honey has high potential for growth and high-value benefits for rural people. Seasonal, limited supplies and strong demand make the value chain highly competitive. Forest honey can contribute $280 per household each year, [104] up to 40 percent of household income.

Enhanced production, inputs for improved quality and perceived value, specialty honey positioning and market access can increase benefits. Microfinance, transportation and telecommunication are some support services that would facilitate the engagement of small-scale producers in the value chain. While social enterprises currently try to provide a long-term and stable engagement, this is difficult because of high competition, and limited entrepreneurial, organizational and financial capacities.

Domestic, regional and tourism markets offer opportunities for increased profits. Unchecked price increases, and uncertain quality and authenticity impact competitiveness in domestic and international markets, however. This calls for measures guaranteeing quality through the implementation of national honey standards and certification.

Figure 4.4.

The value chain for honey



Sources: Andaya 2013; National Institute of Statistics 2014; McNaughton and Meang 2009; MSME 2010; SFB 2015.

Medicinal plants

Collection: Medicinal plants are mainly sourced from eight provinces. In 2012, at least 40 to 50 percent of Cambodians still turned to traditional medicine, according to the Ministry of Health. An estimated 200,000 households collected herbs in 2014, including for medicinal purposes. [105]

Medicinal plants are collected from wild and cultivated sources. About 70 percent come from primary dense forests and 19 percent are from secondary degraded forests. Opportunistic collection sometimes occurs in response to high demand and prices.

Semi-processing/aggregation/wholesale/processing: Aggregators at the village and district levels consolidate collected supplies, sort them for quality, and dry and repack them for transport. Semi-processing is simple and crude, and often consists of collectors cutting plants into small pieces and drying them in the forest.

Retail/export: Phnom Penh is the main hub for the national market, although records on traded medicinal plants are scarce. Export markets are mainly Thailand and Viet Nam, with some re-exports to China by wholesalers or agents through arrangements with consolidators. Some supplies are transported directly to borders without passing through the capital.

Key findings from the value chain analysis

A collector of medicinal plants can earn $3 a day, while a wholesaler can earn double that amount. A processor can earn up to $26 a day, but this requires a high level of capitalization. For ordinary medicinal plants, margins are small for all actors, and income and profits are generated through volume.

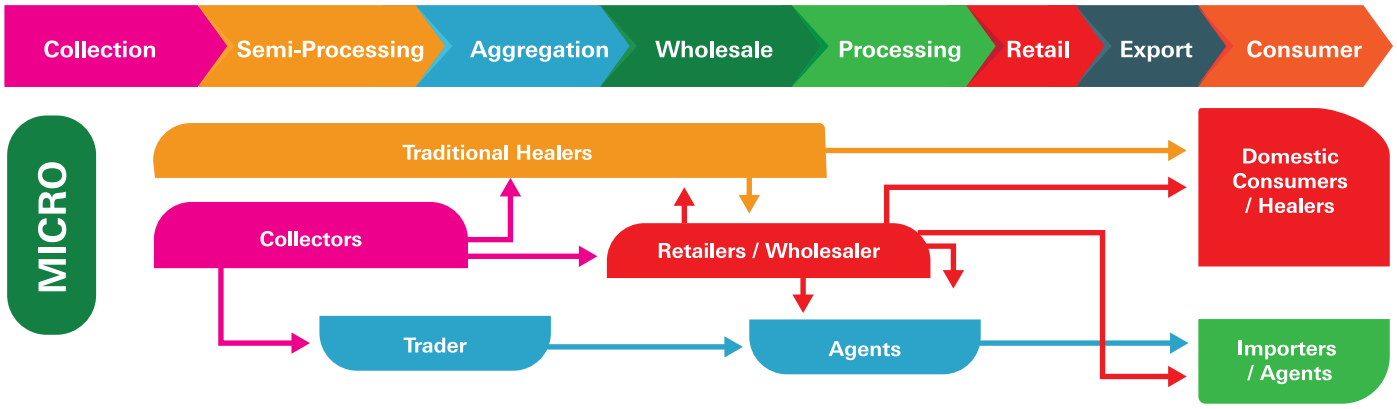
High dependence on traditional medicines, Government support and new generations of traditional healers underpin a stable domestic market, although there are opportunities for innovation and upgrades. A well-organized and active network of traders and retailers operates in key collection areas.

Engaging collectors in sustainably managing resource areas where medicinal plants grow is necessary to sustain supplies over the long term. Besides sustainable harvesting protocols, production enhancement, standards development and an international trade strategy should be formulated, aimed at growing domestic and international markets for natural medicine and biotrade. The tourist market offers opportunities for direct sales by collectors and wholesalers. Improved processing and packaging should help meet standards for safe consumption.

Besides sustainable harvesting protocols, production enhancement, standards development and an international trade strategy should be formulated, aimed at growing domestic and international markets

Figure 4.5.

The value chain for medicinal plants



Sources: UNDP Cambodia 2017b; Walston 2008; Khou et al. 2009; Ministry of Health 2012; WWF 2009.

Challenges to productivity and sustainability

Value chain analysis reveals several challenges faced by rural people striving to benefit from non-timber forest products. These challenges occur across all stages of the value chain, from sourcing to production to marketing, resulting in many lost opportunities.

Benefits are typically constrained by limited production capacity and inadequate use of appropriate tools. Costs can be high and quality low, resulting in uncompetitive products. Poor capacity for investment, innovation and design curtails opportunities for market expansion. Without technical advice and access to capital, it will be hard to improve production, especially at the community level.

Harvesting is often unsustainable, depleting the resource base and eroding potential income. In many cases, external factors such as needs for large-scale commercial agriculture threaten resources. Other issues arise among collectors. With insecure access to resources, they have little incentive to pursue product enhancement, investment or sustainability. Dependence on wild supplies further limits volume and predictability.

Policy support for value addition and commercialization of non-timber forest products has been limited. The National Biodiversity Strategy and Action Plan 2016, the National Forestry Program, the Draft National Strategy for Production Forestry, the National Protected Area Strategic Management Plan and the sub-decree on community forestry have identified non-timber forest products as key to improving rural livelihoods. Yet the implementation of these policies is constrained by insufficient human resources and budgets. Regulation focuses mainly on customary access and subsistence, with limited attention to commercialization. Initiatives to improve the business environment in Cambodia have not yet addressed the specifics of forest-product-based enterprises.

In general, there is still **insufficient support for enterprise development, skills training, product development and trade, limiting potential for growth, innovation and market expansion.** Capacity-building and business development support have mainly been provided by NGOs in discrete projects. These typically focus on small groups or just some actors in the value chain, without the long-term support necessary to develop and grow the sector as a whole. Post-project uptake has been slow as it is not clear who should do this.

Other issues stem from **unclear and complex procedures for permits and royalties** in relation to commercial trade and processing. These erect a compliance barrier for small enterprises, preventing them from expanding their market reach or moving beyond informal activities.

Value chains in general are underdeveloped and depend on single and traditional markets. Information on the demands of domestic and international markets is not readily available to suppliers. The low level of support for enterprise, product and market development leaves value chain actors to operate independently, often missing vital opportunities for value addition (see Box 4.1). Financing is also a challenge.

Box 4.1.

Potential new markets for non-timber forest products

Bamboo: India imports 2,500 tons a day.[106] Estimated annual domestic demand in Cambodia for food sticks is at least 950 to 1,000 tons, of which the current domestic production share is only 10 to 15 percent.[107]

Rattan: Viet Nam's rattan sector was valued at $225 million in 2014.[108] Japan is a market with continued interest in natural colour rattan.

Resin: The global market for all types of resin was valued at $748 million in 2010.[109] Top exporters in Asia are India, Indonesia, Lao People's Democratic Republic, Singapore, Thailand and Viet Nam.

Forest honey: The total national market estimate is 500 tonnes, with the high-value segment and tourist markets estimated at 55 to 75 tonnes per year, equivalent to $3.2 million per year.[110]

Medicinal plants: China is currently the world's largest producer, user and exporter of medicinal and aromatic plant ingredients.[111]

Recommendations

Cambodia's underdeveloped value chains for non-timber forest products undercut livelihood and income opportunities for rural people, and unsustainable production of non-timber forest products can degrade the forest resource base. Products are not contributing to human development and ecosystem sustainability in the ways that they could. Drawing greater benefits will require regulatory interventions; value chain improvements that bolster community empowerment, resilience and income; and sustainable management of forest resources.

Address regulatory barriers

Regulatory and governance issues are key barriers to greater sustainability and profitability for local producers. Policy reform could streamline regulations and legal requirements to ensure that commercial harvesting fully benefits community producers, especially in conservation areas. This could include more transparent and accessible ways to secure permits and licenses.

Sustainable production should be encouraged through more secure property rights for local people, such as through community forestry or community protected areas. This can make local custodianship of resources more likely. Secure property rights will also enable local communities to invest in long-term, higher-value production of non-timber forest products, in a sustainable fashion.

Measures are also needed to ensure that commercial production does not undermine the forest safety net in communities that depend on forest resources for food, fuel and fodder. Sustainable resource management is the only way to guarantee resource availability for commercial and customary uses in the long term.

Improve value chains

This calls for new interventions in market access, financing for local producers and technology development . An overarching national strategy should be designed to boost the competitiveness of non-timber forest products in regional and global markets. It should focus on higher-value activities geared towards greater economic benefits for local producers as well as improved natural resource management and human development in rural communities.

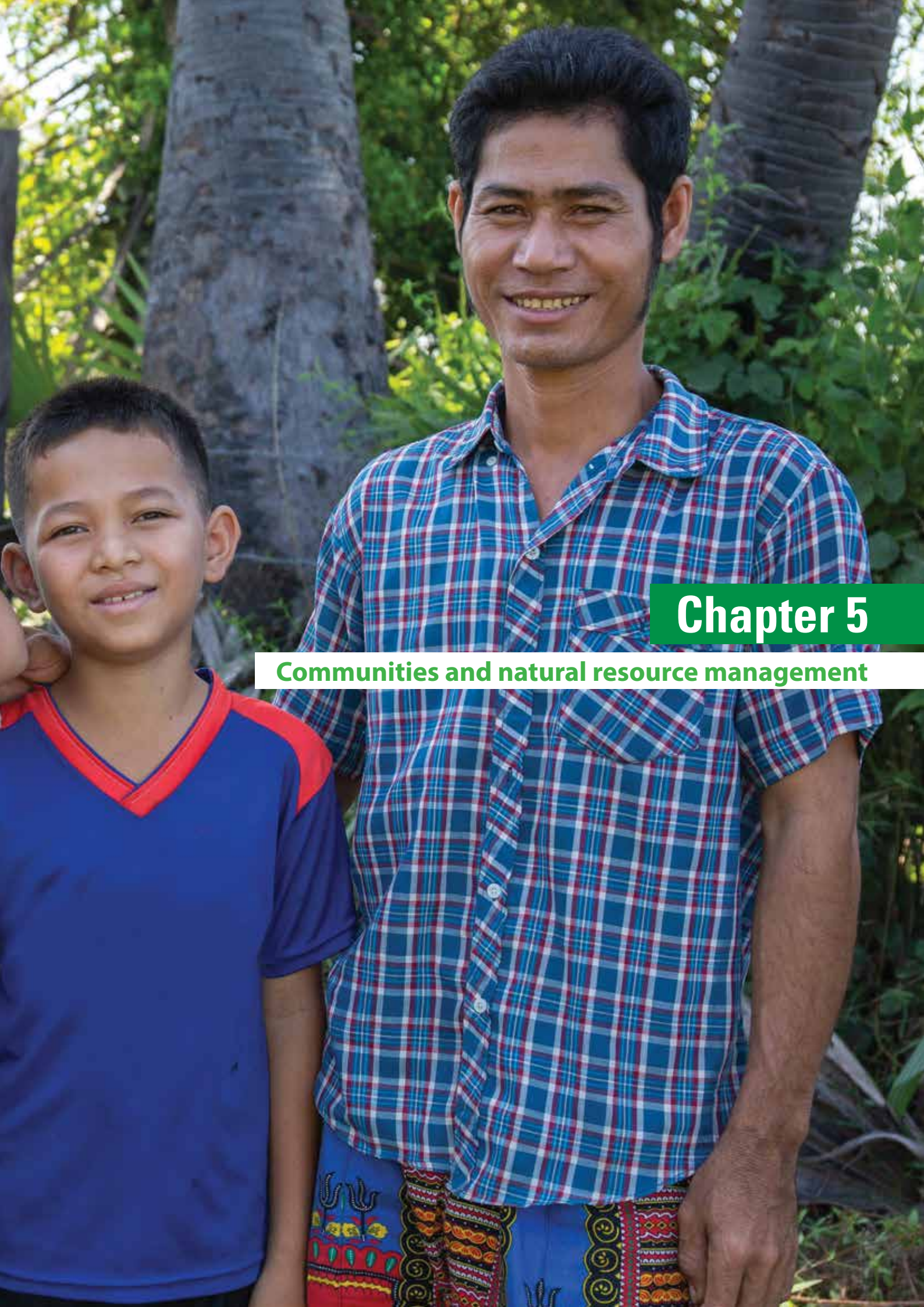
At the harvesting and processing stages, improvements in productivity and quality could come from facilitating access to simple and appropriate equipment. New products could be developed from available materials, such as bamboo pellets used for energy and soil enrichment. Resin with anti-fungal and anti-termite properties has potential in the production of paint and cosmetics. Improving local knowledge of quality requirements can guide harvesting methods and sorting, leading to greater competitiveness in domestic and international markets.

Upgrading market access and marketing depends on providing enterprise support programmes and low-cost finance. Support strategies could target small and/or local enterprises to facilitate expansion into formal export markets, provide assistance with product upgrades that add value, and/or aid sustainability measures to ensure long-term viability. These strategies could bolster the entire non-timber forest product sector, with some specific market opportunities summarized in Box 4.1.

Strengthening collaboration among value chain actors would make local producers more likely to access the resources that they need, and meet legal requirements and quality standards. Collaboration could be cultivated through new social enterprises or cooperatives, or through existing institutions like community forestry.

Developing collective processing centres for local producers could facilitate the collective purchase of capital-intensive equipment, and negotiation of market access and better prices, ensuring that value is captured at the local level.

Drawing greater benefits will require regulatory interventions; value chain improvements that bolster community empowerment, resilience and income; and sustainable management of forest resources.



Chapter 5

Communities and natural resource management

5. Communities and natural resource management

Continued human development in rural areas will depend on the active involvement of local communities in managing shared natural resources vital to their well-being

Continued human development in rural areas will depend in large part on the active involvement of local communities in managing shared natural resources vital to their well-being. Since the 1980s, community-based natural resource management (CBNRM) has proliferated globally, delivering benefits to both the environment and local livelihoods. It complements centralized state-driven conservation measures, which can otherwise be expensive and ineffective. While approaches vary widely, in general, they offer significant scope to resolve trade-offs between conservation and development.[112]

In Cambodia, the Government and its partners have promoted CBNRM since the late 1990s, including through community forestry, community protected areas and community fisheries. The Forestry Law, the Fisheries Law and the Protected Area Law permit the customary use of natural resources by local communities in the forest estate, coastal and freshwater fisheries, and protected areas. Ongoing Government decentralization measures to further strengthen the authority of local communities could bolster community-based management, keeping in mind the imperative for careful planning and execution to balance benefits and challenges.

CBNRM rests on the participation of local people in governing common resources

Despite progress, CBNRM's full contribution to human development has yet to be realized in Cambodia. Community forestry and community protected areas constitute less than 15 percent of total forest and protected areas, and for many communities, for a variety of reasons, initiatives have fallen short of their potential.

Sharing responsibilities and benefits

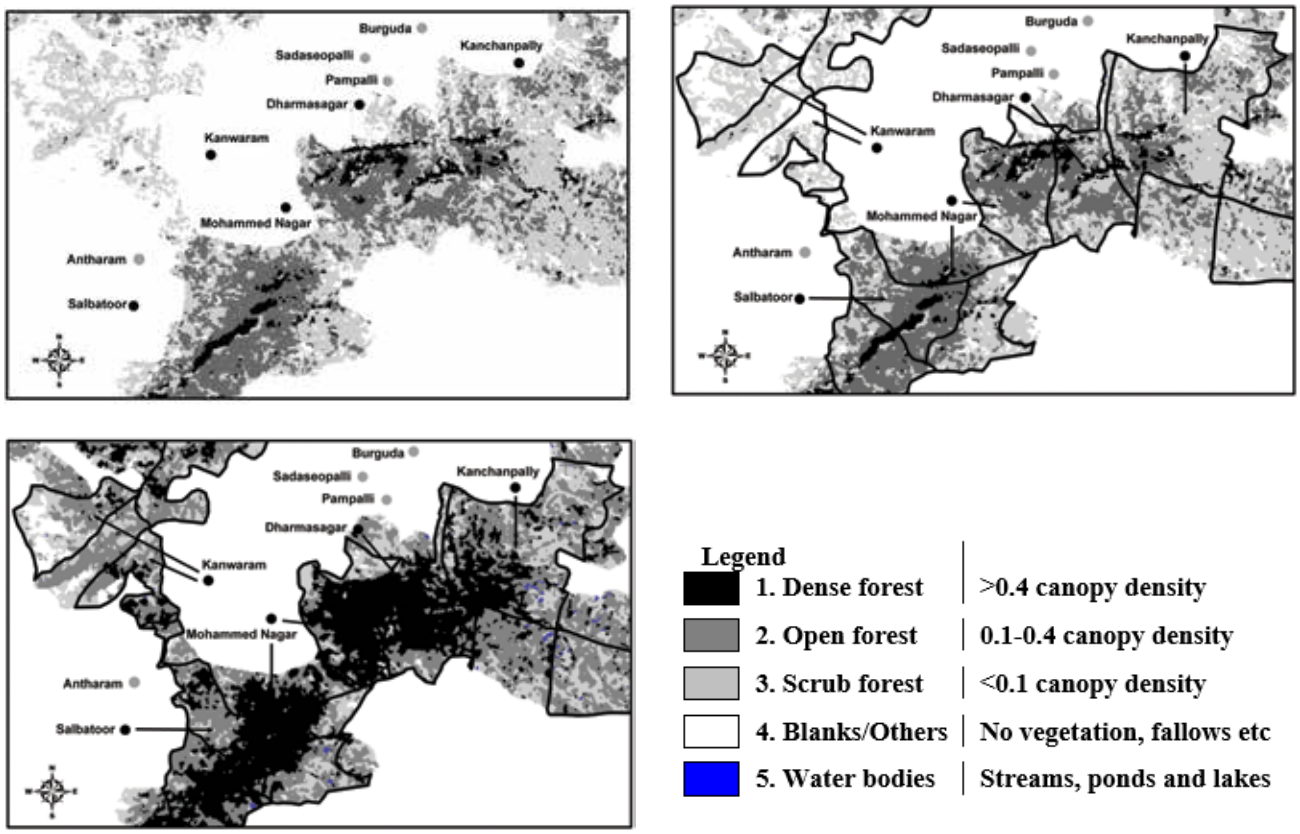
CBNRM rests on the participation of local people in governing common resources,[113,114] typically those used by a group of people where benefits diminish if each individual pursues his or her own self-interest.[115] The approach can offer numerous benefits well aligned with the core aims of human development[116] and sustainable resource use.

Fair common management requires strong group trust and collaboration, as well as the ability to exclude non-group members from using the resource. Most CBNRM arrangements entail the sharing of powers and responsibilities between communities and other actors, such as Government officials or private land holders. Frequently, communities use resources to meet livelihood needs through activities such as grazing, non-timber and timber forest product collection, fishing and hunting.

Resource management can be more effective and sustainable when CBNRM draws on deep local knowledge of ecological conditions.[117,118] This has been observed in India and Nepal, where community management has been actively pursued over a long time (see Box 5.1). Community management can also contribute to livelihood gains, as has happened through co-management of forests in China,[119] joint forest management in India[120] and community-based rangeland management in southern African countries.[121]

Box 5.1.

Community management improved forest cover in India



Since 1996, a programme in the Medak District of India's state of Andhra Pradesh has encouraged joint forest management with nearby villages. Forests were demarcated, divided and allocated to nearby villages for their management and conservation. This increased ownership among communities, and forest cover and quality increased, as illustrated in maps comparing 1996 and 2005.

Source: Saito-Jensen and Jensen 2010.

In areas high in poverty and rich in natural resources, community management can be even more important to improve the livelihoods of the poor, given their often high dependence on natural resources for subsistence and income.[122] The role of natural resources in providing a safety net for the poor is globally recognized. For example, 57 percent of the "GDP of the poor" in India is said to come from natural resources.[123]

The participation of local communities in natural resource management fosters local agency, which underpins human development. Notions of empowerment or power-sharing need to be explicit,[124] as well as directed towards achieving benefit-sharing that is sustainable, equitable and rooted in democratic, transparent decision-making.[125]

Design principles for successful CBNRM

Community participation in natural resource management can take many forms, ranging from consultations with local people on the protection of natural resources to complete community ownership and management of land and other resources.[126]

Many CBNRM programmes draw from the ground-breaking research of Elinor Ostrom, who won the Nobel Prize for Economics in 2009. Ostrom challenged the inevitability of "the tragedy of the commons", which arises when individuals freely access common resources without regard for the consequences.[127] She showed how local resource users can form institutions and abide by local rules for collective management, proposing eight principles for successful management,[128] as outlined in Box 5.2.

Box 5.2.

Avoiding the "tragedy of the commons": design principles for successful CBNRM

Nobel Prize-winning economist Elinor Ostrom proposed eight principles to make the most of CBNRM.

- **Clear definitions:** The boundaries of common resources and the community members who can use them must be clearly defined.
- **Recognition of rights to organize:** The rights of members to form a collective body such as a community organization with its own operational rules must be recognized by governmental authorities.
- **Collective decision-making arrangements:** Procedures must be in place for communities and/or their management committees to make decisions and implement or modify operational rules.
- **Operational rules that meet local needs and conditions:** These typically take the form of resource management plans, and need to account for local voices.
- **Effective monitoring systems:** Communities must regularly monitor the condition of the resources under their management, as well as compliance with the rules by members and external actors.
- **Graduated sanctions:** Those who violate operational rules should be subject to increamentally increasing sanctions administered by local communities.
- **Conflict-resolution mechanisms:** Low-cost, local arenas to resolve conflicts are ideally situated within community structures.
- **Multiple layers of governing bodies:** Where very large areas of resources are being governed, local community management may be nested within larger organizations, with both downward and upward accountability.

Source: Ostrom 1990.

Beyond ensuring that local people gain power and benefits, successful community management largely depends on formally defined communities who collectively manage clearly demarcated resources, based on agreed management rules.

Understanding common challenges

Most community management projects focus on formal structures such as laws, policies and institutional arrangements, including community committees and local management plans. But experiences from around the world demonstrate that the mere introduction of this approach does not necessarily lead to intended outcomes.[129] Common challenges need to be understood and avoided (see Box 5.3).

Box 5.3.

Competing interests complicate community forestry in Nepal

In Nepal, community forestry groups in villages near forests develop management plans stipulating group membership, forest boundaries and operational rules. The plan serves as a contractual agreement with the national Forestry Department. While the Government retains the ownership rights to forests and lands, the forestry groups receive powers to:

- Organize as a collective body and form federations recognized by the state. Federations have won significant political power in Nepal.
- Create a management committee.
- Devise rules for forest management and use. While the commercial use of forest products is largely restricted, groups can use forest products for subsistence.
- Monitor forests by organizing patrols.
- Apply sanctions against offenders by confiscating forest products and/or collecting fines.
- Adjudicate internal conflicts through the management committee.

Some challenges have arisen. For example, in areas where highly valued timber is abundant, such as in the Terai Region, conservation efforts by community groups have often been undermined by illegal loggers.[130] Large communities with multiple competing interests often have difficulties taking collective actions, and elite members within groups, such as higher caste men, tend to dominate decision-making.[131] Finally, even though the law supports community authority, in practice, officials often hinder the devolution of authority.[132]

Problems can stem from a mismatch between community size and resource area, such as when a community is granted a resource area that is too small. If community members can only gain limited benefits, they may lose interest. When the size of the resource is too large, communities may become overwhelmed and less able to implement management plans.

Conflicts can arise if drawing resource boundaries for one community excludes other users who depend on the same resources. If power is transferred to community organizations that are more interested in exploitation, community management can play a role in resource degradation, as seen in some cases in Africa.[133]

If the Government does not grant adequate power to communities to realize rights to organize, to devise operational rules, and to own, manage, use and/or sell resources, then communities will gain limited benefits and be less interested in conservation.[134] The location and quality of resources allocated to communities also affects outcomes, as seen in Cambodia, where distant and degraded sites have been designated as community forests.[135]

Since communities are almost always diverse in terms of wealth, power, class, ethnicity and gender,[136] there is a pronounced risk of elite capture.[137] Powerful community members dominate decision-making and monopolize benefits while further marginalizing disadvantaged groups, especially women and the poor.[138,139] Other pressures come from limited management capacity, patronage networks, endemic corruption and poor law enforcement, which can lead to problems like illegal logging.

Outside powerful actors undermine collective management of natural resources where resources are high in value, such as certain kinds of timber, wildlife and coral resources.[140] Often there are threats of violence against community members, who cannot sustain high-value resources even in community-controlled areas. This has been seen in the case of wildlife in Africa,[141] and in forests in Cambodia[142] and Nepal.[143]

A promising start to CBNRM in Cambodia

Community management offers great promise in Cambodia, especially where communities depend on natural resources and derive meaningful benefits from areas under their management

Despite its challenges, community management offers great promise in Cambodia, especially where communities depend on natural resources and derive meaningful benefits from areas under their management. Community protected areas and community forestry are two existing mechanisms that could be scaled up as the basis for equitable, sustainable resource management that advances human development.

The 2003 community forestry subdecree No. 79 allows forest-dependent communities to participate in sustainable management and use of forests and forest products.[144] The main goals are to strengthen forest protection and conservation, and improve livelihoods.[145] Community forestry can be established within the production forests of the Permanent Forest Reserve under the jurisdiction of the Forestry Administration. The Government has a national target of achieving 2 million hectares of community forestry by 2029, as outlined in the National Forest Programme.[146] As of January 2018, 610 sites had been established, comprising 506,601 hectares.[147]

Under the community forestry subdecree, communities can develop community forestry (*sahakoum*) by entering into an agreement with the Ministry of Agriculture, Forestry and Fisheries. Authorized to manage and use forest resources in a sustainable manner, the community must elect a management committee and chair to develop and implement a management plan approved by the Forestry Administration.

Community protected areas were introduced in 1999 to conserve natural resources while providing livelihood benefits for communities within them. The number of registered community protected areas increased from 4 in 1999 to 168 in March, 2019. Currently, they involve 39,452 families and over 272,110 hectares or around 4 percent of Cambodia's total protected area system of more than 7 million hectares, according to the Ministry of Environment.

Community protected areas can be established in zones of protected areas deemed suitable for sustainable use (see Figure 5.1), following a formal request from at least 60 percent of households within a given village. Villagers must then voluntarily form a community protected area to enter into a formal agreement with the Government. This formal agreement authorizes the community to protect, manage and sustainably use natural resources. As with community forestry, communities must form a representative committee and prepare a management plan.

Under both community forestry and community protected area mechanisms, legal ownership of a given forest or area remains with the Government, but communities gain a range of formal rights and responsibilities related to management and use, as outlined in Table 5.1. Groups in community protected areas may leverage funds from diverse sources, including a monthly membership fee from member households, donations from NGOs and donors, and revenue from sales of non-timber products, eco-tourism, REDD+ finance and the Commune Sangkat Fund. These options to generate funds have yet to be tested extensively in Cambodia.

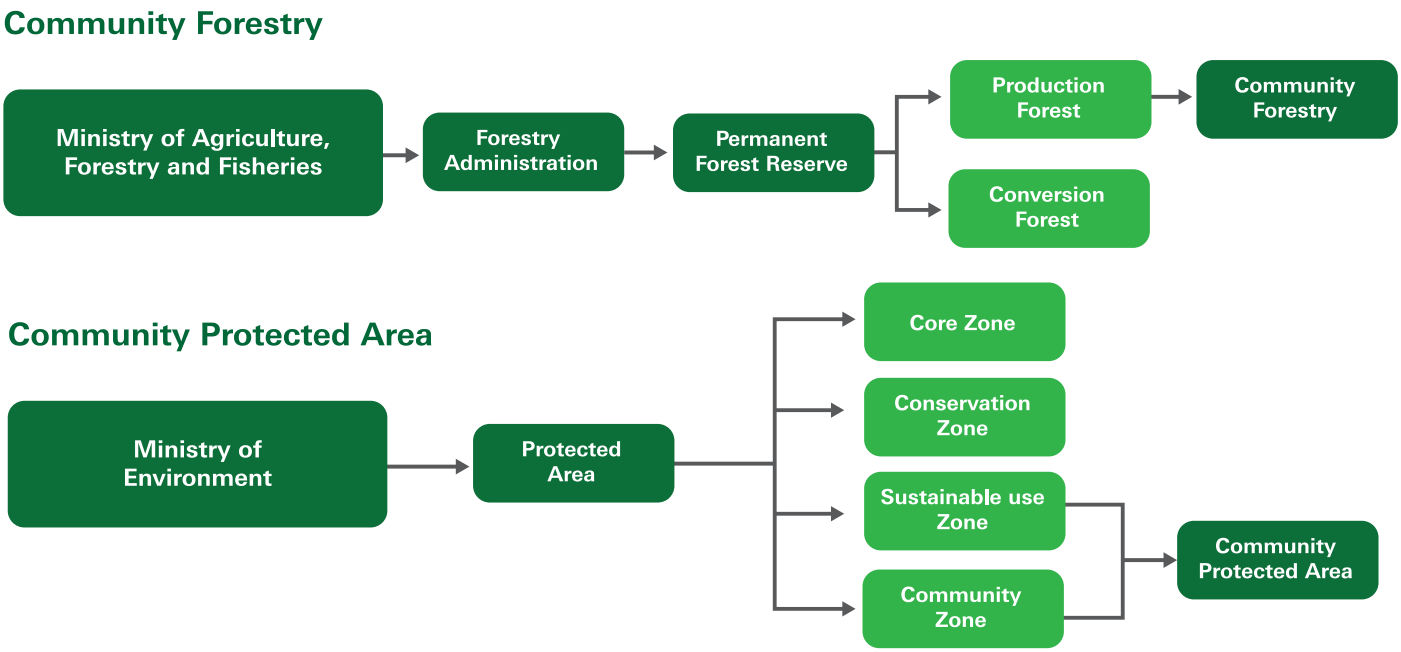
Gaining these rights and responsibilities requires lengthy and technically challenging approval processes. The community forestry process entails 11 steps at a cost from $47,000 to $55,000, with processing times that can exceed five years.[1478] Several steps require approval from high-level officials in the Ministry of Agriculture, Forestry and Fisheries.

Community protected area approval involves eight steps, and usually takes two to three years, depending on community capacity and the level of support provided by the Government and other parties such as NGOs (Table 5.2). Given the extent of Cambodia's protected area system and the need to accommodate community needs within it, the expansion of community protected areas is particularly urgent, and should be conducted in an efficient and transparent manner that supports national conservation and human development goals.

Local market in Aural District, Kampong Speu

Figure 5.1.

Management structures oversee sustainable resource use



Source: Forestry Law and Protected Area Law

Table 5.1.

Communities gain rights and responsibilities under management agreements

	Community Forestry	Community Protected Areas (CPAs)
Rights	• 15 years of management rights for approved areas, with possible scope for an extension of another 15 years. • Customary use rights for religious, cultural and other purposes. • Rights to barter, process, transport and sell non-timber forest products for five years after the approval of the management plan. • Rights to plant, manage, harvest and sell forest products and tree species as approved in the management plan. Selling tree species is allowed for only five years after plan approval. • Rights to practice traditional swidden agriculture at specific times, as defined by the management plan.	• Participation in the development and implementation of the management plan in accordance with guidelines and procedures under the Protected Areas Law (2008). • Right to prevent and suppress offenses in collaboration with the Government. • Sustainably manage and use natural resources in the sustainable-use zone, in accordance with the management plan. • Maintain customary resource use practices on a family scale, especially for indigenous or ethnic minority groups, in accordance with the Protected Areas Law. • Conduct livelihood development activities and seek alternative sources of income.
Responsibilities	• Develop rules and regulations in accordance with the management plan. • Undertake forest management activities. • Monitor the use of forests by other parties. • Conserve and protect forests to ensure sustainability.	• Lead the development of regulations, the management plan and the community protected area agreement • Sign the agreement with the Government. • Monitor and evaluate activities. • Submit quarterly reports to the Government regarding implementation.

Table 5.2.

Approval processes can be protracted

Community Forestry	Community Protected Areas (CPAs)
Early steps can be difficult and time-consuming. Community members, village chiefs and commune councillors must express interest to the Forestry Administration. Extensive consultations with local authorities then follow to avoid overlaps with other land uses. When no other claims are identified in the potential area, the Ministry of Agriculture, Forestry and Fisheries will approve the designation. Before final approval, the community forestry agreement must be signed by community forestry committee chief as well as the Forestry Administration. Completion of all steps depends on the technical capacity of communities and the level of support they receive from NGOs and the Forestry Administration.	Establishing a community protected area typically involves zoning processes. The areas can be established in the sustainable use zone or community zone. Zoning inside the area is developed as part of the area management plan. This process follows participatory methods to engage provincial government staff, local authorities, community protected area committee members and stakeholders, as well as the Ministry of Environment. Once community protected area zones and boundaries are approved by the Ministry, local communities have the right to develop a management plan and manage the area accordingly.
0. Identification of potential community forestry areas 1. Community forestry establishment 2. Information gathering 3. Establishment of management committee 4. Preparation of internal by-laws for committee 5. Demarcation of community forest boundaries and mapping 6. Preparation of community forestry regulations 7. Preparation and approval of the community forest agreement 8. Preparation of the community forest management plan 9. Enterprise development 10. Implementation of the community forest management plan 11. Monitoring and evaluation	1. Participatory study and consultation 2. Application for CPA establishment 3. Development of CPA management structure 4. Identification of CPA boundary 5. Development of CPA by law 6. Development of CPA management plan 7. Development of CPA agreement 8. Monitoring and evaluation mechanism

Taking stock of experiences

Community management offers great promise in Cambodia, especially where communities depend on natural resources and derive meaningful benefits from areas under their management

Some common insights can be gained from Cambodia's experiences with CBNRM. These reveal benefits and conditions for success, as well as challenges.

To start, forests in Cambodia are better under community management. A study of nine sites in Prey Lang[149] showed that community forestry sites are generally in better condition than non-community sites. An earlier review of six community forestry sites across the country argued that they assist in forest and biodiversity recovery by helping to reduce illegal and destructive activities.[150] Improved forest conditions lead to wildlife abundance and a better supply of non-timber forest products, which reinforce livelihood benefits.[151]

Community forestry is more effective when it provides significant livelihood benefits, particularly where communities depend on forest resources for subsistence and livelihoods.[152] Communities have a higher motivation to sustainably manage and use resources such as resin, a major traditional livelihood activity for many indigenous communities living near high-value forest areas, such as in Mondulkiri, Ratanakiri and Preah Vihear provinces.[153] Poor people especially stand to benefit from community forestry through the collection of non-timber forest products such as resin as well as fuelwood and fodder.[154]

In protected areas, communities have more secure access to resources, which benefits livelihoods. A recent impact study of two protected areas in Preah Vihear showed that villagers could derive significant livelihood benefits from forest and land resources, especially through the collection of non-timber forest products.[155] The study used control sites to show that resource-dependent households inside the areas were significantly better off than those outside due to increased resource access and tenure security.

In many cases, communities in Cambodia have gained important non-economic benefits from CBNRM. Studies of forest and fisheries management cases found that organizing communities by providing resources, networks and training builds capacity for collective action.[156] Where community forestry sites secure spirit forests and burial grounds, vital cultural benefits contribute directly to the well-being of ethnic minority and indigenous communities.[157]

Key reasons for communities to engage in community management are to secure resource access and reduce illegal exploitation.[158] Community members have proven to be remarkably effective at deterring illegal activity through low-cost patrolling and monitoring that is often integrated with routine livelihood activities.[159] Where community forestry has been formally approved, it appears to reduce the risk that local communities will lose customary lands to external pressures like economic land concessions.[160]

As is the case elsewhere in the world, Cambodia has encountered some challenges in rolling out CBNRM. With most communities unaware of what these initiatives might mean for them, significant awareness raising is required.[161] Where they have been established, benefits at times have been limited or uneven, including in the critical area of livelihoods. Community forestry sites are often in degraded forest or in forest that is too far away or too small.[162]

Limited benefits or uneven benefit-sharing: in Cambodia, there are significant restrictions placed on commercial harvesting, and/or bureaucratic barriers to obtaining harvesting and transport permits.[163] For example, community forestry regulations allow timber harvesting and non-timber forest product sales for only five years after a management plan is approved. Limited guidance is provided on harvesting amounts and commercialization.[164] Compensation for livelihood restrictions in protected area core zones is not adequate, especially where swidden agriculture is curtailed.[165]

Sometimes, marginalized groups such as women, widowers, young people and the very poor fail to

gain benefits from CBNRM. They may not have the time, capacity or status to attend community meetings, meaning they are left out of decision-making and do not receive information about their rights.[166] The notion of "community" can be strained if it is driven mainly by external or powerful actors.[167]

Recent efforts to comprehensively integrate gender perspectives in CBNRM indicate growing recognition of women's specific roles (Box 5.4). Too often this becomes simply a focus on women, however, without examining power structures and how men and women relate to each other in decision-making.[168] Transformative change depends on rigorous attention to gender dynamics, including those operating through informal processes.

Box 5.4.

A local woman's drive for "development that includes villagers"

Kulen Mountain
Photo credit: UNDP

Yerm Roeung, 32, remembers feeling reluctant in 2016 when her community elected her as deputy chief of a committee managing a community protected area in Popel Village, Khnong Phnom Commune.

"At first, I didn't want to have a leadership position in the community, but I didn't want to lose the remaining forest in my community. I wanted to preserve it for the next generation," she says.

Raised by a single mother and lacking formal education, she saw her inability to read and write as a barrier to participating in managing the area. Further, only two other women in her community take part in community activities.

But Yerm's commitment to protecting the environment overpowered her uncertainty. Nervous at first, her confidence grew as she started doing her new job. Today her responsibilities include regularly meeting with NGOs who come to visit and support the community.

She has a growing concern, though, about the lack of financial support for managing the area. Unpaid committee members struggle to participate and earn enough income to support their families. One result is that members have limited time for patrolling and taking care of the forest.

Despite her own time constraints—her own family practices subsistence agriculture and raises livestock for income—Yerm takes a longer view. She knows the value of the forests for her community and others.

"If we can keep the forest, we can earn a lot from natural resources, such as non-timber forest products. More importantly, we can attract tourists when they visit our commune or village and earn money through that as well," she says.

Forests in her locality maintain the watershed that supplies water to Khnong Phnom Commune and the nearby tourist hub, Siem Reap, and maintains the foundation of the 900-year-old temples at Angkor Wat.

While Yerm hopes to "preserve the forest", she also wants to do more to promote community development, or as she puts it, "development that includes villagers". She sees education as one of the biggest challenges for her community and would like to see stronger schools and vocational training to enhance skills and participation in community affairs.

For now, she continues to engage in the protection and management of the community protected area to ensure that the forest, and her community, can thrive in the years to come.

Short and insecure tenure: Both community protected areas and community forests suffer from overlapping resource claims, especially due to economic land concessions or other kinds of land acquisitions by powerful people or companies.[169] The relatively short timeframe for community forests—15 years with a possible extension up to 30 years—combined with insecure tenure means that communities have limited incentives to engage in long-term management efforts such as planting and reforestation.[170]

Lengthy and cumbersome approval processes: The numerous steps and technically complex procedures imposed under current regulations in Cambodia generally result in delays in the establishment of community forests and community protected areas.[171] The approval process can take many years, depending on the level of technical, financial and political support for communities.[172] In some cases, encroachment has occurred or land has been allocated to economic land concessions before the community agreement was finalized.[173] The same problem has occurred with other forms of community resource rights, such as indigenous communal land tenure in Mondulkiri.[174]

Need for stronger capacity and more resources for implementation: The Forestry Administration and Ministry of Environment have limited staff and budgets to support community management, especially as they face a variety of complex environmental threats.[175] Most community members have only primary education; illiteracy rates are high in some areas. Communities typically struggle to comply with technical requirements such as writing management plans, mapping and demarcation, conducting forest inventories and doing quarterly reports.[176] There is significant reliance on external support from NGOs.[177]

Limited power to sanction offenders:[178] Pressure on community forests and community protected areas has been widely documented, including from logging, hydropower and mining activities, economic land concessions and encroachment by migrants.[179] Legally, community forestry communities can monitor use, but rights to sanction violators are limited. When violations occur, community members must call Government officers and the police, but more support is required for effective law enforcement.

Box 5.5.

Successful community fisheries highlight the potential of community management

A group meeting in Pleuv Tuuk plans the new community fisheries area.

Photo credit: IUCN-NSA project 2013.

Recent experience with community fisheries in Cambodia shows how local livelihoods and natural resources can both benefit from collaborative management approaches.

Dramatic reforms to fisheries in Cambodia in 2012 led to the cancellation of all commercial fishing lots on Tonle Sap Lake. This left great uncertainty, yet also many opportunities, including through establishing community fisheries.[180] One project by the International Union for the Conservation of Nature (IUCN) created three new community-managed sites on the lake, with a focus on protecting fish-breeding grounds. This brought immediate positive effects, for fish stocks and communities, although villagers faced challenges in trying to exclude outsiders from the sites.[181] With strong Government support and community patrolling, it has been possible to defend the areas.

A recent review of nine community fisheries sites on Tonle Sap and in coastal areas[182] found that where communities had been able to negotiate for commercial rights to generate income, success was more likely. Since Cambodian legislation does not provide for these rights, these successes emerged where community groups took the initiative and negotiated arrangements with local government officials.

Recommendations

Cambodia can build on its foundation of community-based natural resource management to deliver greater community benefits, ecosystem services and biodiversity protection. The following recommendations apply to all forested lands and natural ecosystems where local customary user rights exist.

Promote community management in locations where it can maximize social and environmental benefits.

This entails harnessing community interests by prioritizing culturally important areas, such as sacred or ancestral forests, and economically important areas that are accessible, sizeable and resource rich, such as high-value forests. Social and economic incentives can propel sustainable management. Environmental benefits can be secured through selecting locations with globally significant biodiversity or nationally significant watersheds.

Strengthen participatory processes and full community empowerment.

This calls for raising awareness among communities about the potential benefits of community management, and soliciting local ideas on implementation.

All aspects of CBNRM require ample time and resources backing participation at numerous points in the process, such as detailed analysis of the local social context for resource use; boundary demarcation and mapping; development of rules and regulations for resource use; selection of community representatives to oversee community management; and other management decisions relating to benefit-sharing, patrolling and monitoring.

Ensuring a meaningful transfer of power to the community rests on enabling local communities to form a collective body for local representation, and to devise their own resource management rules that build upon customary systems. Local bodies should be empowered to make their own decisions, with adequate support. Bolstering community accountability and autonomy could involve, for example, local third-party monitoring to check community performance, as required.

Specific measures are required to strengthen and defend community resource rights, covering issues such as usage and commercialization rights for fish, timber, woodfuel and non-timber forest products, and shifting cultivation. Legal, technical and financial support can help communities better defend their resources through boundary demarcation, law enforcement, and, where applicable, the seeking of free, prior and informed consent from communities on any activities (e.g., economic land concessions) that may affect them. Communities should be empowered to address illegal activity. Assistance with monitoring and controlling resource use according to agreed management plans could encompass sanctions and/or the leveraging of fines against offenders.

Ensure equity and inclusion within community management institutions.

This should be grounded in support for fair and transparent procedures and safeguards for the interests of marginalized groups, including the poor, indigenous peoples and women. It may entail reserving a share of influential posts within the management committee for these groups; actively engaging them in decision-making and benefit-sharing; and using interpretation between Khmer and local indigenous languages where appropriate. District, provincial and national level federations of CBNRM groups will enable communities to collectively address their concerns and defend their rights, and strengthen community management across the country.

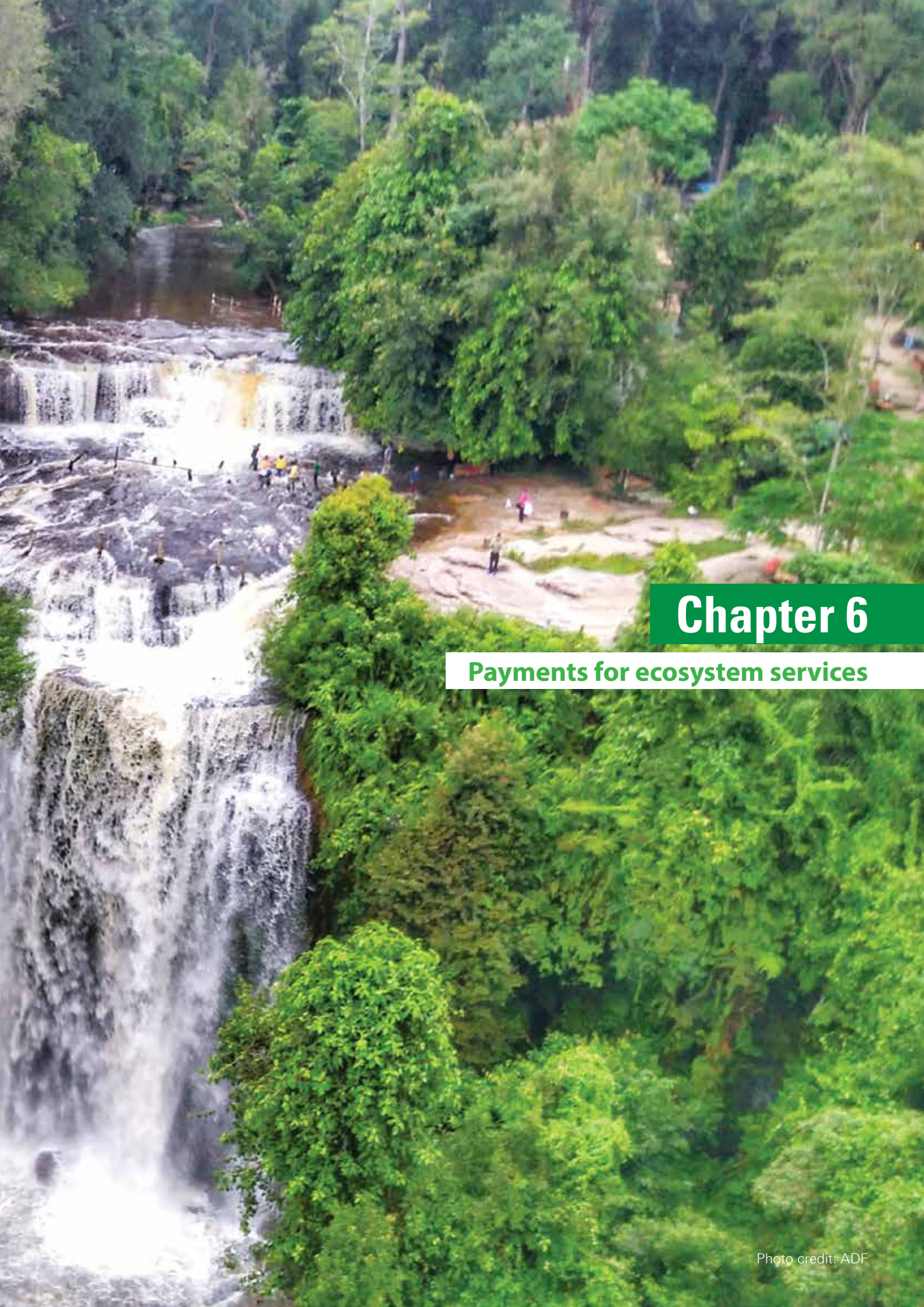
Enhance Government support for community-based natural resource management.

This requires greater capacity among officials to facilitate community participation and support law enforcement. Approval procedures to establish community management should be simplified, with faster processes and reduced costs whenever possible. Establishing appropriate grievance mechanisms would mean community voices are heard if conflicts arise. Small-scale clashes should be addressed through local mechanisms, but third-party mediation, preferably high-level and politically influential, may be necessary for some conflicts.

Building on a sound foundation

The policy and legislative frameworks required for community-based natural resource management in Cambodia are sound. Careful implementation should now bridge the gap between what is on paper and what happens in practice. This should entail strong participatory processes that demonstrate a true regard for community voices and rights, and recognize that local communities are the ideal partners to safeguard the country's natural resources, provided they have opportunities to sustain their livelihoods in the process.

Community-based natural resource management can deliver greater community benefits, ecosystem services and biodiversity protection



Chapter 6

Payments for ecosystem services

Photo credit: ADF

6. Payments for ecosystem services

Even though human development for rural people largely depends on the viability of ecosystems, the value of ecosystem goods and services is not directly reflected in economic accounting. The assumption that these goods and services are in some sense "free" has resulted in overexploitation and depletion, imposing significant economic, social and environmental costs. Many essential ecosystems are now facing critical threats.

Payments for ecosystem services (PES) seek to address the problem of resource exploitation by providing financial incentives for ecosystem conservation

One way to address this market failure is through Payments for Ecosystem Services (or Payments for Environmental Services, referred to as PES). This approach provides financial incentives to encourage behavioural changes that support ecosystem conservation.

In Cambodia, Government interest in experimenting with such payment systems has been stimulated by Costa Rica's highly successful national scheme. In September 2016, a Cambodian delegation visited Costa Rica. This visit prompted Prime Minister Hun Sen to create an official order (*sochornor*) endorsing development of a national payments scheme based on testing at two sites: Phnom Kulen Mountain in Siem Reap and the Kbal Chay watershed in Sihanoukville. Using lessons from these pilots, the Government plans to introduce a national payments policy.

Agreeing on conservation

Payments for ecosystem services establishes voluntary or conditional agreements between buyers and sellers of such services.[183,184,185] Under these arrangements, buyers who benefit from ecosystem goods and services provide payments to sellers who conserve and protect ecosystems, or forego activities that degrade and deplete ecosystems. Payments encourage ecosystems management that is not only environmentally beneficial, but also advantageous for the health, livelihoods and overall well-being of local people.

PES has been introduced in many parts of the world, but mainly in Latin America. In Costa Rica, for example, gasoline users pay fees to forest owners to increase forest cover and implement environmentally friendly land-use practices. In Ecuador and Mexico[186] as well as Viet Nam, Governments pay forest owners for forest protection. In China, Government payments encourage farmers to reduce soil erosion.

REDD+ and ecotourism are among the initiatives defined as payments for ecosystem services. Under REDD+, developed countries, multilateral organizations and the private sector make payments in exchange for national and local efforts to protect and sustainably manage forests. Ecotourism entails tourists paying to preserve key ecosystems and biodiversity as well as scenic landscapes. Similarly, consumers pay "extra" fees for ecologically certified products such as shade-grown coffee, fair-trade chocolate and Ibis rice.

While the core objective of PES is conservation of ecosystems and biodiversity, the synergy between this approach and human development has become increasingly clear. Since most rural poor people depend heavily on natural resources for their livelihoods, the maintenance of viable ecosystems is generally beneficial to human development. This is the case, for instance, when sustainably managed watersheds supply clean water to rural and urban settlements,[187] or when forests protected against degradation provide building materials and marketable products for the people living there. Obviously, however, targeted interventions that integrate pro-poor payments are especially conducive to the improvement of human development.[188] This is exemplified by a Nepalese REDD+ pilot project that specifically supported poor women and landless inhabitants of rural villages.[189]

A decade of experience in Cambodia

The concept of PES is not entirely new to Cambodia. As summarized in Table 6.1, various initiatives have taken place over the last decade. All have been implemented by NGOs in partnership with the Government.[190] The sites have primarily been protected forests or other protected areas. Most experiences have been with contracts that stipulate direct payment for biodiversity to individual villagers or communities living in and around areas targeted for conservation, especially to incentivize the protection of endangered species.[191] These contracts have been implemented on the basis of informal or customary property rights, rather than on formalized land tenure or resource rights.

Table 6.1.

Cambodia has seen a number of PES and similar schemes

Payments scheme	Location	Payer/buyer	Service provider	Ecosystem service	NGO involved
Community-based ecotourism	Preah Vihear	Tourists	Village fund	Protection of endangered bird species and their habitat	Wildlife Conservation Society
Agri-environment payments, e.g., for ibis-rice	Preah Vihear	Urban consumers, hotels and restaurants	Individual farmers	Protection of endangered bird species (e.g., Giant Ibis) and their habitat	Wildlife Conservation Society
Direct payments for nest protection, three separate schemes (a, b, c)	Preah Vihear and Kompong Tom (a)	Wildlife Conservation Society (a)	Individual villagers	Protection of the nests of endangered bird species	Wildlife Conservation Society (a)
	Kratie and Stung Treng (b)	World Wildlife Fund (b)			World Wildlife Fund (b)
	Ratanakiri (c)	BirdLife (c)			BirdLife (c)
Direct payments for turtle nesting	Kratie and Stung Treng	Conservation International	Individual villagers	Protection of specific endangered turtle species	Conservation International
Conservation agreements	Koh Kong (Cardamom Mountains)	Conservation International	Commune fund and individual villagers	Payments for forest conservation and species protection (Siamese Crocodile, Dragon Fish)	Conservation International
REDD+	Seima, Oddar Meanchay		Private sector	Payments for forest conservation	Wildlife Conservation Society

Various PES schemes in Cambodia, which have been implemented mainly by NGOs, have been successful in protecting biodiversity and delivering livelihood benefits

Schemes have been successful in protecting biodiversity and delivering livelihood benefits, such as increased income generation activities.[192,193,194,195] One REDD+ demonstration project in Mondulkiri Province, which entails management of the Seima Protected Area, has successfully sold carbon credits to the voluntary carbon market.

Experiments with direct payments in Cambodia are promising but without sufficient evidence yet to make firm or universal conclusions about how, when and where the schemes work best.[196] As global experience suggests, outcomes are often determined by the context and design of different schemes, making it necessary to learn from actual practice.[197] Formulating a national scheme in Cambodia could benefit from incorporating lessons from around the world, especially in making design and implementation fully inclusive and attentive to the needs of poor and other marginalized groups.

Putting payments into practice

The design and implementation of PES typically entails four steps: first, a diagnosis of the situation, including forms of land use, property rights and the main actors (government, local communities, NGOs and the private sector); second, design of the payments scheme; third, negotiation of agreements with stakeholders; and fourth, implementation and adaptive management.

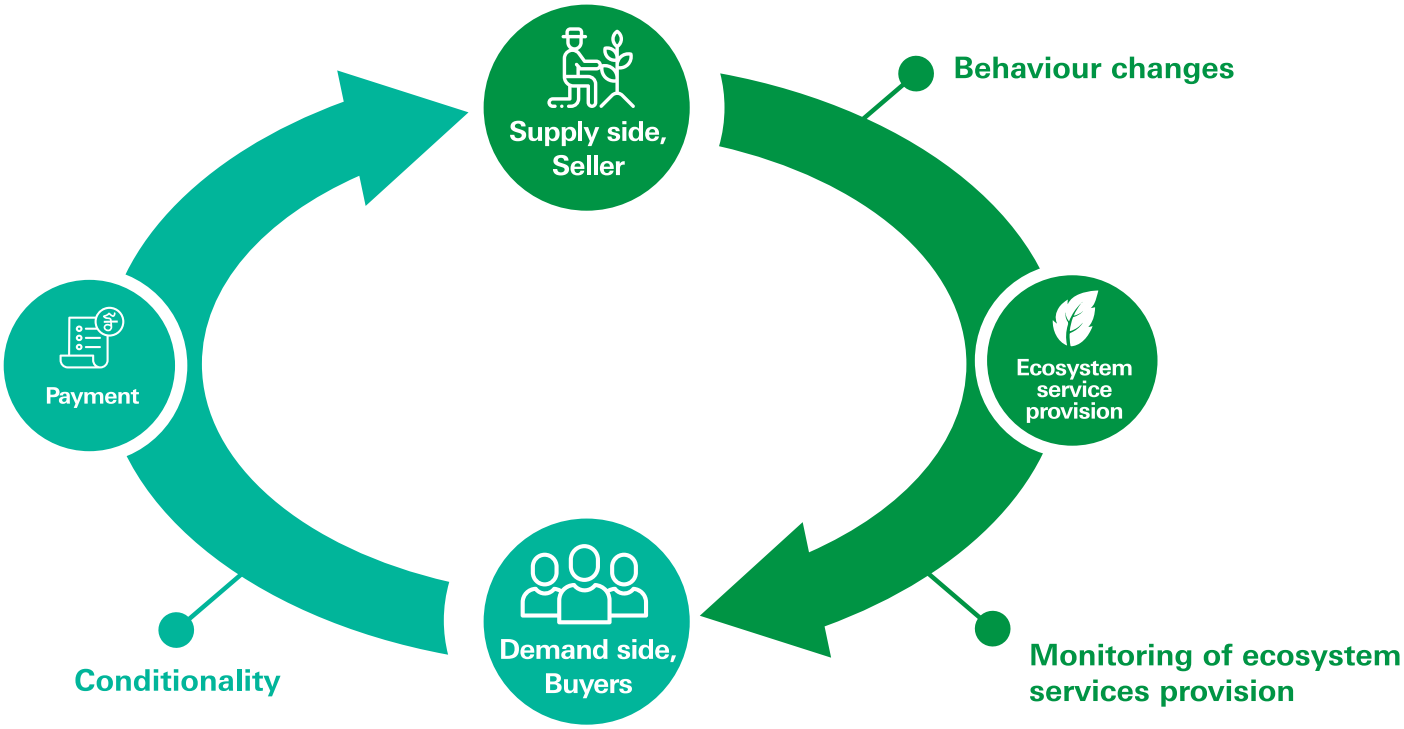
As outlined in Figure 6.1, in a typical scheme, buyers include NGOs, international donors and funding schemes (e.g., REDD+), multilateral organizations, private companies, national governments, philanthropists and tourists. Sellers comprise private landowners, resource users, indigenous communities, national park managers, fisherman, hunters or farmers. A behavioural change by an ecosystem services supplier is usually required. It might be tree planting; refraining from hunting, cutting trees or the use of particular areas or resources; or modifying farming practices in environmentally friendly ways.

Payments can be made in cash or as in-kind benefits. They can be designed to compensate for the opportunity costs of conservation or they may reflect a "willingness to accept" an amount on behalf of the seller. They can be delivered according to any negotiated time-frame. Monitoring of ecosystem services mostly uses proxy measures for ease and efficiency, such as indicators of environmentally friendly behaviour and/or land-use practices by the seller.

Conditionalities aim to protect an ecosystem good or service, for example, through avoiding deforestation, enhancing carbon sequestration, improving biodiversity or species protection, or providing clean water. If the promised environmental services are not delivered, payments or benefits will be withheld or restricted.

Figure 6.1.

Key design elements of PES



Conditions for success and risks to avoid

A significant body of knowledge has grown from experiences with PES, underlining four particularly central conditions for success.[198,199,200] First, users or beneficiaries of environmental services must be willing to pay providers at least their minimal "willing to accept" amount. Otherwise, the deal is not possible. Second, payments should not conflict with existing norms and values, and contracts should be trusted. Third, it must be clear who is responsible for providing environmental services, such as through well-defined land and resource tenure regimes. Finally, good governance backs clear, transparent mechanisms to transfer payments from buyers to consumers along with robust monitoring of implementation and results.

Other success factors include high-level government commitment to finding solutions, and wide recognition of urgent environmental problems, such as when a large number of stakeholders share a common concern.[201] A major beneficiary of ecosystem services, such as a hydroelectric dam or irrigation project, or a substantial number of beneficiaries, such as water consumers in cities, can make it easier to charge fees, either on a larger company with high financing capacity or in small amounts across many beneficiaries.

Systems tend to succeed by introducing small fees with a limited impact on the cost of the final product, such as water, energy or fuel. Low opportunity costs can be important, as ceasing activities that generate significant revenue, such as mining and highly profitable commercial agriculture, can otherwise involve significant compensation.

While there are many ways to broker a payments agreement, some of the best examples have responded to local conditions based on strong knowledge of the context, flexibility and creativity. This lesson has special relevance for Cambodia, given promising new legal frameworks and payment pilot projects.

Central conditions for successful PES include presence of a major beneficiary or a substantial number of beneficiaries and their willingness to pay for environmental services, clear and well-defined tenure, and high-level government commitment for PES

Common implementation challenges

Common implementation challenges include issues of data collection, property rights, fund management, monitoring and sustainability

Experience has also shown some common implementation challenges, such as lengthy processes to operationalize PES. Designing a scheme takes time and persistence, and is premised on overcoming various challenges and facilitating negotiations along the way.

Design often involves technically demanding tasks such as forest cover monitoring, collection of biodiversity data, or analysis of local property rights and land-use practices. It can entail negotiations with potential service providers, which are rendered complex by issues that include language and literacy. Pragmatic solutions to overcome some of these costs include the use of proxy indicators (e.g., of land-use practices) and community-based monitoring to track environmental services.[202]

Capacities and resources to complete complex technical tasks and sustain implementation are often insufficient, as is the case in Cambodia. Training and capacity-building are therefore required, along with skilled support over time.

Even where protected area management plans or payment agreements exist, PES implementation can be compromised by weak law enforcement or policy conflicts. For example, local park rangers may find it hard to enforce the law in the face of powerful interests driving resource and land appropriation. Such outside interests can also render local community members powerless to fulfill their conservation commitments. In addition, areas often have separate or overlapping land-use mandates.

Many schemes are initially implemented with donor funds and technical support. Donors or NGOs may even act as the buyers of environmental services. Yet PES requires sustainable long-term financing. While global carbon markets initially seemed promising, high carbon prices have not materialized, and carbon sequestration services are now more likely to be financed through bilateral and multilateral aid.[203] Prospects for sustainable financing are enhanced where committed private sector buyers or trust funds are available, but these are unusual cases.

Many schemes are implemented in areas where property rights are collectively or customarily held or exercised without formal legal recognition.[204,205,206] This raises issues around consent.[207] Among others, it opens questions such as: How are decisions made in the communities? Does everyone agree to join the scheme? Without community buy-in and awareness, schemes are unlikely to succeed. Other challenges relate to equity. Some households are likely to benefit more than others from payment schemes, just as some households are likely to bear the costs of conservation more than others. Adequate knowledge of the local context is vital to account for the fair distribution of costs and benefits.[208]

Various situations create difficulties for the enforcement of sanctions for violations of payment contracts. Vested interests among involved parties such as NGOs, governments, donors and buyers can deter detection and sanctions. Socioeconomic and political conditions can make it hard for resource users to report violations committed by others in the community or by outsiders. Sometimes payment contracts exist on paper only.

Finally, in highly dynamic "frontier" areas, opportunity costs can change rapidly as prices for land and agricultural commodities fluctuate. When the local cost of conservation rises, buyers of environmental services may be unable to sufficiently compensate local resource users. In the Cambodian forest frontier, for instance, escalating land prices have made it difficult to implement a payment scheme.[209]

Steps towards a national scheme

In 2016, the Royal Government of Cambodia endorsed development of a national PES scheme run by the Government. It will draw on experiences gained at pilots at the Phnom Kulen Mountain watershed in Siem Reap and the Kbal Chay watershed in Sihanoukville. Both are concerned with the protection of valuable watersheds in protected areas. These watersheds regulate water supplies to major tourist centres, beverage companies and urban locations. They are threatened by unmanaged farming, settlements and other economic development activities.

In cooperation with the Food and Agriculture Organization (FAO) and Conservation International, UNDP assisted the Government in conducting feasibility studies for the two pilot sites. These aimed to identify key ecosystem services, possible buyers and sellers of ecosystem services, and potential mechanisms for collecting and transferring payments from buyers to sellers.

Phnom Kulen: a fund for effective park management and environmentally friendly farming

With a 37,500-hectare national park, Kulen Mountain supplies clean water to Siem Reap and maintains the underground aquifer that stabilizes monuments in the Angkor region. For villagers living in the area, surrounding ecosystems provide water and lands for agriculture, timber for houses, woodfuel for cooking, non-timber forest products such as mushrooms, medicinal plants, and bushmeat for subsistence and income.

Despite their value, Kulen Mountain's ecosystems are under threat. The expansion and intensification of cashew nut plantations is one of the largest concerns, leading to heavy forest loss, with coverage on the mountain declining from more than 50 percent to 25 percent over the last three decades (Figure 6.2). Until recently, villagers mainly practiced shifting agriculture or chamka for upland rice production. Since 2005, cashew growing has replaced most of the former natural forest and shifting agriculture system for villagers on the eastern plateau because of its profitability. Since 2015, many cashew farmers have introduced herbicides, which pose additional risks to human health and water quality.

Cambodia is now moving towards designing a national PES scheme run by the Government based on two PES pilots: Phnom Kulen and Kbal Chay watersheds

In light of these threats, a payments scheme would need to consider that most farmers do not have formal tenure rights to the land they farm and are unlikely to obtain land titles due to their location in the park. Further, substantial earnings from cashew nut production make the opportunity costs of forest conservation very high. At the same time, direct compensation for foregoing cashew nut farming in protected areas (which is considered illegal according to the Protected Area Law) could send a misleading signal that illegal activities are rewarded.

A feasibility study proposed several options for a pilot scheme (Figure 6.3). One on the supply side entails implementation of the Phnom Kulen National Park Management Plan. This plan prioritizes boundary demarcation of protected area zones, clarification and formalization of tenure, and effective law enforcement. A second proposal involves creating incentives for local farmers to adopt sustainable, chemical-free practices, and to become the custodians of Kulen Mountain. Incentives may include official recognition of villagers' tenure rights on the condition that they will not expand farms and will adopt environmentally friendly farming practices; technical support for new farming practices; and facilitation of links to high-value markets for sustainable cashew nuts.

For the demand side, the study identified several opportunities related to Angkor Wat tourism and the town of Siem Reap, given that they are the main users of water in the downstream watershed.

During the last few decades, there has been a remarkable increase in the number of tourists in Siem Reap city, reaching approximately 1.8 million international tourists in 2018. Along with the increase, the rate of annual underground water extraction increased dramatically from less than 1 million cubic metres per year before 2006 to 6.8 million cubic metres by the end of 2018 at a value of $1.9 million ($0.28 per cubic metre) in 2018.

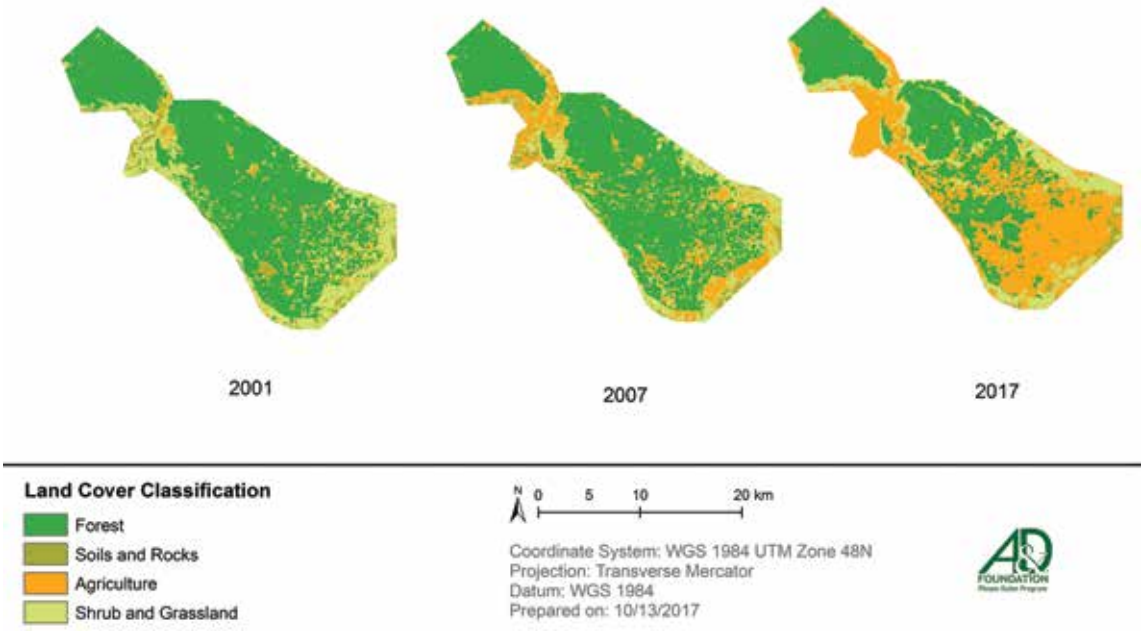
Extra levies or fees could be charged to international tourists at the airport or to major water users such as large luxury hotels in Siem Reap (Tables 6.2 and 6.3). These could in turn be channelled into a fund to finance implementation of the park management plan. Ideally, such funds could also be used to further incentivize environmentally friendly farming and other activities.

Forest clearing and herbicide use for cashew production near Kulen Mountain in 2017.

Photo credit: ADF.

Figure 6.2.

Agriculture is overtaking forests in Phnom Kulen National Park, 2001-2017



Source: ADF 2017.

Figure 6.3.

Proposed components of the Phnom Kulen PES pilot

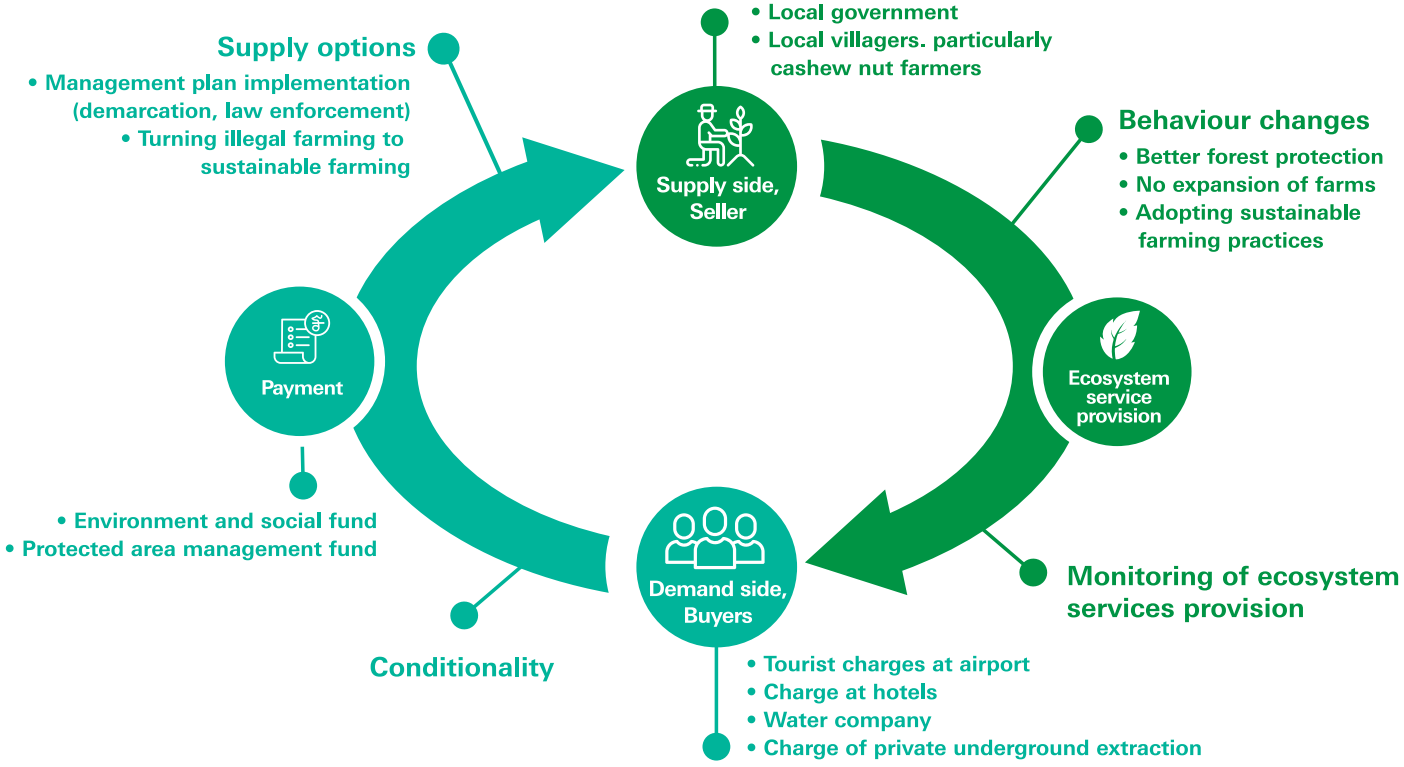


Table 6.2.

The numbers of hotels and rooms in Siem Reap

Province	Department of Tourism (October 2018)					TripAdvisor (24 December 2018)				
	2-star	3-star	4-star	5-star	3-, 4- ,5-star	2-star	3-star	4-star	5-star	3-, 4- ,5-star
No. of hotels	1	6	23	24	54	121	436	173	40	655
No. of rooms	36	378	2,946	4,796	8,120	4,356*	27,468*	22,144*	7,960*	57,572*

Source: Data are derived from the Siem Reap Department of Tourism 2018b, 2018a. *The estimation is based on the data (average number of rooms per hotel) provided by the Department of Tourism. The data from TripAdvisor are included as another reference due to a large number of unregistered hotels.

Table 6.3.

Options for payments from different dimensions of tourism in Siem Reap City

PES options	barge $/unit	Minimum value $*/year	Max value $*/year
1. International tourists arriving at the airport (average 159,754 tourists per month)	$1/person	1,917,054	1,917,054
2. Hotels[211] (3-, 4-, 5-star)*	$0.5/room/night	740,950	1,481,900
3. Other types of accommodations (34 2-star hotels and apartments, 351 guest houses) and 183 restaurants	$1/day	207,320	207,320
4. Water trading companies (e.g., Kulen Water, etc.)	1-5% of the benefit/year?	--	--
5. Private underground exploitation (e.g., hotels, restaurants, etc.)	1-5% of the benefit/year?	--	--
	Total values	**2,865,324**	**3,606,274**

*The minimum and maximum values are applied only to the 3-, 4- and 5-star hotels as their units/rooms are not always fully occupied. Minimum is an estimation based on half the rooms being occupied, and maximum is based on them being fully occupied.

Kbal Chay: Leveraging fees for water and instituting a management plan

The second payments pilot is located in the Kbal Chay watershed, which provides the primary water supply to Sihanoukville, Cambodia's main port, and a hub for tourism and industry. Given the strategic importance of its ecosystem services, a 7,000-hectare forested area is reserved as a protected area.

The ANCO company is responsible for reservoir management, water pumping and water treatment within the Kbal Chay protected area. ANCO sells water to the Sihanoukville Water Authority, which supplies town residents and commercial users including hotels and restaurants. Industrial water users near Sihanoukville include a special economic zone that uses 1,000 cubic metres a day, and the Angkor beer company, which uses 5,000 cubic metres a day.

The rapidly growing number of tourists as well as the expansion of new Chinese developments and the special economic zone has led to a dramatic increase in the total volume of water demand. The number of tourists rose from about 586,000 in 2010 to over 2 million in 2018. Today, Sihanoukville hosts over 100 hotels, according to TripAdvisor (Tables 6.4 and 6.5), and 200 restaurants. The overall supply of water increased fivefold from 2.1 million cubic metres in 2010 to 10.7 million cubic metres in 2018, at a value of around $3.2 million in 2018 ($0.3 per cubic metres).[212]

Table 6.4.

The numbers of hotels and rooms in Preah Sihanoukville

Province	Department of Tourism (October 2018)					TripAdvisor (24 December 2018)				
	2-star	3-star	4-star	5-star	3-, 4- ,5-star	2-star	3-star	4-star	5-star	3-, 4- ,5-star
No. of hotels	1	1	3	5	10	17	28	8	1	54
No. of rooms	45	97	402	992	1491	765*	2716*	1072*	198*	3986*

Source: Data are derived from the Preah Sihanoukville Department of Tourism 2018b, 2018a, and the TripAdvisor website. *The estimation is based on the data (average number of rooms per hotel) provided by the Department of Tourism. The data from TripAdvisor are included as another reference due to a large number of unregistered hotels.

Table 6.5.

Options for payments from different dimensions of tourism in Preah Sihanoukville

PES options	Charge $/unit	Min value $*/year	Max value $*/year
1. International tourists arriving at the airport (as of November 2018, 43,645 tourists per month)	$1/person	523,740	523,740
2. Hotels[213] (3-, 4-, 5-star)*	$0.5/room/night	136,053	272,107
3. Other types of accommodations (87 2-star hotels, apartments and bungalows, 289 guest houses), 321 restaurants	$1/day	254,405	254,405
4. Casinos, Angkor beer company, special economic zones	1-5% of the benefit/year?	--	--
5. Water trading companies (e.g., ANCO)	1-5% of the benefit/year?	--	--
	Total values	**914,198**	**1,050,252**

*The minimum and maximum values are applied only to the 3-, 4- and 5-star hotels as their units/rooms are not always fully occupied. Minimum is an estimation based on half of the rooms being occupied and maximum is based on them being fully occupied.

Such rapidly-growing demand for water from tourism and industrial development is likely to exceed the carrying capacity of the reservoir, which can only provide 27.6 million cubic metres.

In spite of the obvious need for protecting Kbal Chay, the watershed is threatened by illegal settlements and land encroachment, both of which lead to forest loss or degradation. Only half of the protected area is properly demarcated. Other challenges relate to limited law enforcement. Visitor management at the waterfall site is weak, with no systems for dealing with sewage or rubbish. This affects water quality as well as the aesthetic appreciation of the site.

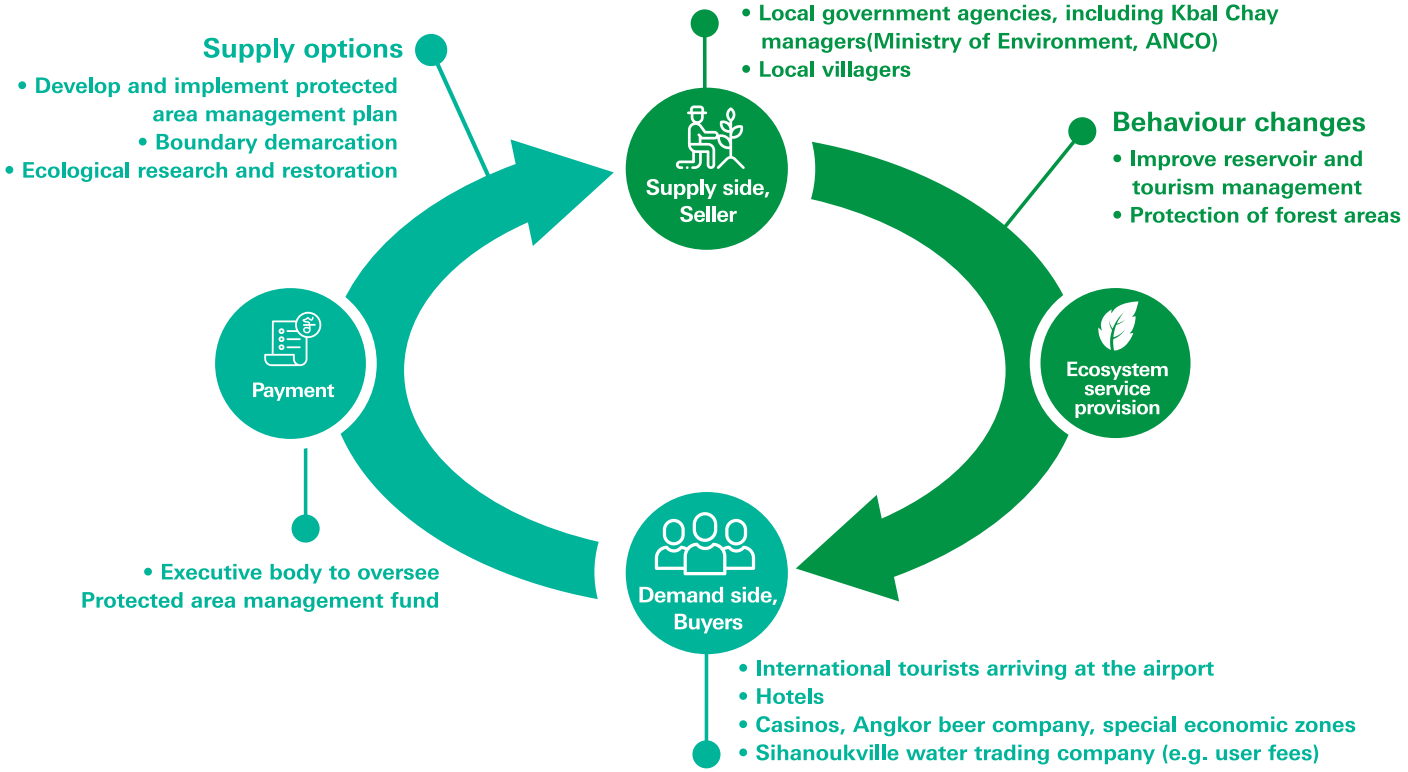
The feasibility study identified a number of potential buyers and institutional arrangements to operationalize a pilot payments scheme (Figure 6.4).

On the demand side, private beneficiaries, including the Angkor Beer company and other industrial users in the special economic zone, could be willing to pay to secure their water supply. The Sihanoukville water authority (via ANCO) may provide an institutional structure to leverage fees from water users. A voluntary or private sector scheme could direct payments to an executive body that could initially oversee the funds, contracts and management systems. In the long run, other payment channels can be explored, such as an additional mandatory fee paid by the special economic zone for water and by water users in Sihanoukville.

On the supply side, the study outlined actions involving the proper management of the reservoir and the surrounding watershed, including through instituting a management plan. Sellers of ecosystem services are likely to be ANCO and the Ministry of Environment, although other actors such as NGOs, tourist operators and third-party contractors may become involved.

Figure 6.4.

Proposed components of the Kbal Chay PES pilot



Recommendations

The two PES pilots suggest that there are significant opportunities for achieving outcomes that both benefit the environment and advance human development. The need to secure ecosystem services is increasingly urgent, given the vital importance of water supplies to Siem Reap and Sihanoukville, and surrounding rural populations. In addition, there are possible buyers whose payments could be easily leveraged, such as international tourists in Siem Reap.

Specific recommendations for priority actions for Kulen Mountain and Kbal Chay

Assess the carrying capacity of water resources as well as needs for groundwater extraction to ensure the long-term sustainability of the two watersheds, paying attention as well to issues related to the structural integrity of Angkor Wat in Siem Reap.

Enforce business registrations for star-hotels to ensure effective fee collection.

Formalize mechanisms for payment collection, and fund management and use for ecosystem services, including decisions on fee collection options, fund management structures and responsibilities, land uses and priority actions for sustainable watershed management.

Develop and implement management plans for the two watersheds.

General recommendations for PES

Strong political and financial support are pre-conditions for a PES scheme to work. High transaction costs and technical requirements to start and run payment schemes underline the need for support from the Government, donors and the private sector.

Property rights should be clarified to balance livelihood needs and environmental sustainability. With recent reforms to protected areas, there are significant opportunities for resolving the resource rights and tenure claims of people living inside conservation areas, thereby providing a sustainable basis for implementing payment schemes, and securing the human development and livelihood needs of local people. For indigenous communities and long-established villages, customary and traditional rights must be recognized. This can be done, for example, through community-based natural resource management mechanisms, including community forestry.

Payment schemes should be clear, simple and equitable to demonstrate their potential and foster buy-in from all stakeholders. Buyers need to know where their money is going. Service providers need to see clearly what they are accountable for and why. Monitoring systems should be created to easily and transparently detect impacts. Transparent payment mechanisms will also help achieve an equitable distribution of benefits among providers and sellers.

Measures to achieve equity, pro-poor and gender equality objectives should be in place. Payments should be at a minimal level broadly targeted to people with higher income levels (e.g., international tourists, medium and large industries, and large hotels) or in small amounts across many beneficiaries. The design of PES schemes at all stages needs to factor in the human development priorities of users of ecosystems. Explicitly pro-poor and gender-sensitive measures should be geared towards the full participation of marginalized groups in decision-making and the distribution of benefits.

The idea of paying for ecosystem services is likely to encounter resistance, at least initially. Bringing about real change, including at policy levels, will take time. It will require recognition that resources like fresh water have "production" costs and hold values that must be reflected in environmental policies and pricing mechanisms.

If the payment pilots prove successful in capturing buyers' willingness to pay, the models should be expanded to other protected areas. Hydropower companies could be engaged as buyers to protect forests, for example. The proposed Phnom Kulen environmental fund could be scaled up to regional or national levels to mainstream a notion of "green" taxes. Direct payments schemes for biodiversity offer other avenues for exploration.

The two PES pilots suggest that there are significant opportunities for achieving outcomes that both benefit the environment and advance human development

Chapter 7

Spatial planning as a tool for integrated natural resource management

Photo credit: Chhun Delux

7. Spatial planning as a tool for integrated natural resource management

Spatial planning is an important tool, which can guide decisions about land and resource use in order to balance ecosystem, conservation and human development concerns

Cambodia's 2016 jurisdictional reform in natural resources management resulted in a significant expansion of protected areas, which are primarily managed for conservation and some community use (Figure 7.1). These areas now make up more than 40 percent of the country's total land area.

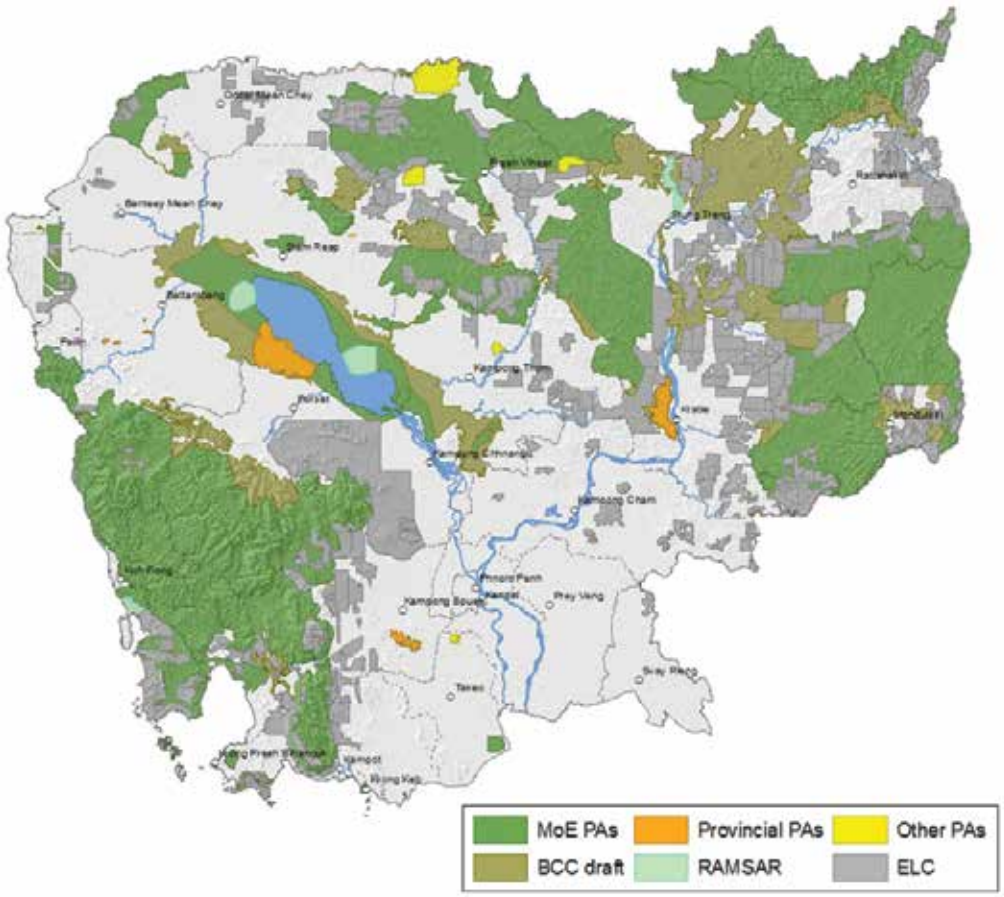
Based on the 2008 Protected Area Law, areas are to be classified in different zones, depending on their ecological and economic significance. A core zone offers the highest level of environmental protection. The conservation zone has limited access and use, while the sustainable use zone allows for a minimal level of economic activities approved by the Ministry of Environment. In community zones, people are allowed to live and pursue their livelihoods.

In practice, only a handful of protected areas have been properly zoned. There is considerable uncertainty about how to manage the areas, especially relating to decisions about which parts should be strictly protected, and which should be made available for sustainable use and community livelihoods.

Unless proper planning is initiated, these uncertainties may undermine the sustainability of protected areas and the ecosystems that rural people depend on. Spatial planning is one tool to guide decisions about land and resource use in order to balance ecosystem, conservation and human development concerns. It offers particular value when it is based on participatory processes that bring forward the perspectives of local people.

Figure 7.1.

Newly expanded protected landscapes



Source: WCS.

Developing an integrated approach to land-use planning

Cambodia's Ministry of Land Management, Urban Planning and Construction oversees land-use planning at the national and subnational levels, and increasingly views spatial planning as an indispensable tool for sustainable development.[214] In 2011, the National Policy on Spatial Planning[215] provided a vision, goals and strategic objectives, and specified the mechanisms of planning at national to subnational levels.

While the Ministry of Land Management, Urban Planning and Construction is the focal agency for land-use planning, other line ministries guide decisions on ecosystems, land and resources under their respective jurisdictions. The Ministry of Environment is responsible for land-use decisions within protected landscapes, particularly in relation to protected area boundaries, zoning and management plans. It is also charged with assessing and managing the environmental and social impacts of developmental projects such as hydropower, mining and infrastructure development.

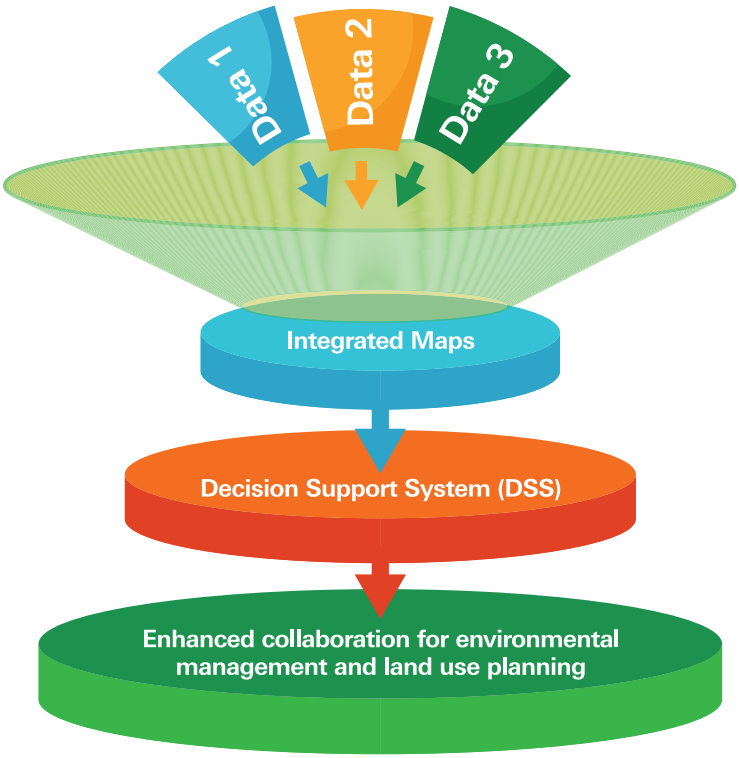
In 2015, the Ministry of Environment initiated the Integrated Ecosystem Mapping Initiative to consolidate existing spatial data and to strengthen the Ministry's capacity to make sound decisions on ecosystems and the environment (Figure 7.2). Before that point, different Government bodies, NGOs and international organizations had collected a range of data related to ecosystems, but these were never consolidated and could not be used easily or systematically.

The Integrated Ecosystem Mapping Initiative has several objectives. The first has been to create a nationwide integrated ecosystem map. It has brought together more than 200 layers of geospatial data to support informed decisions about land use and natural resource management. Geospatial information now includes data on land tenure and uses, forest cover, key biodiversity areas, climate change vulnerability, agriculture and development activities. More than 20 non-governmental, multilateral and Government organizations have shared data, although to the extent possible, priority has been given to Government data.

The Ministry of Environment initiated the Integrated Ecosystem Mapping Initiative to consolidate existing spatial data and to strengthen the Ministry's capacity to make sound decisions on ecosystems and the environment

Figure 7.2.

Integrated ecosystem mapping initiative



A second emphasis has focused on developing a decision support system and using it for collaborative deliberation. A decision support system makes it possible to spatially assess multiple, competing priorities in natural resource use, and to take into consideration diverse ecological, socio-political and economic values as part of identifying integrated land-use options based on different management approaches.

The system helps identify priority areas suitable for specific land uses, for instance, to secure a clean water supply, build resilience against floods and droughts, generate income for local communities and accelerate economic development. Equally, it can define critical ecosystems or areas important for rural livelihoods where proposed development activities should not take place. It can be used for environmental and social impact assessments of developmental projects, and can guide proposals to avoid or mitigate negative consequences while maximizing positive human development and ecological benefits.

Under the Integrated Ecosystem Mapping Initiative, a decision support system was designed to visualize and identify priority areas for conservation, livelihoods and development

Comprehensive spatial analyses of different land-use options only become highly useful in the context of collaboration with different affected stakeholders, including communities. This can take the form of participatory planning processes in which the suggestions made by the decision support system provide a starting point for community reflections upon land use and human development needs. Although the tool can identify priority areas in which there are conflicts of interest, it cannot resolve such conflicts, which depends on collective deliberation.

A third objective of the Integrated Ecosystem Mapping Initiative has been to promote inter-ministerial decision-making in balancing human development and environmental priorities in land-use planning. New data-sharing platforms are planned along with an interministerial committee to oversee the decision support system.

Applying the decision support system

Two cases illustrate the uses of the decision support system. The first, at the national level, involves identifying suitable areas for the potential different zones within Cambodia's protected areas. The second case provides a snapshot of an existing protected area, Kulen Promtep Wildlife Sanctuary, where a decision support system facilitated local integrated land-use planning.

Zoning protected landscapes at the national level

Under the Integrated Ecosystem Mapping Initiative, a decision support system was designed to visualize and identify priority areas for conservation, livelihoods and development. The system was applied to all protected landscapes, including national and provincial protected areas and biodiversity conservation corridors under both the Ministry of Environment and the Ministry of Agriculture, Forestry and Fisheries.

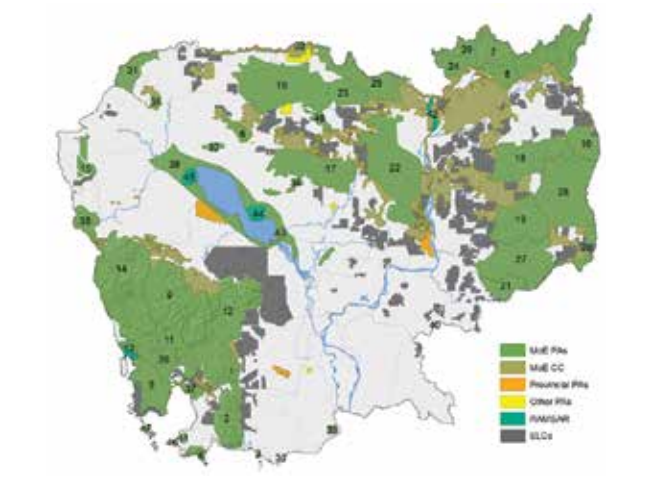
An initial step involved defining three main objectives. These included balancing conservation (i.e., core and conservation zones) and human development needs (i.e., sustainable use and community zones); supporting integrated planning by considering multiple uses and objectives at a national scale; and coordinating and prioritizing conservation and sustainable uses across Cambodia's conservation landscapes.

Data were collected from a range of Government and NGO sources, and assessed for suitability, accuracy, coverage and resolution. This process led to additional datasets and GIS processing.[216] Over 200 data layers represented a wide range of data types. Proxy data were used to fill some gaps related to biodiversity, key ecosystem functions and recent forest cover; real data will be required in the future.

A tool called "Zonation" was applied to rank different sites as high conservation value at one end, sustainable use in the middle and community use at the other end (Boxes 7.1 and 7.2). Priority "weights" were assigned to key variables from the datasets, corresponding with the protected area zoning system and its purpose (Box 7.3). The process produced a series of national maps reflecting spatial priorities.

Box 7.1.

Key sets of land-use data for defining spatial priorities across Cambodia's protected landscapes

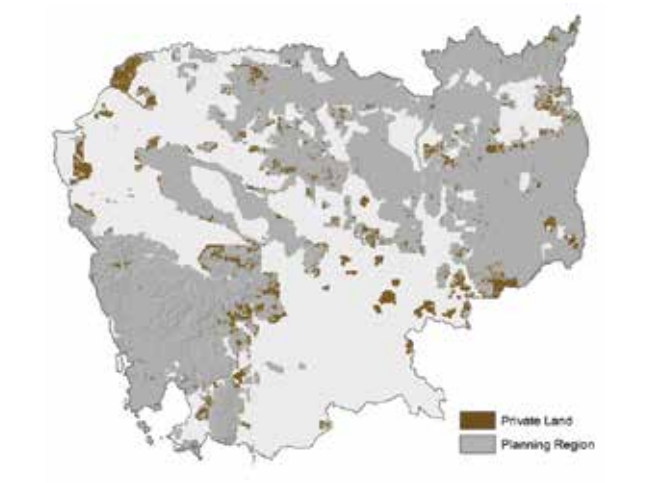


Map of Cambodia's protected landscapes and economic land concession

Tenure and land use: Tenure or jurisdictional data were used to define land uses and governance across the conservation landscapes; to define the spatial limits of the planning region; and to include the area being considered for the prioritization analysis. The datasets identified existing management institutions that may influence the effectiveness of proposed recommendations.

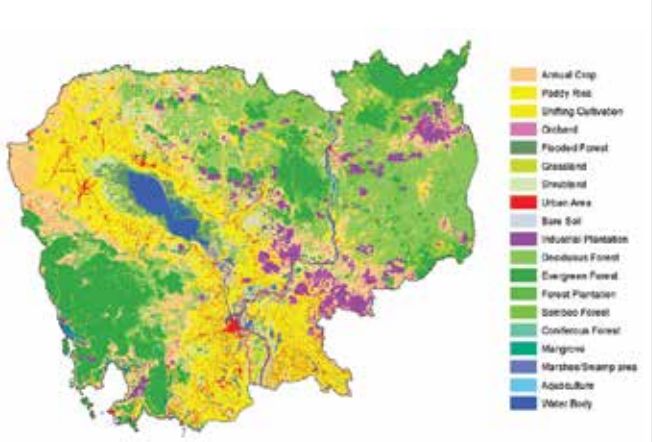
Protected areas: The conservation landscapes comprised protected areas overseen by the Ministry of Environment. These included national parks, wildlife sanctuaries, protected landscapes, multiple use areas, a national heritage park and conservation corridors. Four of the sites are or include Ramsar sites. Also included were 21 provincial protected areas covering 136,100 hectares.

Economic land concessions: Contained within and around the protected areas are 286 economic land concessions (grey areas) for which spatial information is publicly available.[217] The concessions were established between 1996 and 2012, and represent long-term contracts allowing land clearing for industrial agriculture by a range of national and international corporate developers. There are over 2.1 million hectares of known concessions.



Location of private land within the planning region concession

Private land: Numerous parcels of privately owned land are contained within the protected area network. Comprehensive private tenure data were not obtained and are not publicly available. Thus, this dataset was partly deduced from land use reported in the 2015 land cover dataset provided by the Ministry of Environment.



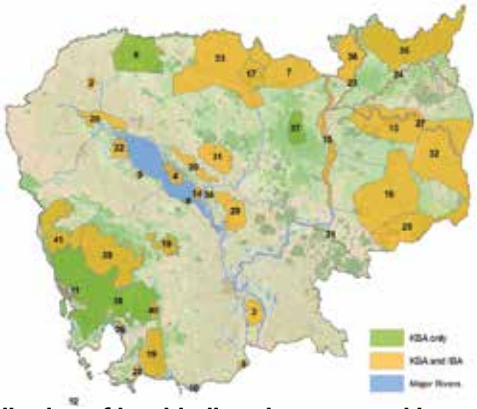
Map of different land uses

Source: Cambodia National Mekong Committee

Land cover 2015: Land cover maps are a central component of land-use planning. The Land Cover 2015 dataset was produced by the Cambodia National Mekong Committee Information and Knowledge Management Programme using satellite imagery, and provides both land cover and land use information.

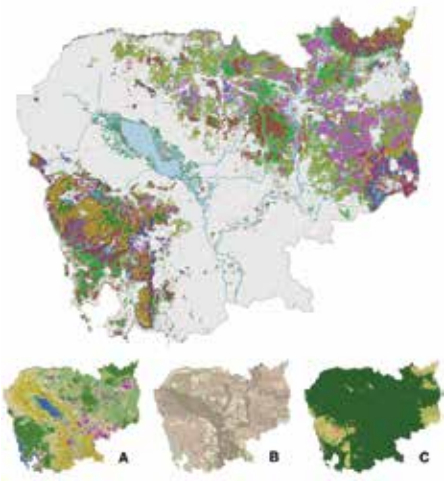
Box 7.2.

Key ecosystem and community datasets for prioritization analysis of protected landscapes



Distribution of key biodiversity areas and important bird areas shown over 2015 land cover

Biodiversity values: Key biodiversity areas and important bird areas were identified nationally using global criteria and thresholds. These areas indicate critical habitat and conservation priorities. Information on both areas was updated in 2014 by a consortium of conservation practitioners led by BirdLife International.

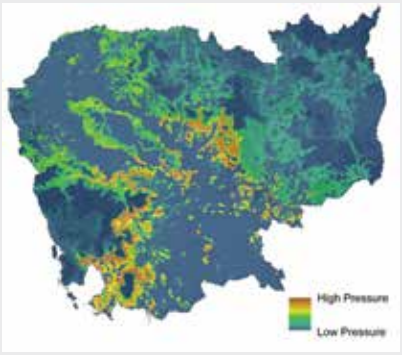


Unique vegetation communities identified by combining (A) land cover, (B) soil and (C) elevation.

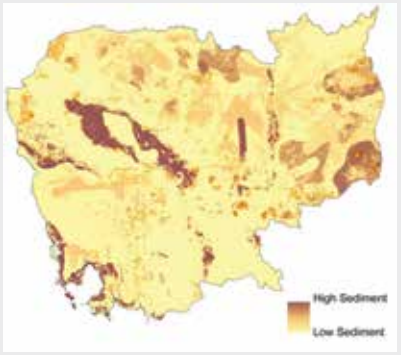
Ecosystems: Different ecosystem types are understood to support different species and can be used as biodiversity surrogates for conservation planning.[218]

An ecosystem map is not available for Cambodia so a proxy map was developed using land cover and the abiotic variables of soil and elevation to represent unique vegetation assemblages.

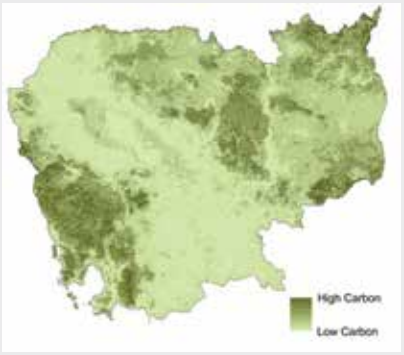
Cambodia's soil types were sorted into seven groups expected to have distinct vegetation characteristics due to water content, structure, chemical and pH properties. After sorting by soil class, four elevation zones were set to capture variability due to precipitation and temperature, with breaks at 200 metres, 500 metres and 1,000 metres. This resulted in 33 distinct vegetation communities



Fuelwood pressure
Source: GERES

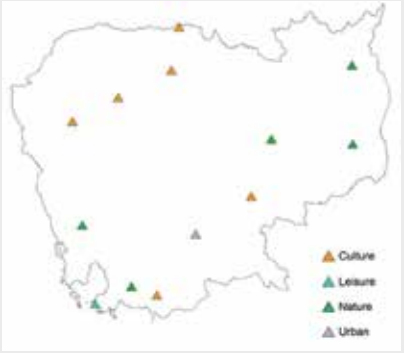


Avoided sedimentation
Source: Winrock International

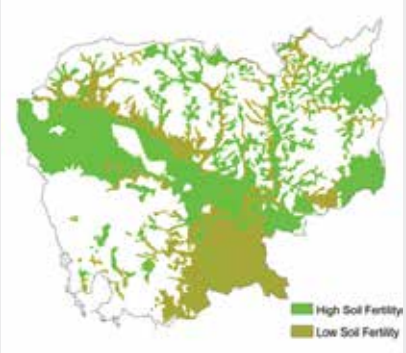


Carbon density
Source: Avitabille *et.al*

Ecosystem service values: Four different ecosystem services were mapped, including a model of fuelwood exploitation,[219] a watershed model of where sedimentation would be highest if the natural land cover was modified,[220] a model of carbon density,[221] and a model of the locations of tourist sites within the planning region covering cultural, leisure and natural uses.[222]



Tourism
Source: greater Mekong subregion



Soil Fertility
Source: Crocker 1962

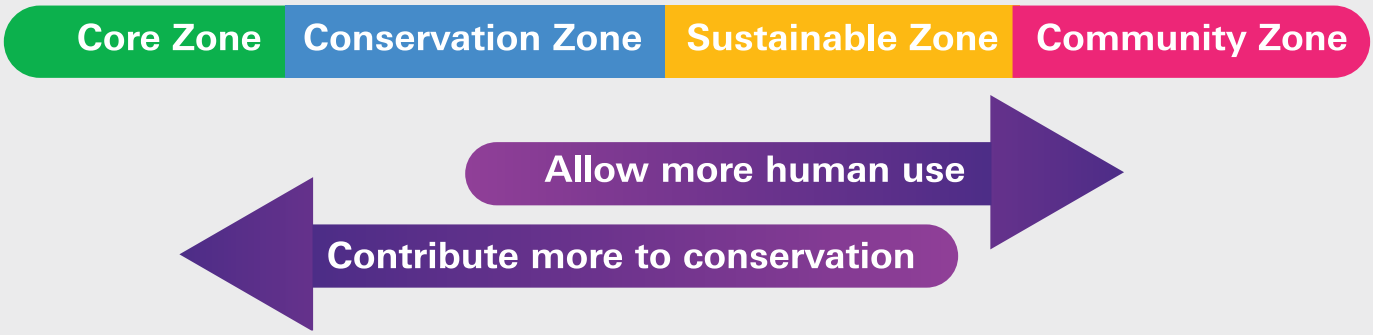
Location of potential reservoirs
Source: ODC

Areas important for fisheries
Source: IUCN

Other community interests: Using village and road locations[223] and a distance function, distance maps were generated to provide metrics of accessibility, human impact and conservation significance.[224] With agricultural suitability being a primary requirement for settlement areas, soil fertility was included,[225] along with fisheries (providing the majority of protein for Cambodians), and the location of potential water reservoirs from hydroelectric dams and mining activities.

Box 7.3.

How variables are weighted in the prioritization tool, according to protected area zones



Different datasets or variables correspond with the protected area zones.

Different protected area zones correspond with diverse land-use priorities and outcomes (see Box 7.2). These zones are mapped onto variables in the dataset, using a weighting system shown below. A schematic illustration of the protected areas zoning system shows how different zones contribute more or less towards human development and conservation objectives.

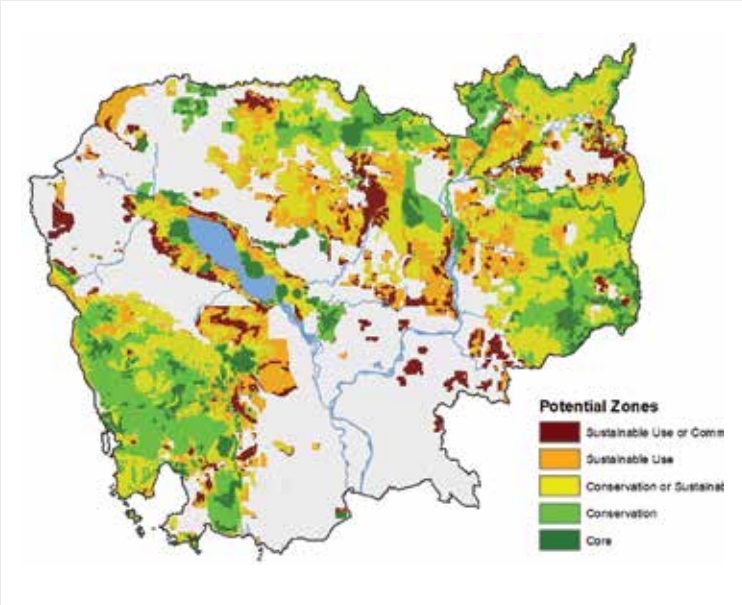
Zone focus	Name of datasets	Weighting
Core/conservation	Key biodiversity areas	1
Core/conservation	Forest types, shrubs and grasslands	0.75
Conservation/sustainable use	Watershed avoided sediment	0.5
Conservation/sustainable use	Carbon biomass	0.5
Conservation/sustainable use	Tourism sites	0.25
Sustainable use/community use	Firewood collection	-0.25
Sustainable use/community use	Distance to villages	-0.5
Community use	Community fisheries	-0.5
Community use	Soil fertility	-1 (high fertility) -0.5 (medium fertility)
Community use	Mining exploration	-0.75
Community use	Hydro reservoir/reserves	-0.8
Community use	Distance to roads	-1

Source: WCS.

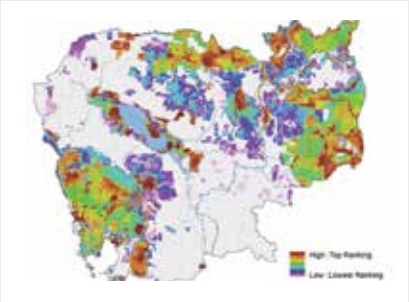
The analysis confirmed that most high-priority areas for biodiversity and ecosystems are already located within Cambodia's protected area system—notably in the north-east and south-west of the country, and around Tonle Sap lake (Box 7.4). Some priority areas fall outside of the protected areas, however, particularly in the north-west provinces of Oddar Meanchey and Banteay Meanchey, and along the north and east sides of the Mekong river in Stung Treng. This signals a limitation of the analysis; the ranking only captured areas within Cambodia's protected landscapes. Habitats that are not well covered by the protected area system, such as lowland evergreen forest, riverine forests, limestone forests and marine areas, were left out, requiring additional analysis.

Box 7.4.

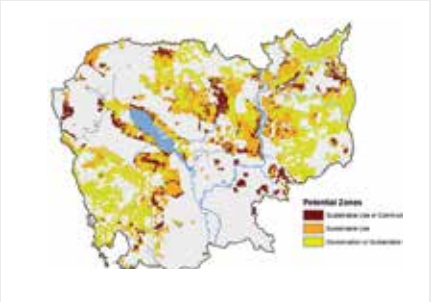
Conservation prioritization results from decision support system analysis



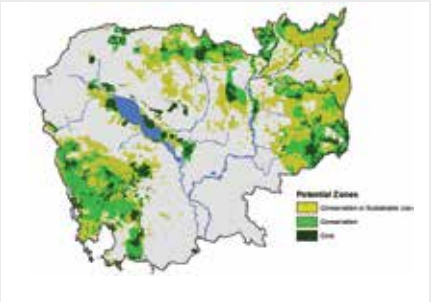
Four potential zones are identified within the planning region and are shown left based on the prioritization ranking and REDD+ areas zoned for conservation.



The rankings from the prioritization analysis show a concentration of high conservation priorities in the north-east and south-west of Cambodia, and around Tonle Sap. Higher ranking areas for conservation are warmer colours and the lowest ranking areas are cool colours.



Potential sustainable use and community zones are predominantly located around the forest edge, in areas within close proximity to villages, roads and other human activities



Potential conservation zones are mainly located along the northern border, dispersed around Tonle Sap, and in two larger connected areas in the south-west and eastern parts of the country.

Source: WCS.

The prioritization was checked against two key datasets that are proxy measures for high biodiversity: key biodiversity areas and different forest ecosystem types. Most of the former are located within the core and conservation zones of the protected landscapes, which comprise about 20 percent of the entire planning area. A good correspondence between forest ecosystems and the core and conservation zones was also identified.

Potential sustainable use and community zones are predominantly located around the forest edge, in areas within close proximity to villages, roads and other human activities. These zones avoid the high-priority conservation areas, allowing connectivity to be maintained across conservation-focused zones. The community zones are mainly located outside the protected areas, in buffer zones and/or former economic land concessions within the planning area. Where protected areas have been heavily degraded, such as along the border with Thailand, potential community development zones were identified.

While informative, the maps generated by the assessment do not provide an "answer" to the zoning task that must be completed for Cambodia's protected landscapes. Instead, they must be seen as an indicative first step in a land-use planning process. For one thing, they can be used as input for participatory planning exercises in which affected communities can reflect on the relation between land use and their human development needs. More local inputs are in fact needed for improved on-the-ground verification of actual land uses and types for which little or no data are available. Additional data collection and analysis will most likely be required, for example, in relation to high-priority conservation areas outside of the protected areas and areas of overlapping land claims. Careful definition of "sustainable use" will be essential in management plans for each protected area.

Zoning a protected landscape at the subnational level

To demonstrate the decision support system at the subnational level, a zoning process was applied to Kulen Promtep Wildlife Sanctuary in Preah Vihear province, not far from the northern border with Thailand, under a project of the Wildlife Conservation Society. This protected area contains 32 villages as well as an array of land concessions, making zoning an essential input to biodiversity conservation and human development.

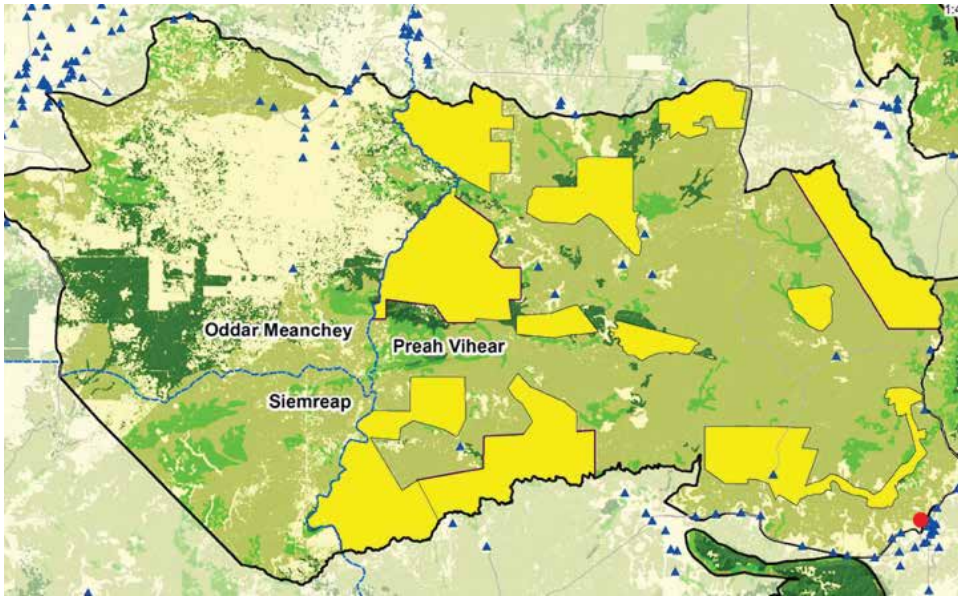
The decision support system was used to categorize protected areas into four zones following the Protected Area Law classifications. These included core zones with high conservation value, threatened and critically endangered species, and fragile ecosystems. Conservation zones were also of high conservation value, containing natural resources, ecosystems, watershed areas and natural landscapes adjacent to core zones. They allowed small-scale community uses of non-timber forest products provided there was no threat to biodiversity. Sustainable use zones covered areas of high economic value for national development that were also important for conservation of the protected area. In community zones, the priority was sustainable development for local communities and indigenous ethnic minorities; these zones contained some existing residential lands.

Zoning at Kulen Promtep Wildlife Sanctuary

The first step in applying the system involved identifying sustainable use zones, which covered the areas in 8 economic land concessions, and 13 existing and 6 proposed community protected areas. These areas are shown in yellow in Figure 7.3.

Figure 7.3.

The sustainable use zone comprised economic land concessions and community protected areas

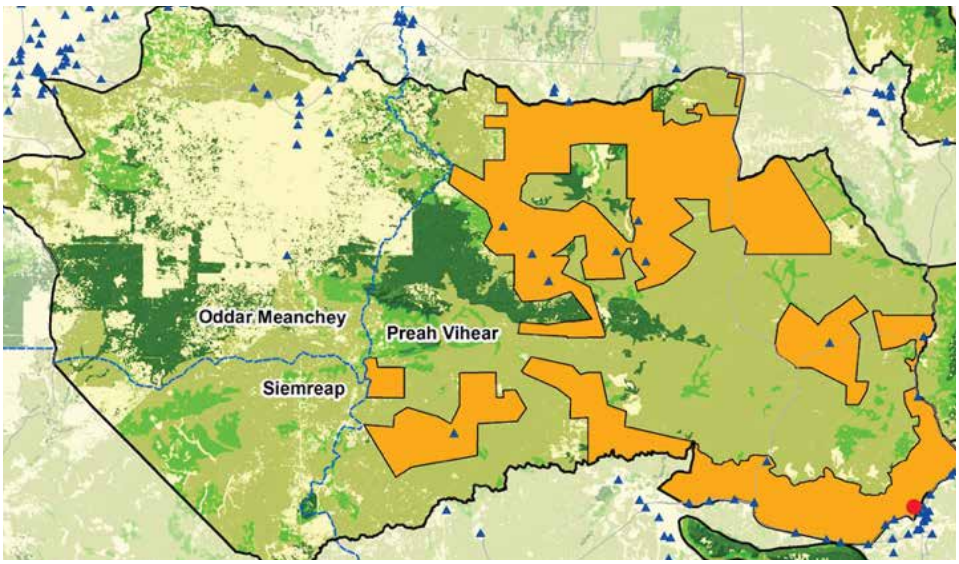


Source: WCS Cambodia.

As a second step, community zones were identified to cover the boundaries of 32 villages inside the protected area and 9 social land concessions, as in Figure 7.4.[226]

Figure 7.4.

The community zone encompassed village agricultural areas and social land concessions

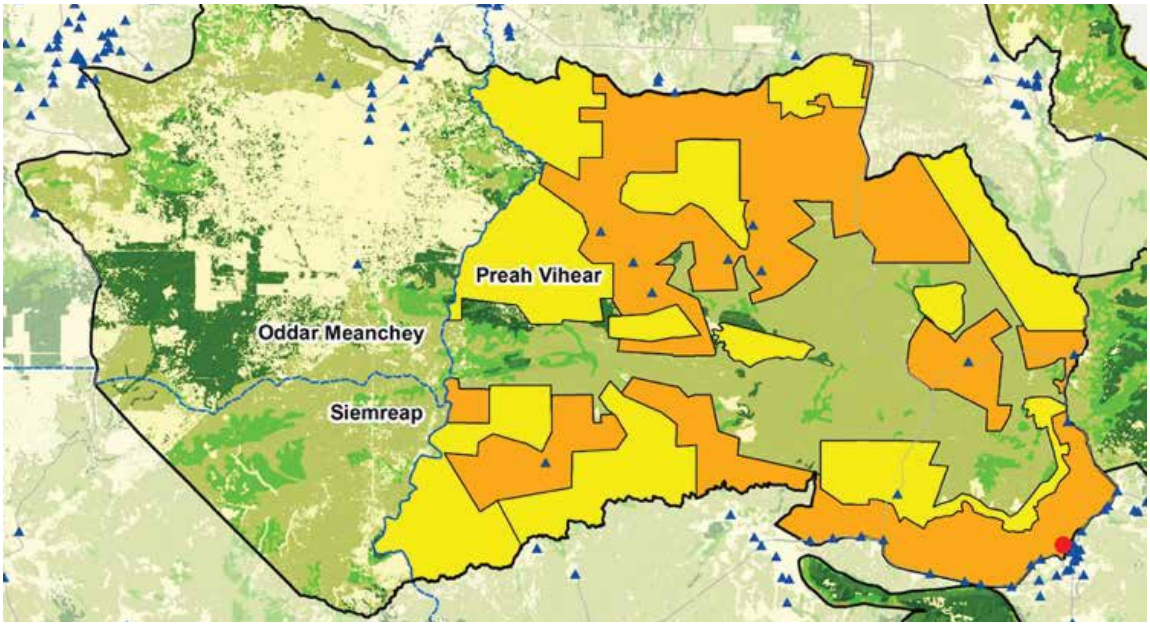


Source: WCS Cambodia.

The combined community tenure areas are shown in Figure 7.4, and the combined sustainable use and community zones are shown in Figure 7.5.

Figure 7.5.

Combined sustainable use and community zones



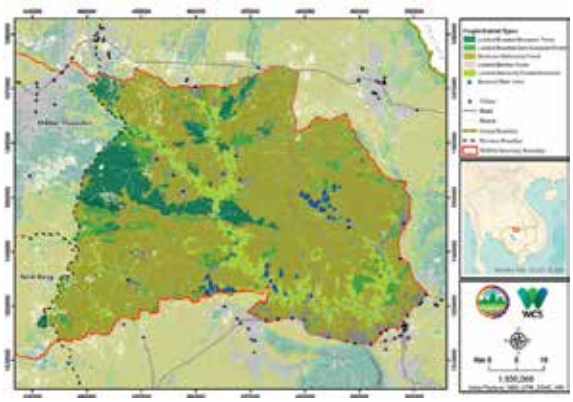
Source: WCS Cambodia.

Once sustainable use and community zones were identified, the protected area outside of these was divided into conservation and core use zones.

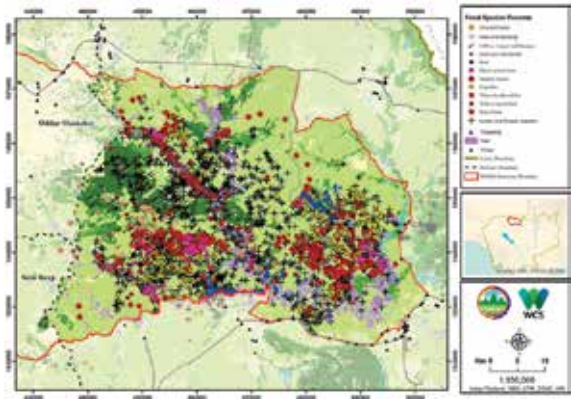
These were defined based on spatial mapping of important habitat, species occurrence records from monitoring and globally threatened species range estimations. Core areas were also established through consultation meetings with local stakeholders.

Figure 7.6.

Maps used to identify conservation and core zones.



Important habitat

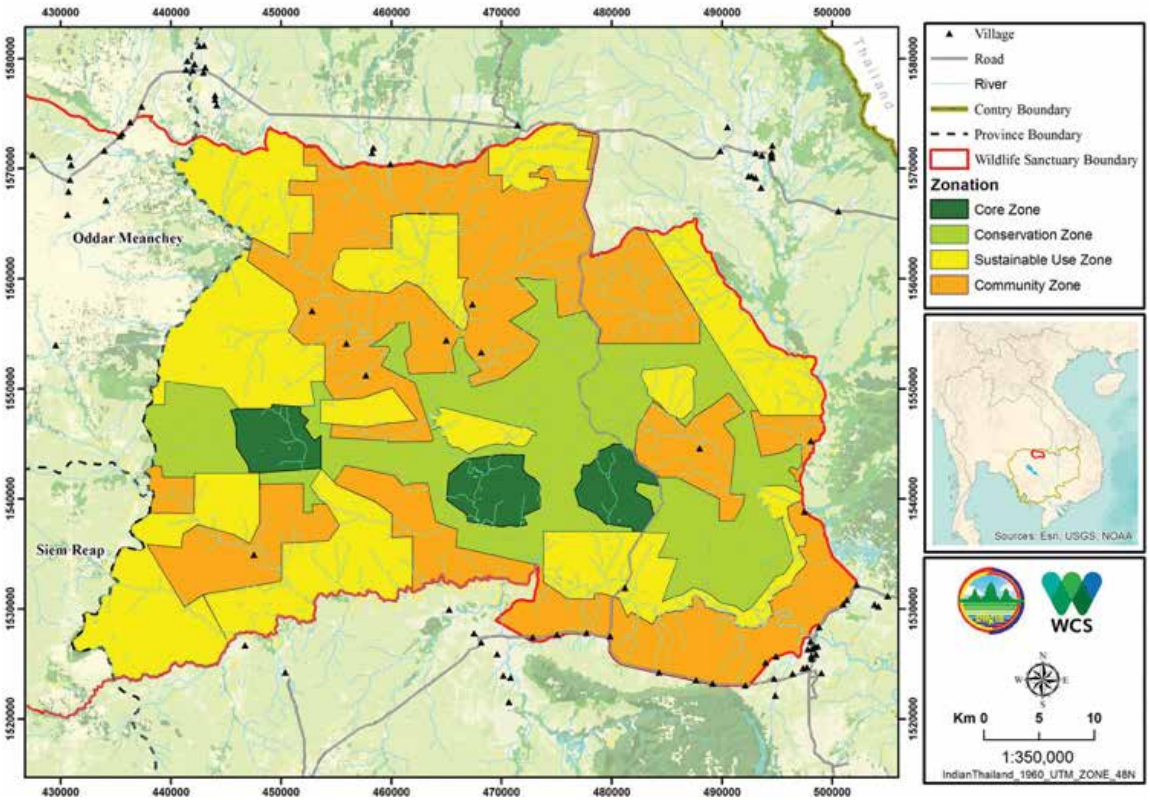


Species occurrence records from monitoring

On the basis of ecological evaluations and inputs from stakeholders—encompassing NGOs, communities, rangers, subnational and national Government representatives (including the provincial governor and representatives from the Ministry of Environment), and researchers—a consolidated map was produced showing the four zones (Figure 7.7).

Figure 7.7.

Development of a proposed zoning system for Kulen Promtep Wildlife Sanctuary



Source: WCS Cambodia.

Bringing together people and data

Cambodia's ecosystem mapping initiative has yielded a number of lessons. It has underscored several critical data gaps that pose challenges to identifying priority areas for conservation. These gaps relate particularly to habitats and distributions of endangered and threatened species and soil maps. Although numerous documents survey biodiversity, no nationwide maps show the distribution of key red-listed species.

To identify and fill data gaps, the mapping initiative aimed to integrate data held by numerous agencies and organizations. But data consolidation was a lengthy and difficult process. The sharing of Government data between and beyond ministries had to follow request letters written by the minister. In some cases, Government data are not available for sharing with the Ministry of Environment.

The capacity to apply spatial data for planning purposes is limited. While communal land-use planning has been widely used in Cambodia, spatial information tools for guiding decisions on either protected area zoning or environmental and social impact assessments are rarely used.

The decision support system tool is potentially useful for future planning interventions around land tenure and protected area zoning. Balancing conservation and human development priorities, however, will require a consultative process. The system still lacks key data inputs such as recent forest cover and key biodiversity distribution, which means that it presently relies on various assumptions and proxy measures. Since the mapping process did not involve on-the-ground verification of actual land uses and types, boundaries and village locations are unlikely to be fully accurate.

Specific land-use zones and categories suggested by the decision support system must be treated with care. Some of the protected area system was classified as "sustainable use". This concept is subject to a range of interpretations, however, including by actors attempting to exploit protected landscapes for commercial purposes. From a different vantage point, it may also be necessary to consider customary indigenous claims and rights even within strictly protected core areas. In both cases, the issue is how to harmonize human development and conservation.

A significant challenge relates to the resolution of competing and overlapping claims over particular land uses. While the decision support system is an important tool for making land-use decisions, full effectiveness depends on collaborative deliberation with different affected stakeholders, including communities (Box 7.5). Final decisions must be based on these consultations along with on-the-ground verification of actual land uses. Kulen Promtep Wildlife Sanctuary provides a good example of how to address human development needs by prioritizing sustainable use and community zones, including existing village residential and agricultural areas. Notably, this case included a series of consultations in which stakeholders could voice their views on proposed land uses in order to avoid conflicts.

Box 7.5.

Community monitoring: an empowering approach to collecting spatial data

Research from South-east Asia, including from Lao People's Democratic Republic and Viet Nam, shows that community members can reliably and cost-effectively collect ecological data to monitor forest biomass and other aspects of natural resources.[227] With repeated measurements, accuracy increases and costs decline.[228] From a human development perspective, this approach goes hand-in-hand with other gains, such as improved local ownership and the forging of important links between monitoring activities and local decision-making. These can lead to greater local agency and increased resilience over time.[229]

In Cambodia, community monitoring has progressed through an advanced smartphone app tailor-made for forest-wide mapping. It allows local community members to collect and share data and stories on the forest condition.[230] With the widespread use of relatively cheap devices and easy-to-use apps, such initiatives have enormous potential for accurate spatial data collection, ranging from community-based approaches to satellite-based earth observations.[231]

Recommendations

Future policy and planning related to land use and protected area zoning needs to balance the protection of ecosystems with advances in human development. Important steps forward include establishing and formalizing data collection and data-sharing arrangements across Government entities, and data management protocols between Government and external agencies, especially for sensitive data. This can be supported by the following steps.

Use spatial planning tools to guide land- and resource-use decisions in a way that takes into consideration ecosystem, conservation and human development requirements.

Operationalize the decision support system to assist decision-makers in visualizing and identifying areas suitable for specific land uses. The tool can also be used to explore the likely effects of developmental projects, and to propose ways of mitigating or avoiding adverse impacts.

Establish and formalize data collection mechanisms, data-sharing arrangements, and data management protocols across and beyond Government agencies, especially with a view to managing sensitive data.

Strengthen the capacity of Government staff to conduct spatial planning. This requires training on data collection, consolidation, maintenance and analysis. It also calls for assistance in conducing spatial analysis, applying the decision support system tool, carrying out on-the-ground verification of actual land uses, and sponsoring stakeholder consultations on land use and conflict resolution.

Ensure full incorporation of all human development concerns in the use of the decision support system and other spatial planning tools. Towards inclusive and transparent decision-making, information dissemination, community consultation and active involvement of all stakeholders should be cornerstones of spatial planning. Incorporating diverse views, including from communities, and making final decisions through on-the-ground verification of actual land uses will realize the full power of spatial data for planning that meets the needs of people and their environment. This is especially the case in rural Cambodia, where requirements for local livelihoods still often conflict with guidelines for protected areas.

Future policy and planning related to land use and protected area zoning needs to balance the protection of ecosystems with advances in human development

Conclusion

Conclusion

Cambodia is uniquely placed to demonstrate how human development and sustainable ecosystem management can go hand-in-hand

Cambodia is uniquely placed to demonstrate how human development and sustainable ecosystem management can go hand-in-hand. The country boasts one of the world's most extensive protected area systems, and its rural population still largely depends on natural resources derived from forests, floodplains and fisheries. Despite a history of civil war, Cambodia has achieved strong economic growth and steady increases in human development over the last decade, recently graduating to the status of a lower-middle income country.

The challenge now is for Cambodia to sustain its progress for its people while safeguarding the ecosystems and natural resources upon which national and rural economies depend. This means making decisions about resources and land use that can sustain both short and long-term gains. Given Cambodia's high vulnerability to climate change and the vicissitudes that come with greater integration in the global economy, it entails a focus on the role of ecosystems in ensuring resilience.

The stakes are high because decisions made now will shape the future for Cambodia's children and subsequent generations. Cambodia has a young population, with hopes for achieving prosperity, health, and further human development. Realizing the potentials of the coming generations will depend on wise and equitable use of natural resources, and the maintenance of healthy ecosystems that guarantee clean water and fertile soil.

Recent reforms in Cambodia demonstrate significant momentum and scope to implement progressive policies to achieve sustainable ecosystem management and human development. This National Human Development Report has sought to bolster and inform the Government's commitment to sustainability by asking three interlinked questions.

- How can Cambodia promote natural resource use and production that are sustainable, economically viable and supportive of human development?
- How can Cambodia further empower communities to enhance the ongoing Government efforts to ensure sustainable natural resources management for improved well-being, resilience and human development?
- How can Cambodia balance conservation and development to maximize human development benefits against a backdrop of financing constraints and competing interests for land use?

Accelerating the shift to sustainable management

The report shows that in order to enable the shift to sustainable management, a set of cross-cutting topics will need to be addressed.

At present, the proliferation of cheap, unsustainably sourced natural products as well as complex regulatory requirements discourage communities and industries from pursuing sustainable modes of production. As Chapter 2 shows, illegal logging is highly lucrative. However, excessive resource extraction comes with high social and environmental costs that must be taken into consideration. In effect, resources that are removed today are permanently taken from future generations. This will have severe human development implications felt mainly, but not only, by the rural poor.

Second, communities have limited powers and rights in relation to natural resource management. If they are unable to derive adequate benefits or exert custodianship over land and other resources due to weak tenure arrangements, unsustainable extraction is inevitable. Communities must have formal rights to manage natural resources sustainably and to derive tangible livelihood benefits from doing so. That said, community-based natural resource management is not a panacea, given the significantly variable interests, contexts (types of resources and degree of abundance) and capacities of community-based institutions in relation to sustainable management.

The final issue relates to the need for policy tools such as integrated land-use planning and payments for ecosystems services to balance the needs of conservation and development.

Based on these findings, this report makes several priority policy recommendations for Cambodia, all of which are aimed at facilitating and accelerating the shift to sustainable management of natural resources.

Maximize the potential of sustainably produced products

- Strengthen law enforcement to regulate and control illegal harvesting, production and sale of products from natural resources.
- Improve the security of property rights to encourage local communities as well as the private sector to invest in long-term, higher-value, sustainable products.
- Simplify regulations, legal requirements and administrative procedures.
- Facilitate access to simple and appropriate equipment for processing and packaging sustainable forest products. This can increase productivity and quality and raise the net income of producers.
- Improve local knowledge and production techniques to meet quality requirements and market demands, including in wider domestic and international markets.
- Develop new higher-value products from available materials. For example, bamboo can be used for high-end furniture, bamboo pellets for energy and as soil enrichment, and resin with anti-fungal and anti-termite properties for paint and cosmetics.
- Improve efficiency gains and maximize values for rural communities by directly linking producers with consumers and reducing transaction and search costs, and by developing niche markets for sustainable products.

Empower communities to foster sustainable natural resources management

- Find viable alternatives to short- and long-term destructive practices, like illegal forestry, by introducing environmentally friendly commercial production models that deliver triple wins—for the economy as a whole, for household livelihoods and for the preservation of natural resources.
- Secure clear long-term community-based resource use and management rights for fish, timber, woodfuel and non-timber forest products.
- Simplify approval procedures to expand areas under community management. Whenever possible, accelerate approval time frames and reduce costs while also working towards transferring power to local institutions accountable for local residents' interests and environmental goals.
- Support communities in protecting their resources through clear boundary demarcation and law enforcement. Where applicable, acquire prior informed consent from communities on activities that may affect them, such as economic land concessions and emerging developmental projects.
- Explore community-based natural resource management approaches to ensure participatory and equitable decision-making around the distribution of benefits.
- Establish regional and national networks of community associations that empower communities to collectively address concerns, and strengthen management in collaboration with the Government.
- Ensure safeguard measures to monitor community-based institutions in adhering to sustainability principles.

Test and scale up new initiatives that simultaneously support sustainable ecosystems and human development.

Building on the Government's decision to explore payments for ecosystem services models as a sustainable financing option for protected areas, an early priority could be to implement pilot projects in Kulen Mountain and Kbal Chay. The priorities would include:

- Clarify land use to maximize livelihood needs as well as environmental sustainability. Resolving the resource rights of people living inside conservation areas is central for the successful implementation of this kind of scheme.
- Design payment schemes that are clear, simple and equitable. They will need to be easily implementable. Buyers need to know where their money is going, and service providers need to know what they are accountable for, and why. Monitoring systems should be put in place to track impacts.
- Ensure equity and an orientation that is pro-poor and gender sensitive. At a minimum, payments should be broadly targeted at users who are likely to be able to pay (e.g., international tourists, medium and large industries, and large hotels). Pro-poor and gender-sensitive measures integrated in the design of schemes help to ensure the participation of marginalized groups in decision-making and benefit distribution.
- If the pilots prove successful, the Government should explore replicating them in other protected areas.
- Recognize that ecosystem services such as fresh water involve "production" costs and carry a financial value that should be reflected in policies and decision-making.

Future policy and planning related to land-use and protected area zoning should aim to balance ecosystem integrity and human development gains. In particular, it should:

- Use modern spatial planning tools to guide land- and resource-use decisions, taking into consideration ecosystem, conservation and human development requirements.
- Use the decision support system to identify areas suitable for specific land uses based on an understanding of likely impacts and measures to mitigate risks.
- Ensure full incorporation of human development concerns in the decision support system and other spatial planning tools. Spatial planning should be combined with participatory management planning to mitigate risks to biodiversity and local communities, on-the-ground verification of actual land uses, and stakeholder consultations on land uses and conflict resolution.
- Establish and formalize data collection mechanisms, data-sharing arrangements and data management protocols across Government agencies and beyond to other partners.
- Strengthen the capacity of Government staff to conduct spatial planning through training on data collection, consolidation, maintenance and analysis.

Towards a better future

Cambodia has the opportunity to avoid a future of continued degradation of its natural environment. With a recent history of impressive strides in human development, extensive remaining natural ecosystems, and a growing commitment to sustainable development, it can act now to achieve future socio-economic and environmental sustainability. Rural communities can be empowered as custodians of natural resources, and new roles can be designed for state agencies as regulators and enablers, supporting and guiding communities and building partnerships. If communities are enabled to meet their own needs by working with the State, they can do much to protect the fragile and finite natural resources of the nation, while also contributing to the improvement of its human development.

Cambodia can act now to achieve future socio-economic and environmental sustainability while contributing to the improvement of human development.

Notes

1. UNDP 2011.
2. National Institute of Statistics 2014.
3. WHO 2005.
4. Pienkowlski et al. 2017.
5. World Fish 2019.
6. Mekong River Commission 2017.
7. Standard and Poor's 2014.
8. Maplecroft 2013.
9. Crothers 2016.
10. Millennium Ecosystem Assessment 2015.
11. CIFOR 2016.
12. Royal Government of Cambodia 2016.
13. REDD+ refers to reducing emissions from deforestation and forest degradation and promotion of sustainable forest management and forest conservation. To reduce greenhouse gas emissions, REDD+ offers financial incentives, primarily to developing countries.
14. TEEB 2010.
15. Royal Government of Cambodia 2018a, 2018b.
16. HDR and DHI 2015.
17. World Fish 2016.
18. Diepart and Dupuis 2014.
19. Milne 2013.
20. Marschke 2012.
21. Milne and Mahanty 2015.
22. UNDP Cambodia 2017a.
23. UNDP Cambodia 2017b.
24. Ibid.
25. Ibid.
26. Ibid.
27. Saito-Jensen et al. 2015.
28. Saito-Jensen and Nathan 2011.
29. Royal Government of Cambodia 2017b.
30. Royal Government of Cambodia, forthcoming.
31. Royal Government of Cambodia 2014.
32. Cambodian Center for Human Rights 2016.
33. A Ramsar site is a wetland site designated to be of international importance under the Ramsar Convention. The Convention on Wetlands, known as the Ramsar Convention, is an intergovernmental environmental treaty established in 1971 by the United Nations Educational, Scientific and Cultural Organization (UNESCO). It came into force in 1975.
34. Sen 1999.
35. UNDP 2011.
36. Sen and Anand 2002.
37. Adger 2006.
38. Adger 2000.
39. International Monetary Fund 2017.
40. Royal Government of Cambodia, forthcoming.
41. International Monetary Fund 2011.
42. National Institute of Statistics 2016.
43. National Institute of Statistics 2016.
44. World Bank 2013.
45. Whitehead 2015.
46. UNDP 2018.
47. Alkire and Foster 2011.
48. UNDP 2017b.
49. Whereby gender differences on the three key components (life expectancy, years of schooling and incomes) are used to recalculate the index, on the basis of parity between men and women. The level of inequality is therefore given by the reduction in the headline HDI value.
50. World Economic Forum 2017.
51. World Economic Forum 2017, p. 16.
52. UNDP 2017b.
53. As per the work of Todaro on migration choices and the structural model of Lewis.
54. Shafik 1994. Noting also that the original Kuznets relation has been discredited.
55. Kauppi et al. 2018.
56. See UNDP 2011 and http://hdr.undp.org/sites/default/files/reports/271/hdr_2011_en_complete.pdf.

57. We use both the conventional product moment correlation coefficient and Spearman's rank correlation coefficient.
58. Jain, forthcoming.
59. Royal Government of Cambodia 2018.
60. Royal Government of Cambodia forthcoming.
61. Ibid.
62. FAO 2017.
63. Royal Government of Cambodia 2002.
64. UNDP Cambodia 2012.
65. Gazull and Gautier 2015; Maes and Verbist 2012.
66. Lim et al. 2012.
67. International Energy Agency 2017.
68. GERES 2015.
69. GERES 2015.
70. D'Amico 2010.
71. GERES 2015.
72. Romero 2015.
73. GERES 2015.
74. GERES 2015.
75. Shigematsu et al. 2011.
76. GERES 2015.
77. UNDP 2019 (draft).
78. Sparrevik et al. 2015.
79. To ease comparison between all the technologies, the values presented are from laboratory tests. Results might differ according to the type of wood and charcoal used. Very significant differences in terms of efficiency can be observed between laboratory tests and real situations where other parameters can strongly influence cooking behaviours and thus fuel consumption.
80. Nguyen 2015.
81. Ministry of Agriculture, Forestry and Fisheries 2017.
82. Royal Government of Cambodia 2002.
83. Royal Government of Cambodia 2008.
84. To ensure the healthy growth of timber, sustainable production normally involves pruning, coppicing and thinning, which produce ample residues that can be used for woodfuel. Pruning involves removing all small branches to enable a few large branches of the tree to grow. Coppicing is a technique that cuts trees to ground level, to ensure rapid growth of new shoots during the growing season. Thinning is done to ensure the growth of quality trees by removing the smaller and poorer quality trees. Timber harvest also generates a significant amount of residue, such as tree branches that can be used for woodfuel.
85. See Programme for the Endorsement of Forest Certification 2018. Chain of custody refers to a mechanism for tracking certified material from the forest to the final product to ensure that the forest produce can be traced back to certified forests.
86. Royal Government of Cambodia 2011.
87. National Institute of Statistics 2018.
88. UNDP 2019 (draft).
89. RECOFTC 2017.
90. UNDP 2019 (draft).
91. Ribot 1998.
92. The analysis was based on a review of project documents, case studies, Government policy papers, trade reports, market studies and grey literature. Empirical data were collected through a seven-day field trip, and 59 semi-structured interviews with NGO representatives, Government officials, middle-persons and villagers involved in harvesting the products (see UNDP 2019 (draft)a, b).
93. Khou 2015.
94. National Institute of Statistics 2018.
95. WWF 2013.
96. International Trade Centre 2016.
97. UNDP 2019 (draft).
98. Prom 2015.
99. Royal Government of Cambodia 2002.
100. Prom 2009.
101. See NTFP-EP 2012; Prom 2009, 2015.

102. See Crossroads to Development 2010; Prom 2015, 2017.
103. National Institute of Statistics 2014.
104. NTFP-EP 2012.
105. National Institute of Statistics 2014.
106. Kesireddy 2013.
107. NTFP-EP 2016.
108. Investment and Trade Promotion Centre 2014.
109. NTFP-EP 2011.
110. NTFP-EP 2012.
111. Vasisht et al. 2016.
112. Blaikie 2006.
113. Brosius et al. 1998.
114. McKean 1998.
115. Ostrom 1990.
116. Chambers 1983.
117. Ribot 2004.
118. Baland and Platteau 1996.
119. Chen et al. 2012.
120. Saito-Jensen and Nathan 2011.
121. Getz et al. 1999.
122. Sunderlin et al. 2005.
123. Sukhdev 2009.
124. Cornwall 2008.
125. Ribot 2002; Mahanty et al. 2006, 2007.
126. Borrini-Feyerabend et al. 2004.
127. Hardin 1968.
128. Ostrom 1990.
129. Dressler et al. 2010.
130. Paudel et al. 2008.
131. Saito-Jensen et al. 2010.
132. Paudel et al. 2008.
133. Blaikie 2006.
134. Saito-Jensen and Nathan 2011.
135. Biddulph 2015.
136. Agrawal and Gibson 1999.
137. Cleaver 2005.
138. Mahanty et al. 2006; Nathan and Pasgaard 2017.
139. Lund and Saito-Jensen 2013.
140. Persson and Prowse 2017; Marschke 2012; Lo Cascio and Beilin 2010.
141. Nelson and Agrawal 2008.
142. Persson and Prowse 2017.
143. Ribot et al. 2008.
144. Royal Government of Cambodia 2003.
145. Ibid.
146. Royal Government of Cambodia 2010.
147. Forestry Administration 2018.
148. Blomley et al. 2010.
149. Lambrick et al. 2014.
150. Blomley et al. 2010.
151. Ibid.
152. Lambrick et al. 2014.
153. McKenney et al. 2004; Lambrick et al. 2014.
154. Blomley et al. 2010.
155. Clements et al. 2014.
156. Blomley et al. 2010; Marschke 2015; IUCN 2015.
157. Blomley et al. 2010; Lambrick et al. 2014.
158. Blomley et al. 2010.
159. Lambrick et al. 2014; Argyriou et al. 2015; IUCN 2015.
160. Blomley et al. 2010.
161. San 2006; Chanthou 2014; Pasgaard and Nielsen 2016.
162. Biddulph 2015; Lambrick et al. 2014; Blomley et al. 2010; Pasgaard and Nielsen 2016.
163. Blomley et al. 2010.
164. Ibid.
165. Diepart 2015; Lo Cascio and Beilin 2010.
166. Persson and Prowse 2017; Blomley 2010; San 2006.
167. Pasgaard and Nielsen 2016.
168. Resurreccion 2006; Mahanty et al. 2006.
169. Persson and Prowse 2017; Blomley et al. 2010.
170. Ibid.
171. Kurashima et al. 2015.
172. Ibid.
173. Blomley et al. 2010.
174. Milne 2013.
175. Blomley et al. 2010, Argyriou et al. 2015.

176. Lambrick et al. 2014, San 2006.
177. Blomley et al. 2010, Biddulph 2015.
178. RECOFTC 2015.
179. Blomley et al. 2010, Persson and Prowse 2017.
180. Chap et al. 2016.
181. Naval and Sorn 2016.
182. See Chap et al. 2016.
183. Wunder 2005.
184. Ferraro 2001.
185. Ferraro and Kiss 2002.
186. Corbera et al. 2009.
187. For example, Wunder and Albán 2008.
188. Wunder 2008.
189. Saito-Jensen et al. 2014.
190. Milne and Chervier 2014.
191. Milne and Niesten 2009.
192. Classen et al. 2017.
193. Clements et al. 2010.
194. Clements and Milner-Gullard 2015.
195. Clements et al. 2013.
196. Milne and Niesten 2009; Börner et al. 2017.
197. Ibid.
198. Wunder 2008, 2013.
199. Börner et al. 2017.
200. Sunderlin et al 2015.
201. UNDP 2018.
202. Milne and Niesten 2009.
203. Angelsen 2017.
204. Mahanty et al. 2013.
205. Nelson et al. 2009.
206. Sommerville et al. 2010.
207. Milne and Adams 2012.
208. Pasgaard 2013.
209. Milne 2012.
210. UNDP 2019.
211. The number of hotels has to be carefully assessed again as there is a big difference between the number given by the authority and the number by TripAdvisor.
212. UNDP 2019.
213. The number of hotels has to be carefully assessed again as there is a big difference between the number given by the authority and the number by TripAdvisor.
214. Sophal et al. 2016.
215. Royal Government of Cambodia 2011.
216. See UNDP 2016.
217. Open Development Cambodia 2016.
218. Kirkpatrick and Brown 1994.
219. GERES 2015.
220. Winrock International 2016.
221. Avitabile et al. 2016.
222. GMS 2014.
223. Open Development Cambodia 2016.
224. This work on the distance from roads and distance from villages is an adaptation of village and roads location content produced by Open Development Cambodia and shared with UNDP in 2016. It is used under CC-BY-SA. A distance function was applied to the datasets to produce raster distance layers. Distance from villages and distance from roads are licensed by UNDP under CC-BY-SA.
225. Crocker 1962.
226. Social land concessions seek to provide lands to the landless or land-poor for residential use and small-scale agriculture.
227. Danielsen et al. 2013.
228. Brofeldt et al. 2014.
229. Lund 2014.
230. Pernell 2015.
231. For example, Nam et al. 2015.

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Appendix A: Source data used for estimation of provincial HDIs

Province	2005 GDP per capita	2010 GDP per capita	2015 GDP per capita	2005 Mean years of schooling	2010 Mean years of schooling	2015 Mean years of schooling	2005 Life expectancy	2010 Life expectancy	2015 Life expectancy
Banteay Meanchey	1,608	2,325	3,048	2.03	4.31	4.73	64.89	66.10	69.80
Battambang	1,499	2,208	2,881	3.13	5.61	6.13	64.45	65.65	70.30
Kampong Cham	1,385	2,086	2,709	2.73	4.41	4.43	63.95	65.13	67.50
Kampong Chhnang	1,396	2,098	2,726	2.78	4.07	5.24	68.60	69.92	65.00
Kampong Speu	1,378	2,079	2,698	2.62	5.56	5.62	60.65	61.75	71.20
Kampong Thom	1,347	2,046	2,652	2.54	3.73	4.28	61.71	62.83	67.30
Kampot	1,386	2,087	2,710	2.98	5.02	5.63	56.45	57.45	68.30
Kandal	1,473	2,180	2,842	3.67	5.82	5.34	64.38	65.57	69.70
Kep	1,444	2,149	2,798	2.98	5.02	5.63	62.00	63.13	67.90
Koh Kong	1,655	2,375	3,119	2.47	4.81	5.92	57.52	58.54	69.20
Kratié	1,422	2,126	2,765	2.39	4.28	4.21	61.01	62.12	63.50
Mondulkiri	1,382	2,083	2,560	0.19	2.15	3.40	41.17	41.84	61.20
Oddar Meanchey	1,407	2,110	2,743	1.63	3.86	4.02	57.40	58.42	69.50
Pailin	1,554	2,267	2,965	3.13	5.61	6.13	61.11	62.22	70.50
Phnom Penh (Cap.)	4,402	4,965	5,437	5.71	8.70	8.70	68.73	70.05	73.40
Preah Sihanouk	1,772	2,500	3,296	2.47	4.81	5.92	52.02	52.92	69.10
Preah Vihear	1,362	2,061	2,673	1.43	3.14	3.23	39.02	39.64	62.50
Prey Veng	1,329	2,026	2,623	2.96	4.56	5.15	62.85	64.00	66.80
Pursat	1,364	2,064	2,677	2.38	4.42	4.63	62.21	63.34	69.60
Ratanakiri	1,441	2,146	2,794	0.19	2.15	3.40	41.17	41.84	61.90
Siem Reap	1,520	2,231	2,914	1.78	3.67	3.73	67.80	69.09	69.10
Stung Treng	1,470	2,177	2,838	1.43	3.14	3.23	52.11	53.01	62.40
Svay Rieng	1,329	2,026	2,624	3.11	4.16	5.40	55.24	56.21	66.60
Takéo	1,307	2,003	2,591	3.57	5.46	6.22	61.25	62.35	70.50
Tboung Khmum	1,354	2,053	2,662	2.73	4.41	5.26	63.95	67.41	67.50

Notes:

(1) GNI per capita data are based on a pro-rata scaling of per capita incomes given in CSES (for the respective years). This also followed estimation of incomes for all provinces (except Phnom Penh) based on rural/urban population shares.

(2) The education index is a composite of means years and expected years of schooling. The latter is not available at provincial level, and therefore national values were used (for the respective years): 10.1 years for 2005, 10.7 years for 2010 and 10.9 years for 2015.

(3) Education and health data are sourced from the CHDS in respective years. Schooling data required some scaling where data were gender-disaggregated.

(4) It was necessary (for all data) to adjust for boundary changes and the creation of new provinces (which take the value of their parent provinces for past survey years).

Appendix B: Forest cover data

Province	2005 forest cover area, hectares	2010 forest cover area, hectares	2015 forest cover area, hectares	2005 forest cover, percentage	2010 forest cover, percentage	2015 forest cover, percentage
Banteay Meanchey	102,965	74,167	27,688	16.7%	12.1%	4.5%
Battambang	535,647	408,119	270,848	45.1%	34.4%	22.8%
Kampong Cham	161,478	156,405	52,585	17.0%	16.5%	11.6%
Kampong Chhnang	207,891	209,841	146,015	39.3%	39.6%	27.6%
Kampong Speu	410,857	405,153	252,490	59.0%	58.2%	36.3%
Kampong Thom	618,694	620,476	512,244	49.7%	49.8%	41.2%
Kampot	227,154	219,903	167,577	48.1%	46.6%	35.5%
Kandal	18,854	17,657	16,138	5.3%	5.0%	4.5%
Kep	12,009	3,083	3,094	79.1%	20.3%	20.4%
Koh Kong	970,490	968,698	967,862	80.1%	80.0%	79.9%
Kratié	935,464	902,573	755,555	78.1%	75.4%	63.1%
Mondulkiri	1,240,937	1,234,707	1,230,419	90.8%	90.3%	90.0%
Oddar Meanchey	457,131	406,268	224,033	68.9%	61.3%	33.8%
Pailin	54,599	45,338	33,394	50.7%	42.1%	31.0%
Phnom Penh (Cap.)	0	0	0	0.0%	0.0%	0.0%
Preah Sihanouk	82,805	86,955	82,662	55.5%	58.3%	55.4%
Preah Vihear	1,309,210	1,280,489	1,124,177	93.3%	91.3%	80.1%
Prey Veng	8,239	5,962	1,874	1.7%	1.3%	0.4%
Pursat	885,440	874,207	742,397	76.4%	75.5%	64.1%
Ratanakiri	948,754	943,351	919,381	80.5%	80.0%	78.0%
Siem Reap	476,824	441,668	347,834	45.2%	41.9%	33.0%
Stung Treng	1,046,172	1,027,027	980,092	87.1%	85.5%	81.6%
Svay Rieng	11,931	14,590	5,350	4.2%	5.1%	1.9%
Takéo	15,327	14,579	13,678	4.4%	4.2%	3.9%
Tboung Khmum	NA	NA	106,587	NA	NA	NA

Notes:

(1) All data are sourced from the Ministry of the Environment.

(2) Forest areas are given in hectares at the survey dates.

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