

DRAFT:
**An annotated guide
to useful resources
for monitoring the
impacts of REDD+ on
biodiversity and
ecosystem services**

UN-REDD PROGRAMME

February 2011

Draft for comment



The UN-REDD Programme, a collaborative partnership between FAO, UNDP and UNEP, was created in response to, and in support of, the UNFCCC decision on REDD at COP 13 and the Bali Action Plan. The Programme supports countries to develop capacity to reduce emissions from deforestation and forest degradation and to implement a future REDD mechanism in a post-2012 climate regime. It builds on the convening power of its participating UN agencies, their diverse expertise and vast networks, and "delivers as One UN".

The United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) is the biodiversity assessment and policy implementation arm of the United Nations Environment Programme (UNEP), the world's foremost intergovernmental environmental organization. The centre has been in operation since 1989, combining scientific research with practical policy advice.

The United Nations has proclaimed 2010 to be the International Year of Biodiversity. People all over the world are working to safeguard this irreplaceable natural wealth and reduce biodiversity loss. This is vital for current and future human wellbeing. We need to do more. Now is the time to act.

Prepared by

Nathalie Doswald and Barney Dickson

Copyright: UN-REDD Programme

Copyright release: Reproduction of this publication for educational or other non-commercial purposes is authorised without prior permission from the copyright holders. Reproduction for resale or other commercial purpose is prohibited without the prior written permission of the copyright holders.

Disclaimer: Should readers wish to comment on this document, they are encouraged to get in touch via ccb@unep-wcmc.org.

The contents of this report do not necessarily reflect the views or policies of UN-REDD, UNEP-WCMC or contributory organisations. The designations employed and the presentations do not imply the expressions of any opinion whatsoever on the part of UNEP-WCMC or contributory organisations concerning the legal status of any country, territory, city or area or its authority, or concerning the delimitation of its frontiers or boundaries.

Citation: Doswald, N. And Dickson, B. 2010. An annotated guide to useful resources for monitoring the impacts of REDD+ on biodiversity and ecosystem services. Draft. Prepared on behalf of the UN-REDD Programme. UNEP World Conservation Monitoring Centre, Cambridge, UK.

Acknowledgements With thanks for comments and input to Matea Osti



Introduction

The draft *Guidelines for monitoring the impacts of REDD+ on biodiversity and ecosystem services* (herein after called “the Guidelines”) provide a few clear recommendations to take into account when scoping, designing and implementing monitoring for the impacts of REDD+ on biodiversity and ecosystem services. This guide is intended to direct the readers of the Guidelines to resources that a) provide basic information on biodiversity and ecosystem services, b) provide guidance on monitoring these, and c) some useful tools that can help with the first two issues.

There exists a significant body of literature on these topics and therefore this guide cannot be exhaustive. Literature was chosen that was relevant to the Guidelines and, wherever possible, accessible online.

This draft annotated guide, like the guidelines themselves, will be widely circulated for comment and testing, among UN-REDD countries and more broadly. Subsequently the annotated guide will be revised and finalised. Comments from any sources will be gratefully received. Please send them to: Rebecca.Mant@unep-wcmc.org or Barney.Dickson@unep-wcmc.org.

Structure of the guide

This guide is grouped into three sections (A, B and C), corresponding to the sections in the Guidelines (see also Annex). Under each section, there are general headings grouping resources (see below). Each resource under these headings contains an overview and a section on its relevance to the Guidelines. The Annex contains a summary table detailing which resources are useful for which Guidelines. This can serve as a quick overview for readers wishing to find resources relevant to particular Guidelines.

A. Resources for the SCOPING section in the guidelines	2
Forest biodiversity and ecosystem services and related pressures.....	2
General monitoring practical guides.....	7
B. Resources for the DESIGNING section in the guidelines	10
Indicators	10
Monitoring biodiversity and the environment	13
C. Resources for the IMPLEMENTING section in the guidelines	16
Forest monitoring & remote sensing.....	16
Community-based monitoring and management	19
Annex	21

A. Resources for the SCOPING section in the guidelines

Forest biodiversity and ecosystem services and related pressures

Information sources

[1] Millennium Ecosystem Assessment – <http://www.maweb.org/en/Index.aspx>

MA (2003) *Ecosystems and human well-being: A framework for assessment*. Island Press, Washington, DC.

MA (2005) *Ecosystems and human well-being: global assessment reports*. Island Press, Washington, DC.

Overview

The Millennium Ecosystem Assessment (MA) is the most notable work which has mainstreamed ecosystem services and assessed the conditions and trends of the worlds' ecosystem services. The MA is comprised of a framework manual describing key concepts, five technical manuals that detail the condition and trends of ecosystem services, future scenarios and possible policy responses; and six synthesis reports that highlight findings according to different themes (e.g. biodiversity, desertification and health). All these documents are accessible online.

The MA is the first port of call for all information related to ecosystem services, their link to human well-being, as well as information on their condition and trends at a global scale. Additionally, a number of sub-global assessments have been undertaken. These are intended to meet the needs of decision-makers, and strengthen global findings with on-the-ground verification. There are 18 MA approved sub-global assessments and an additional 15 with an associated status. These provide more in depth information for specific regions.

Relevance

The MA provides information for the scoping phase for monitoring the multiple benefits and risks of REDD+. It gives a generic description of what ecosystem services and biodiversity are and how they link to human well-being, thereby helping to identify those attached to REDD+ (guideline 2). It also highlights some of the pressures on ecosystem services, and their overall condition and trend. The MA can help set objectives for biodiversity and ecosystem services (guideline 4), and determines factors affecting these objectives (guideline 6). The MA also gives definitions, methods and data sources, which may be useful.

[2] Millennium Ecosystem Assessment Methods Manual – <http://www.unep-wcmc.org/eap/eco-serv-val.aspx>

Ash, N. Blanco, H., Brown, C., Garcia, K., Henrichs, T., Raudsepp-Hearne, C., Simpson, D.R., Scholes R., Tomich, T.P., Vira, B. & Zurek, M. (2010) *Ecosystems and human well-being: a manual for assessment practitioners*. Island Press, UK.

Overview

This manual is designed as a 'how to' guide on undertaking ecosystem assessments for assessment practitioners, especially at sub-global scales. It draws on learning and experience from the Millennium Ecosystem Assessment (MA) and other completed and ongoing assessment type

activities. The manual provides detailed guidance on conceptual frameworks for ecosystem assessment, assessing status and trends in ecosystem services and human wellbeing, and how to design and implement an ecosystem assessment. The manual is intended to complement other related ecosystem assessment manuals, such as [3] and [4] below.

Relevance

The manual provides practical advice on how to undertake an ecosystem service assessment. Specifically relevant to the guidelines, is the advice on constructing conceptual frameworks useful for identifying impacts (guideline 2), engaging with stakeholders (guideline 5) and choosing indicators (guideline 6). However, as the manual was designed to guide a formal MA-style assessment, the depth of information contained in this manual is more than is needed for informing the scoping phase of monitoring multiple benefits from REDD+. For example, the manual provides detailed guidance on developing future scenarios and assessing interventions, all of which are important if achieving (and enhancing) ecosystem-based multiple benefits from REDD+ in the long-term is desired.

[3] GEO resource book training manual – <http://www.unep.org/dewa/cbps/georesource/>

UNEP & IISD (2007) *GEO Resource Book: A training manual on integrated environmental assessment and reporting*. United Nations Environment Programme and International Institute for Sustainable Development.

Overview

The GEO resource book is a training manual on Integrated Environmental Assessment (IEA) and reporting at the sub-global level, developed jointly by the United Nations Environment Programme (UNEP) and the International Institute for Sustainable Development (IISD). The resource book defines IEA as “the process of producing and communicating future-oriented, policy-relevant information on key interactions between the natural environment and human society”. It consists of eight training modules covering the design of an integrated environmental assessment, monitoring, analyses, development of scenarios, and communicating results. The online documents are publicly accessible and provide links to further resources.

Relevance

The resource book contains more information than is needed to monitor the impacts of REDD+ on biodiversity and ecosystem services, as it is designed for assessing the state of the environment in general. However, guidance on conducting environmental assessments can be used to identify the ecosystem-based benefits and harms of REDD+ (guideline 2). The framework used in the IEA is the Driving-force – Pressure – State – Impact – Response framework (DPSIR), which is described. The DPSIR framework is useful for establishing the factors that impact on biodiversity and ecosystem services and for indicator selection (guideline 6). The manual also provides guidance on organising assessments, such as how to identify and engage with stakeholders (guideline 5), and the communication and review process (guideline 12). Module 4 focuses on monitoring, data and indicators. It provides useful background information for indicators and types of data (guideline 6) and includes a section on remote sensing that covers remote sensing basics and its use in environmental assessments (guideline 10). Finally, the resource book provides information about ongoing-monitoring and relevant websites (guideline 8).

[4] Ecosystem Services: a guide for decision-makers –

http://pdf.wri.org/ecosystem_services_guide_for_decisionmakers.pdf

Ranganathan, J., Raudsepp-Hearne, C., Luca, N., Irwin, F., Zurek, M., Bennett, K., Ash, N. & West, P. (2008) *Ecosystem Services: a guide for decision-makers*. World Resource Institute

Overview

This guide, accessible online and produced by the World Resource Institute, aims to mainstream consideration of ecosystem services in decision-making for the public and private sector. It introduces methods to incorporate the concept of ecosystem services into different types of decision-making. It uses both actual and hypothetical case study examples to illustrate how to integrate ecosystem services into decision-making and suggests different tools. It does not provide detailed methodological guidance on how to assess the conditions and trends of ecosystem service, instead pointing to the *Millennium Ecosystem Assessment Methods Manual* [2] for further information on such guidance.

Relevance

This document is particularly relevant to the scoping phase of monitoring multiple benefits of REDD+, because it provides clear definitions ecosystem services and biodiversity, and outlines the steps needed to assess risks and opportunities related to ecosystem services from a given decision or activity (such as REDD+), including a comprehensive list of the types of ecosystem services decision-makers may need to consider (guideline 2). The guide also highlights the importance of addressing future ecosystem change in decision-making, and includes information and steps required for scenario building, which are useful for long term considerations of REDD+ impacts on biodiversity and ecosystem services.

[5] Multiple benefits series –

http://www.un-redd.org/AboutUNREDDProgramme/GlobalActivities/New_Multiple_Benefits/tabid/1016/Default.aspx

Overview

The UN-REDD Programme website contains a dedicated section on multiple benefits of REDD+, and related issues. A number of publications on ecosystem-based benefits from REDD+ can be found via this website. These publications cover a diverse range of topics, such as what comprises ecosystem-based benefits from REDD+ (Series No. 1), approaches to safeguard and enhance multiple benefits from REDD+ (Series No. 2), monitoring for REDD+ (Series Nos. 3, 6 and 9), and carbon resilience (Series No. 10). The publications are publicly accessible online.

Relevance

The UN-REDD Programme multiple benefits series form the background knowledge for these guidelines (especially guidelines 1-3; guidelines 6-10), and in particular the three series reports examining monitoring for REDD+. Series No. 3, *Monitoring for REDD+: carbon stock change and multiple benefits* explores the relationship and potential synergies between monitoring systems for carbon stock changes, and for biodiversity and ecosystem service changes under REDD+ (guideline 9). Series No. 6, *Methods for assessing and monitoring change in the ecosystem-derived benefits of afforestation, reforestation and forest restoration* summarises the steps needed to design a system

which monitors changes in ecosystem services resulting from these REDD+ activities (guideline 8). Series No. 9, *Potential links between monitoring for multiple benefits of REDD+ and the monitoring requirements of the Rio Conventions*, looks at the extent to which monitoring systems for multiple benefits of REDD+ can benefit from and/or support existing monitoring work that has already been started or carried out under the Rio Conventions (guideline 8-9).

In addition to the multiple benefits series, other relevant publications can be found on the UN-REDD Programme multiple benefits webpage, including two summary reports exploring the relationship between carbon, biodiversity and ecosystem services in Tanzania and Nigeria, and selected journal papers and other documents.

[6] Carbon, biodiversity and ecosystem services: exploring co-benefits – <http://www.carbon-biodiversity.net/>

Overview

This website hosts the portfolio of work undertaken by UNEP-WCMC and partners on mapping the relation between carbon, biodiversity, ecosystem services, and pressures on these at global, national and subnational scales. Identifying areas where high carbon density and high biodiversity priority overlap, and relating these to pressures and management options within a country can help to inform decisions on where and how REDD+ is implemented. To date, UNEP-WCMC has undertaken work with a number of countries, including Argentina, Honduras, Ecuador, Bolivia, Nigeria, Tanzania, Cambodia, Viet Nam, Jiangxi Province in China, and is exploring potential future work with the Democratic Republic of the Congo, and Sulawesi Island in Indonesia. The website also hosts interactive tools, which consist of interactive maps (allowing users to manipulate visible map layers) and a link to the interactive carbon calculator; a tool of the LifeWeb Initiative, which calculates initial estimates of carbon stored in existing protected areas or any polygon drawn by users on a global map.

Relevance

This website is intended to help REDD+ stakeholders visualise how carbon, biodiversity and ecosystem services are distributed relative to each other across landscapes. The primary aim of the work, therefore, is to assist decision-makers in making a first step towards considering co-benefits when planning and implementing REDD+. This work particularly useful for guideline 2, as it shows how it start identifying areas where REDD+ could help to maintain or enhance biodiversity and ecosystem services. This work does not include guidance specifically on monitoring the impacts of REDD+ on biodiversity and ecosystem series.

Tools

[7] Geographical Information Systems (GIS)

Overview

A Geographic Information System (GIS) is a type of computer software that enables spatial data to be compiled, mapped, and overlaid, among other things. GIS allows for the large scale analysis of spatial information, and generates information that is visually accessible and useful for decision-makers. GIS is also used in conjunction with remote sensing to process and derive data. GIS software can be purchased, and although many desktop GIS are becoming increasingly more user-friendly and incorporate a number of very useful tools, they are still complex software requiring training, and can

be expensive. ArcGIS (see <http://www.esri.com/software/arcgis/index.html>) is the most commercially successful and widely used GIS product. However, there exist other GIS software such as IDRISI (see <http://www.clarklabs.org/>) and GRASS (<http://grass.fbk.eu/>), which is free software. A list of open source or free GIS software and related projects can be found at <http://opensourcegis.org/>.

Recent years have also brought a number of mapping applications on the web. These are either viewing applications, such as Google Earth (http://www.google.co.uk/intl/en_uk/earth/index.html), mapping (such as www.ArcGIS.com), or specific applications, such as the interactive carbon calculator (see above; and <http://www.carbon-biodiversity.net/Interactive/CarbonCalculatorNotes>) or mapping of protected areas (<http://www.protectedplanet.net/>).

Relevance

GIS can be used as a tool for all three phases of REDD+ monitoring. In the scoping phase, it can be used for exploring the spatial relationship between different environmental, biological and anthropic factors, thereby identifying which factors are important in REDD+. For example, it can highlight areas where high biodiversity and carbon coincide. In the design phase, it can be used to inform spatial indicators and where to locate field monitoring as well as plan sampling strategies. In the implementation phase, it can be used to process remote sensing data, derive new data and analyse and visualise monitoring data. GIS is therefore an important monitoring tool.

[8] Environmental Assessments

Overview

Environmental Assessments are important tools that establish the effects of a land use plan on the environment and people, and come in many forms. Strategic environmental assessments (SEA) allow for the exploration of environmental considerations of decisions, policies and plans to ensure effective strategies. Environmental Impact Assessments (EIA) are typically more narrowly focused on the potential impacts of individual projects and are often legislatively mandated prior to the commencement of a project. Integrated Environmental Assessment (IEA) is another framework that assesses the environment-society relationship.

Relevance

Environmental Assessments are particularly useful for scoping the impacts of REDD+ on biodiversity and ecosystem services (guideline 2), and in the design phase (guideline 6). There exist online a number of general resources and handbooks/sourcebooks devoted to environmental assessments. The World Bank, for example, has a comprehensive sourcebook (<http://go.worldbank.org/LLF3CMS1I0>) designed to help environmental assessment practitioners and other involved in the environmental assessment process. The GEO training manual [3] covers the whole sequence involved in the IEA process, including monitoring. There are also specific manuals that have been developed for social and environmental assessments of REDD+ related projects specifically, e.g. REDD+ at Project Scale: Evaluation and Development Guide [24].

[9] OSIRIS – <http://www.conservation.org/osiris/Pages/overview.aspx>

Overview

The Open Source Impacts of REDD Incentives Spreadsheet (OSIRIS) is a free, open source decision support spreadsheet tool designed by the Collaborative Modelling Initiative on REDD Economics. The tool is an initiative of Conservation International and several conservation and research organisations, and enables “comparison of global, regional and country-by-country emissions reduction, deforestation and revenue impacts of alternative approaches to providing positive economic incentives for REDD”. The tool is meant to serve as an illustrative means by which the outcomes for alternative policies for REDD can be compared. The latest version (v3.4) incorporates biodiversity in its analysis, by including biodiversity as an added value to carbon-based payments.

Relevance

Although OSIRIS allows users to independently determine various REDD designs and model parameters, and has in-built analysis, the spreadsheet itself may be somewhat detailed for those not previously exposed to economic modelling. However, the parameters and the calculations used are transparent. This tool is useful for considering the economic aspects of implementing REDD, and useful for guideline 1.

General monitoring practical guides

Information sources

[10] Open Standards for the Practice of Conservation – <http://www.conservationmeasures.org>

The Conservation Measures Partnership (2007) *Open standards for the practice of conservation*. Version 2.0.

Overview

The Open Standards for the Practice of Conservation represent an aggregation of common concepts, terminology and approaches for success in implementation of conservation projects, and address project design, management and monitoring. They are the result of a collaborative effort by the Conservation Measures Partnership (CMP), and have been subjected to field tests. The CMP is comprised of various conservation non-governmental organisations (NGOs) around the world. The standards are based on the concept of adaptive management, or the project management cycle, in which monitoring is a large component. They include steps and general guidance on conceptualizing project vision and context; planning and implementing actions and monitoring; analysing data, using results to adapt the project, and capturing and sharing data with intended audiences.

Relevance

The Open Standards provide general principles and steps, as opposed to detailed methodological guidance, that are required to design and implement conservation projects and monitoring. They describe how to derive objectives from identified conservation targets, which is directly relevant to deriving objectives for biodiversity and ecosystem services under REDD+ (guideline 4). They describe how to identify the factors impacting on these goals, and how to identify subsequent indicators for these (guideline 6). They also provide practical tools such as a monitoring plan template, and

practical guidance on implementing actions and monitoring, such as how to develop a work plan, timeline and budget for projects.

[11] Effective ecological monitoring

Lindenmayer, D.B. & Likens, G. (2010) *Effective ecological monitoring*. Earthscan, London, UK

Overview

This book, available from Earthscan and Csiro publishing, provides a direct, well-written framework for effective ecological monitoring aimed at a wide audience, from researchers to resource managers and policymakers. It draws upon the experience of the authors and includes many case studies of effective, as well as problematic, monitoring programmes. It gives insight into why ecological monitoring fails, what constitutes good and bad monitoring, and provides guidance on how to create effective monitoring programmes, proposing a new monitoring framework called “adaptive monitoring”, which incorporates key features of successful ecological monitoring programmes.

Relevance

The book provides information covering the whole monitoring process (from scoping to implementation), and is particularly relevant to guidelines 4-7. It is not intended as a practical field manual, so it is by no means exhaustive, although additional references for further reading are cited throughout the text. The book’s value lies in its identification and comparison of effective versus ineffective ecological monitoring programmes, supplemented by actual case studies.

[12] “Monitoring and Reporting One-Stop-Shop” Website – <http://www.qualityplanning.org.nz/monitoring/index.php>

Overview

This website provides information on environmental monitoring and reporting relevant to New Zealand’s environmental legislation. However, the information provided is generic enough to be valuable and applicable to environmental monitoring in other contexts. The website contains seven guidance notes on: getting started; state of the environment monitoring; policy and plan effectiveness; resource consents, compliance and complaints; delegations and transfers; monitoring tools, indicators and data management; and review and reporting. Each guidance note (displayed as a webpage) includes key messages, guidance, relevant publications and websites, and challenges in practice.

Relevance

The website provides accessible information for the general reader about various aspects of the environmental monitoring and reporting process, with guidance that is relevant for guidelines 4-7. The ‘best practices examples’ and ‘challenges in practice’ sections under each guidance note may be of particular interest.

[13] Guidelines for Biodiversity Assessment and Monitoring for Protected Areas – http://www.unep-wcmc.org/collaborations/BCBMAN/PDF/PA_Guidelines_BMA.pdf

Tucker, G., Bubb P., de Heer M., Miles L., Lawrence A., Bajracharya S. B., Nepal R. C., Sherchan R., Chapagain N.R. 2005. *Guidelines for Biodiversity Assessment and Monitoring for Protected Areas*. KMTNC, Kathmandu, Nepal.

Overview

These guidelines (available online) were collaboratively produced by the King Mahendra Trust for Nature Conservation in Nepal and UNEP-WCMC in Cambridge, UK. They are the result of a capacity building project undertaken in Nepal for biodiversity assessment and monitoring in the Annapurna Conservation Area in Nepal, funded by the Darwin Initiative. The guidelines describe, step-by-step, how to undertake biodiversity assessments and develop biodiversity monitoring programmes in protected areas.

Relevance

Although these guidelines were written for the assessment and monitoring of biodiversity in protected areas, they are general enough to be of use in a REDD+ context. The document itself is comprehensive, and includes constructive examples and information on identifying constraints, opportunities and pressures on biodiversity (guideline 2), setting objectives (guideline 4), establishing indicators (guideline 6), choosing methods and collecting data, and conducting statistical analyses. This document is highly compatible with, and complementary to the 'guidelines for assessing the impacts of REDD+ on biodiversity and ecosystem services' document.

Tools

[14] Miradi software – <https://miradi.org/>

Overview

Miradi is user-friendly software that is based on the Conservation Measures Partnership's Open Standards for the Practice of Conservation [10]. It is management systems software that takes users through every step in the management cycle. It is designed to help project teams design, manage, monitor, and learn from their conservation projects. The software includes functions such as flowcharting, project planning, spreadsheet, accounting, and other software packages. Users can also plan goals, develop strategies, highlight threats and actions, and build in indicators. The software does not currently include any spatial Geographic Information Systems (GIS) functionality, though this is planned for the future. Miradi is a non-profit venture and is provided at a range of pricing to suit different needs and circumstances.

Relevance

The software could potentially be a particularly useful tool for planning and designing the monitoring of impacts of REDD+ on biodiversity and ecosystem services. It is very comprehensive, allowing all aspects of project management and monitoring to be created and stored in one package. Setting up a project in Miradi will to some degree require additional effort during REDD+ implementation, and if carbon management and monitoring is not also documented in Miradi whilst biodiversity monitoring is, this could result in disparate processes preventing an integrated approach. However, using Miradi does have the advantage of saving considerable time and effort in the long term, ensuring a well thought out management and monitoring strategy, as well as keep all information in one place.

B. Resources for the DESIGNING section in the guidelines

Indicators

Information sources

[15] Guidance for national biodiversity indicator development and use. Version 1.3 – <http://www.twentyten.net/>

Biodiversity Indicators Partnership (2010) *Guidance for national biodiversity indicator development and use. Version 1.3*. UNEP-WCMC, Cambridge, UK.

Overview

This document, freely available online, is a product of the Biodiversity Indicators Partnership (BIP), a global collaboration of organisations and agencies working to develop global biodiversity indicators in the context of the Convention on Biological Diversity (CBD). The primary aim of this guidance document is to assist countries in developing national level biodiversity indicators, which can then be used for purposes such as policymaking, reporting, environmental management, and education. There is also a corresponding BIP website, which provides general information on the BIP, and links to further resources on biodiversity indicators at both the global and national level. It contains information on experiences from African countries in developing indicators, different indicator initiatives, and the global biodiversity indicators that were developed for the CBD.

Relevance

The guidance document is compatible with, and complementary to the ‘guidelines for assessing the impacts of REDD+ on biodiversity and ecosystem services’ document, and particularly to guidelines 4-7 and 12. The indicator development process described within this document can be applied and adapted to the development of indicators for assessing the impacts of REDD+ on biodiversity and ecosystem services.

[16] Indicators for sustainable development: guidelines and methodologies – <http://www.un.org/esa/sustdev/natlinfo/indicators/guidelines.pdf>

UN (2007) *Indicators for sustainable development: guidelines and methodologies*. Third Edition. The Department of Economic and Social Affairs, United Nations, New York, USA.

Overview

This comprehensive document presents the Commission on Sustainable Development’s (CSD) third set of revised indicators for sustainable development, following two previous sets developed in 1994 and 2001. This revised set of indicators have been tested, applied and used in many countries in the development of national indicators for sustainable development. The document outlines the history of indicator development under the CSD, provides an overview of the revised CSD indicators, which include indicators for land-use, freshwater and biodiversity, and provides suggestions on how to adapt them for national circumstances or priorities.

Relevance

The focus of this publication is the CSD indicators, which have been developed to measure progress towards achieving sustainable development, rather than progress towards conservation goals. Nonetheless, it is useful for guidelines on monitoring the impacts of REDD+ on the environment, because of its generic advice on indicator selection and adaptation (guideline 6). The chapter on indicator frameworks provides a good overview of what these are, including the most commonly used PSR or Pressure – State – Response (and variants) framework. Indicator frameworks are common and useful tools for organizing thinking about what to measure, but are not a necessary component of a monitoring programme.

[17] Sourcebook on remote sensing and biodiversity indicators – <http://www.cbd.int/ts/>

Strand, H., Hoft, R., Stritthold, J., Miles, L., Horning, N., Forsight, E., Turner W. (2007) *Sourcebook on remote sensing and biodiversity indicators*. Secretariat of the Convention on Biological Diversity, Montreal, Technical Series no. 32.

Overview

This Sourcebook, available online, is part of the Convention on Biological Diversity's (CBD) technical series and as such was written for the CBD, with its information and monitoring needs in mind. It is intended to assist those working with environmental indicators, through illustrating the role that remote sensing can play in developing and monitoring biodiversity indicators. The document provides an introduction to indicators and remote sensing, and then covers how remote sensing can inform trends in selected biomes, habitats and ecosystems (from forests to inland waters); species populations; invasive species; protected areas; and habitat fragmentation and connectivity.

Relevance

This document is a very useful resource for choosing indicators to establish the impacts of REDD+ on biodiversity and ecosystem services (guideline 6), and enabling a wider range of data to be collected (guideline 10), and more feasibly than under large-scale field operations (guideline 7).

[18] ITTO policy paper, manuals and guidelines – http://www.itto.int/policypapers_guidelines/

Overview

The International Tropical Timber Organization (ITTO) has developed a series of documents designed to assist tropical member countries of the Organization in achieving conservation and sustainable management, use and trade of their tropical forest resources. The documents cover different topics such as manuals for project formulation, project monitoring, guidelines for the conservation and sustainable use of biodiversity in tropical timber production forests, and documents on criteria and indicators for sustainable management of forests. Many of the policy papers, manuals, and guidelines are intended to assist member countries with adapting the information contained within the documents to local circumstances, and implementing them accordingly in the field.

Relevance

These documents are worth consulting as they cover a broad range of issues that are relevant to REDD+ implementation. In terms of monitoring the impacts of REDD+ on biodiversity and ecosystem services, the criteria and indicators for Sustainable Forest Management (SFM) could be used depending on the goals chosen (guidelines 4 & 6).

Tools

[19] CIFOR criteria and indicators toolbox – <http://www.cifor.cgiar.org/acm/pub/toolbox.html>

Overview

The Center for International Forestry Research (CIFOR) has created a Criteria & Indicator (C&I) Toolbox, which consists of a series of resources to assist with the monitoring of Sustainable Forest Management (SFM). The series is currently comprised of nine “tools”. The first tool is a manual providing methods for the development and evaluation of C&I for SFM. The second tool is a manual that provides a comprehensive set of C&I for sustainable forest management based on CIFOR’s research. The third tool is software called CLIMAT, and enables users to modify different C&I sets or develop a new set. Tools five to eight assist in assessing human welfare and focus on the social criteria and indicators for SFM. The ninth tool is a manual on multi-criteria decision analysis (MCA). MCA is a decision-making tool developed for complex problems to be used in this setting for selecting or modifying C&I.

Relevance

Each of these manuals is comprehensive and fairly lengthy. The manuals contain valuable information, tools and methods to help develop indicators (guideline 6). However, since they are designed for SFM initiatives, they contain material which is not of relevance in a REDD+ setting.

[20] Ecosystem Service Indicators Database – <http://www.esindicators.org/>

Overview

The Ecosystem Service Indicator Database (ESID), a World Resource Institute initiative, is a searchable database compiling indicators that have been used for ecosystem services (ES), which mostly originate from the global and subglobal Millennium Ecosystem Assessments [1]. The database includes a description of the indicator, what ecosystem service it covers, and the ecosystem(s), scale, data units and data collection methods it uses. Although the fields for each indicator are comprehensive, many fields are data deficient. The filters that can be applied to the database make it easy to search for forest-related ES indicators.

Relevance

This database may be more useful for familiarising oneself with different indicators for various ecosystem services, rather than as a site for accessing ready-made biodiversity and ecosystem service indicators for REDD+. This is not only because of the limited information given under many of these indicators, but also because in practice the choice of indicators needs to be informed by policy or management objectives (guideline 6).

Monitoring biodiversity and the environment

Information sources

[21] Monitoring forest biodiversity

Gardner, T. (2010) *Monitoring forest biodiversity: improving conservation through ecologically-responsible management*. Earthscan, London, UK.

Overview

This book, published by Earthscan, is a comprehensive ‘textbook’ on monitoring forest biodiversity. It consists of three parts. The first part provides the context for monitoring forest biodiversity, which addresses and discusses the reasons for why monitoring forest biodiversity is important. The second part discusses challenges to monitoring forest biodiversity, and the third part discusses the methods for monitoring forest biodiversity, and provides an operational framework.

Relevance

This book is intended to help readers design forest biodiversity monitoring, and could therefore be of particular use for monitoring biodiversity under REDD+. The operational framework described by the author concurs with the guidelines, and with the other resources in this guide, e.g. [10], [11], [13] & [15].

[22] Ecological census techniques: a handbook

Sutherland, W. J. (2006) *Ecological Census Techniques: a Handbook*. 2nd Edition. Cambridge University Press, Cambridge

Overview

This handbook, published by Cambridge University Press, provides practical advice for ecological surveys and monitoring. It contains twelve chapters. The first chapter is on planning a research programme. Although the precepts laid out in this are useful, within a REDD+ context, this chapter is too academic. Chapters two and three are on sampling and general census techniques. These provide the essential backbone for conducting field monitoring. The remaining seven chapters showcase techniques for different species types (e.g. plants, mammals and fish). Chapter 11 provides methodology to monitor environmental variables, whilst the final chapter details some of the common pitfalls in censuses.

Relevance

This handbook is comprehensive and academically rigorous. Nevertheless, it is useful for considering the design and implementation of monitoring the impacts of REDD+ on biodiversity and ecosystem services (guidelines 6 to 8).

[23] Guidelines for monitoring and evaluation for biodiversity projects

<http://siteresources.worldbank.org/INTBIODIVERSITY/214584-1110959186651/20611829/270310Guidlines0for0monitoring.pdf>

World Bank (1998) *Guidelines for Monitoring and Evaluation for Biodiversity Projects*. Biodiversity Series, World Bank Environment Department Papers, Global Environment Division, Washington DC.

Overview

The Global Environment Division of the World Bank has produced a set of guidelines intended for use by World Bank task teams and consultants in the monitoring and evaluation (M&E) of biodiversity conservation projects. The document indicates that their guidelines may also be a useful resource for government agencies, non-governmental organisations, and others involved in M&E of biodiversity projects. Their guidelines outline how to formulate an M&E plan, identify and select indicators (and include example indicators in an accompanying Annex), consider the institutions that may feed into various components of the M&E process, and how to address M&E at various stages of the project cycle.

Relevance

These guidelines outline key concepts and considerations on M&E in a concise and compact manner. However, they only focus on monitoring biodiversity and not ecosystem services. The example biodiversity indicators are particularly useful as they specify the required datasets and methods needing to be employed to develop different types of indicators. The indicators described in these guidelines could be useful when thinking about biodiversity indicators in a REDD+ context, as they introduce the types of indicators donors might eventually expect for biodiversity monitoring of REDD+ activities. This document is useful for guidelines 1-7.

[24] REDD+ at project scale (Chapter 5)

<http://www.onfinternational.org/en/publications/313-qguide-redd-a-lechelle-projetq-guide-devaluation-et-de-developpement.html>

Calmel, M., Martinet, A., Grondard, N., Dufour, T., Ragearde, M., Ferte-Devin, A. (2010) *REDD+ at project scale. Evaluation and development guide*. ONF International.

Overview

This document is available online and developed by ONF International, an international environmental consulting agency focusing on forest-related sustainable ecosystem management and climate change. The document is intended to guide the development of REDD+ projects and their evaluation, and is geared towards single REDD+ projects, rather than a broader, national-scale implementation of REDD+. The guide states that it is “not designed to become a methodology or a standard, but to offer insights into existing tools and key questions that have to be addressed at the project scale”. The sections of the guide cover the definition of REDD+ at project scale; technical recommendations for a) REDD+ project development b) the methodological aspects of REDD+, and c) the financial REDD+ component; and recommendations for the socio-environmental aspects of REDD+.

Relevance

Latter sections of the guide, and in particular Section 5 (recommendations for the socio-environmental aspects of REDD+), are most relevant to the guidelines on monitoring the impacts of REDD+ on biodiversity and ecosystem services. This section outlines the social and environmental issues involved in REDD+ projects, and provides recommendations on how to identify and monitor the social and environmental impacts of a REDD+ project (guidelines 2-8). The section has a greater

focus on monitoring social impacts (as opposed to environmental impacts), but in many cases, the recommendations for monitoring social impacts are also transferable to monitoring for environmental impacts.

[25] Water Quality Monitoring - A Practical Guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Programmes –

http://www.who.int/water_sanitation_health/resourcesquality/wqmonitor/en/

UNEP/WHO (1996) *Water Quality Monitoring- A Practical Guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Programmes*. UNEP and WHO.

Overview

This book, available online, is a guide for the entire freshwater quality monitoring process. It provides detailed guidance on designing and implementing water quality monitoring programmes, with step-by-step descriptions of field and laboratory methods, and is particularly relevant for application in developing countries. It is intended for use by a wide audience, ranging from research groups, to local, regional and national government agencies, and consulting agencies and non-governmental organisations. The guide is based on two decades' worth of experience in the field of freshwater quality monitoring. The guide also considers the problems that may arise when conducting monitoring programmes in developing countries or remote areas.

Relevance

Water regulation is an ecosystem service, and one of the multiple benefits of REDD+. Therefore, water quality may be included in the monitoring of impacts of REDD+ on biodiversity and ecosystem services (guidelines 6-7). Water quality monitoring is one example of a monitoring scheme that may already exist outside of REDD+ but which could feed into monitoring for REDD+ (guideline 8).

C. Resources for the IMPLEMENTING section in the guidelines

Forest monitoring & remote sensing

Information sources

[26] Forests Sourcebook (Chapter 7) –

<http://siteresources.worldbank.org/EXTFORSOUBOOK/Resources/completestorestssourcebookapril2008.pdf>

World Bank (2008) *Forests sourcebook: practical guidance for sustaining forests in development coordination*. World Bank

Overview

The World Bank's forests source book, available online, is a large volume that is divided into two parts. The first part contains seven chapters covering different priority themes and operational aspects of development in the forestry sector, such as poverty and forest communities, the private sector, governance and monitoring. Each chapter provides the contextual background for the topic at hand, and main issues, challenges, and related policies and institutional requirements. The second part (five chapters) provides guidance for implementing the World Bank's safeguards on forests.

Relevance

Although the sourcebook covers a range of useful topics, chapter 7 'Monitoring and information systems for forest management' is the most relevant to monitoring the impacts of REDD+ on biodiversity and ecosystem services. This chapter gives a very good brief overview of forest monitoring, including topics such as current monitoring schemes, national forest inventories, remote sensing and associated costs. It therefore provides a good introductory reading to the section on monitoring implementation, guidelines 8-11.

[27] Measurement and Monitoring of the world's forests. A review and summary of remote sensing technical capability 2009-2015 –

<http://www.rff.org/Publications/Pages/PublicationDetails.aspx?PublicationID=20971>

Fagen, M. & Defries, R. (2009) *Measurement and Monitoring of the world's forests. A review and summary of remote sensing technical capability 2009-2015*. RFF Report.

Overview

This is a complex, highly technical and extensive document that examines remote sensing (RS) technical capability in the present and near future for measuring and monitoring forests. The review is a product of Resources for the Future, a non-governmental organisation specialising in economics and social science research on environmental and natural resource issues. In addition to evaluating RS capacity in the present and near future, the review explores why satellite imagery is useful for global forest measurement, provides an overview of the application of remote sensing in forest measurement, and outlines technical considerations for global forest measurements. The document also gives estimated costs for different types of remote sensors.

Relevance

Despite being a detailed document, which may be difficult for those unfamiliar with RS to understand, the introductory overview sections on RS, as well as estimations on sensor costs, make this a useful resource for guidelines 9-10.

[28] Dr Nicholas Short remote sensing tutorial – <http://rst.gsfc.nasa.gov/>

Overview

This online tutorial, originally sponsored by NASA, aims to be an intuitive, easily accessible remote sensing (RS) tutorial, to serve as an introduction for new users as well as a teaching tool. The tutorial contains many example images, and questions and answers. It covers the basic theoretical and technical aspects of RS, image processing and interpretation, applications (e.g. geological, vegetation, urban, land use), types of RS (e.g. radar, microwave, thermal) and geographical information systems (GIS).

Relevance

This tutorial is a useful resource for gaining a basic understanding of RS and its use (guideline 10).

[29] IPCC Methodology Reports – <http://www.ipcc-nggip.iges.or.jp/public/index.html>

IPCC (2003) *Good Practice Guidance for Land Use, Land-Use Change and Forestry*. IPCC National Greenhouse Gas Inventories Programme Technical Support Unit. Institute for Global Environmental Strategies, Japan.

IPCC (2006) *IPCC Guidelines for National Greenhouse Gas Inventories*. IPCC National Greenhouse Gas Inventories Programme Technical Support Unit. Institute for Global Environmental Strategies, Japan.

Overview

The IPCC methodological reports are the first port of call for estimating greenhouse gas (GHG) emissions from forestry. The 1996 Revised IPCC guidelines provide the methodological basis for the estimation of national GHG emissions inventories. Accompanying this text is the 2003 good practice guidance for land use, land-use change and forestry (LULUCF), which was compiled to help estimate LULUCF and associated emissions because the 1996 guidelines did not sufficiently cover this aspect. The 2006 guidelines report is the latest methodology report but is as yet unofficial within the UNFCCC.

Relevance

These resources are most relevant to GHG emissions monitoring in REDD+ (guideline 9). But they are also a relevant resource for monitoring impacts of REDD+ on biodiversity and ecosystem services, because some of the elements that need or could be monitored for GHGs, such as biomass and deadwood, can also be used as indicators for biodiversity and ecosystem services, thus creating synergies between carbon stock change monitoring and biodiversity monitoring.

[30] Sourcebook for monitoring GHG in REDD+ –

http://unfccc.int/files/methods_science/redd/methodologies/other/application/pdf/sourcebook_version_nov_2009_cop15-1.pdf

GOFC-GOLD (2009) *A sourcebook of methods and procedures for monitoring, measuring and reporting anthropogenic greenhouse gas emissions and removals caused by deforestation, gains and losses of carbon stocks in forest, remaining forests, and forestation* (Eds. Achard F., Brown S., DeFries R., Grassi G., Herold M., Mollicone D., Pandey D., Souza C.). GOFC-GOLD Report version COP15 (GOFC-GOLD Project Office, Natural Resources Canada, Alberta, Canada).

Overview

While the IPCC guidelines provide the compendium for national greenhouse gas inventories, this sourcebook is specific to REDD+. It is an initiative of the Global Observation of Forest and Land Cover Dynamics (GOFC-GOLD), a technical panel of the Global Terrestrial Observing System (GTOS). The sourcebook provides guidance on methodological issues in quantifying the greenhouse gas (GHG) emissions and removals caused by REDD+. The sourcebook is comprehensive and more accessible than the IPCC guidelines, and is complementary to the IPCC guidelines for Land Use, Land Use Change, and Forestry (LULUC), and is likely to be a key resource for monitoring changes in carbon stocks under REDD+.

Relevance

This sourcebook does not outline how to monitor the impacts of REDD+ on biodiversity and ecosystem services. However, some of the methods used and data collected for monitoring changes in carbon stock may be transferable to monitoring for biodiversity and ecosystem services. Monitoring changes in forest cover through remote sensing, for example, will help determine changes in carbon stocks, but it can also be used to determine certain changes in biodiversity and ecosystem services, such as changes in area of a particular habitat type. Therefore, this sourcebook is a relevant resource for monitoring the impacts of REDD+ on ecosystem services, and consideration of it can help generate synergies between carbon and biodiversity monitoring (guideline 9).

[31] Moving ahead with REDD: issues, options and implications –

<http://www.cifor.cgiar.org/nc/online-library/browse/view-publication/publication/2601.html>

Angelsen A. (Ed)(2008) *Moving ahead with REDD: issues, options and implications*. CIFOR, Bogor, Indonesia

Overview

This book, freely available online and published by the Centre for International Forestry Research (CIFOR), discusses a number of issues relating to monitoring for REDD+. Specifically, it discusses reference levels, monitoring deforestation and degradation, leakage and the impacts of REDD+ on people and the environment.

Relevance

This book provides good background material for monitoring for REDD+ in the broadest sense, with some methods (e.g. monitoring deforestation and degradation) being transferable to monitoring for biodiversity and ecosystem services (guideline 9).

Community-based monitoring and management

Information sources

[32] Realising REDD+: National strategy and policy options (Chapter 8) –

<http://www.cifor.cgiar.org/nc/online-library/browse/view-publication/publication/2871.html>

Angelsen, A. with Brockhaus, M., Kanninen, M., Sills, E., Sunderlin, W.D., Wertz-Kanounnikoff, S. (eds) 2009. *Realising REDD+: National strategy and policy options*. CIFOR, Bogor, Indonesia.

Overview

This book, available online and published by the Centre for International Forestry Research (CIFOR), discusses a number of issues relating to the implementation of REDD+. Chapter 8 is of particular relevance, as it focuses on community monitoring. It details how communities could carry out forest inventories to monitor changes in forest carbon stock, and discusses reliability and costs involved.

Relevance

This chapter is important because it outlines the potential role of communities in the implementation of REDD+, and therefore their potential role in also monitoring the impacts of REDD+ (guideline 11). It should be noted, however, that the chapter considers the role of community monitoring for carbon stock changes, as opposed to biodiversity and ecosystem services specifically.

[33] Monitoring matters network – <http://www.monitoringmatters.org/>

Overview

This website contains a wealth of information on monitoring natural resources, livelihoods and governance. The Monitoring Matters Network is a network of international researchers looking for innovative methods, which are often community-based, for monitoring the socio-environment. The website has an introductory page on monitoring, details (on-going) monitoring schemes and research initiatives (guideline 8), and includes a large number of useful publications, many of which are on community monitoring (guideline 11).

Relevance

These publications outline the reliability, costs and examples of successful community monitoring for both carbon and biodiversity. One of the publications (Danielsen et al. 2000) documents a simple system for monitoring biodiversity in a protected area that has been subsequently used in a REDD+ project in north-western Cambodia. This site is a very useful resource for information on community monitoring (guideline 11).

[34] Community-based natural resource management manual –

http://assets.wwf.no/downloads/cbnrm_manual.pdf

WWF (2006) *Community-based natural resource management manual*. Prepared by I Bond, A. Davis, C. Nott, K. Nott & G. Stuart-Hill. Wildlife management series. WWF-World Wide fund for Nature, Southern African Regional Office (SARPO), Harare, Zimbabwe.

Overview

The manual is intended to be an introduction to Community-Based Natural Resource Management (CBNRM) in Southern Africa. CBNRM is a type of natural resource management which is based on the principle that natural resources should be managed by the people who live alongside and depend on these resources. This manual lays out the basic issues surrounding natural resource management, provides some policy background (guideline 3), information on potential stakeholders and how to identify these (guideline 5), and key steps in the adaptive management cycle including monitoring and community monitoring (guideline 11). The manual draws on several case study examples across the region.

Relevance

Monitoring the impacts of REDD+ on biodiversity and ecosystem services is best undertaken in conjunction with management of these resources. The issues and principles of community management and monitoring laid out in this manual are transferable to a REDD+ community management framework. However, the focus on Southern Africa, does limit the scope to some degree.

[35] Developing Science-Based Tools for Participatory Watershed Management in Montane Mainland Southeast Asia – <http://www.worldagroforestrycentre.org/SEA/W-New/RF-2000-GI-086-ICRAF-Final-Report-STD.pdf>

Thomas, D.E.; Preechapanaya, P.; Saipothong, P. (2004) *Developing Science-Based Tools for Participatory Watershed Management in Montane Mainland Southeast Asia*. Final Report to the Rockefeller Foundation.

Overview

Watershed degradation is an important problem affecting livelihoods in developing countries. REDD+ has the potential to improve this problem by protecting and restoring watershed forests. This document is produced by one initiative amongst many that helps to develop tools for participatory watershed management. It describes monitoring methods and indicators that were developed for community-based watershed monitoring in montane mainland Southeast Asia.

Relevance

This resource shows how communities can easily monitor water quality and is therefore relevant to indicators of REDD+ impact (guideline 6) and community-based monitoring (guideline 11).

Annex

This table shows the guideline, the theme associated with the guideline, and resources which may be useful in implementing the guidelines.

Headings	Guideline No	Theme	Useful resources ID
A. Scoping	Guideline 1	REDD+ activities	[9] [24] [26]
	Guideline 2	Benefits and risks from REDD+	[1] [2] [3] [4] [6] [7] [8] [13] [24]
	Guideline 3	Policy commitments	[15] [18] [24] [26] [34]
	Guideline 4	Setting objectives	[1] [4] [10] [11] [12] [13] [14] [15] [18]
B. Designing	Guideline 5	Consulting stakeholders	[2] [3] [11] [12] [15] [34]
	Guideline 6	Choice of indicators	[1] [2] [3] [4] [5] [7] [8] [10] [11] [12] [13] [14] [15] [16] [17] [18] [19] [20] [21] [23] [25] [35]
	Guideline 7	Feasibility	[5] [11] [12] [14] [15] [17] [21] [22] [24] [25]
C. Implementing	Guideline 8	Using existing monitoring	[3] [5] [21] [22] [24] [25] [26] [33]
	Guideline 9	Using REDD+ monitoring	[5] [26] [27] [29] [30] [31]
	Guideline 10	Using remote sensing	[3] [5] [7] [17] [26] [27] [28]
	Guideline 11	Using community monitoring	[26] [32] [33] [34] [35]
	Guideline 12	Communicating	[3] [15]