UN-REDD
PROGRAMME

Role of satellite remote sensing in REDD

by Peter Holmgren
UN-REDD PROGRAMME
13 october 2008

Food and Agriculture Organization of the United Nations
United Nations Development Programme
United Nations Environment Programme

UN-REDD Programme
MRV Working Paper 1
2008

The UN-REDD Programme, implemented by FAO, UNDP and UNEP, has two components: (i) assisting developing countries prepare and implement national REDD strategies and mechanisms; (ii) supporting the development of normative solutions and standardized approaches based on sound science for a REDD instrument linked with the UNFCCC. The programme helps empower countries to manage their REDD processes and will facilitate access to financial and technical assistance tailored to the specific needs of the countries.

The application of UNDP, UNEP and FAO rights-based and participatory approaches will also help ensure the rights of indigenous and forest-dwelling people are protected and the active involvement of local communities and relevant stakeholders and institutions in the design and implementation of REDD plans.

The programme is implemented through the UN Joint Programmes modalities, enabling rapid initiation of programme implementation and channeling of funds for REDD efforts, building on the in-country presence of UN agencies as a crucial support structure for countries. The UN-REDD Programme encourage coordinated and collaborative UN support to countries, thus maximizing efficiencies and effectiveness of the organizations' collective input, consistent with the "One UN" approach advocated by UN members.

UN-REDD Programme contacts:

Peter Holmgren
Environment, Climate Change and Bioenergy Division
Food and Agriculture Organization of the United Nations (FAO)
peter.holmgren@fao.org

Tim Clairs
Bureau for Development Policy, Environment Group
United Nations Development Programme (UNDP)
tim.clairs@undp.org

Tim Kasten
Division of Environmental Policy Implementation
United Nations Environment Programme (UNEP)
tim.kasten@unep.org

Website: www.undp.org/mdtf/un-redd www.unredd.net

Disclaimer

The UN-REDD Programme MRV Working Paper Series is designed to reflect the activities and progress related to the Programme. These MRV Working Papers are not authoritative information sources – they do not reflect the official position of FAO, UNDP or UNEP and should not be used for official purposes.
The MRV Working Paper Series provides an important forum for the rapid release of information related to the UN-REDD Programme. Should readers find any errors in the documents or would like to provide comments for improving their quality, they are encouraged to get in touch with one of the above contacts.

Summary

The paper addresses the role of satellite remote sensing technologies as a tool for monitoring, assessment, reporting and verification of carbon credits and co-benefits under an eventual REDD mechanism. The paper identifies five issues and suggests immediate actions to build confidence and capacities during the preparatory phase of REDD.

Identified issues:

1. Define the role of satellite remote sensing
2. Clarify technical opportunities and limitations
3. Secure adequate and relevant data supply
4. Enhance technical and institutional capacities
5. Be flexible as REDD requirements are not known

The UN-REDD Programme is committed to support developing countries in preparing for a REDD mechanism. Action items proposed in this paper will be addressed by the Programme, however the issues at hand also call for actions and collaboration involving a much wider set of government and non-government stakeholders.

Context

Reduced deforestation and forest degradation (REDD) may play a significant role in climate change mitigation and adaptation, can yield significant sustainable development benefits, and may generate a new financing stream for sustainable forest management in developing countries. If cost-efficient carbon benefits can be achieved through REDD, increases in atmospheric CO2 concentrations could be slowed, effectively buying much needed time for countries to move to lower emissions technologies. Support for efforts to reduce emissions from deforestation and forest degradation has been expressed at the highest political levels (G8, UN General Assembly) and has been included in the Bali Action Plan of the United Nations Framework Convention on Climate Change (UNFCCC).

The Bali Action Plan, adopted by UNFCCC at the thirteenth session of its Conference of the Parties (COP-13) held in Bali in December 2007, mandates Parties to negotiate a post 2012 instrument, including possible financial incentives for forest-based climate change mitigation actions in developing countries. COP-13 also adopted a decision on “Reducing emissions from deforestation in developing countries: approaches to stimulate action”. This decision encourages Parties to explore a range of actions, identify options and undertake efforts to address the drivers of deforestation and forest degradation. It also encourages all Parties in a position to do so, to support capacity-building, provide technical assistance, facilitate the transfer of technology and address the institutional needs of developing countries to estimate and reduce emissions from deforestation and degradation. Furthermore, it lays out a process

under the Subsidiary Body for Scientific and Technological Affairs (SBSTA) to address the methodological issues related to REDD emissions reporting.

Against this backdrop it is obvious that functional monitoring and verification systems are a fundamental requirement in an eventual agreement between the parties and between stakeholders in the implementation of such a mechanism. While national forest monitoring has a long science and implementation history, this is the first occasion when the international community may set compliance standards for national forest monitoring in developing countries. Depending on the construction of the eventual agreement, implications on monitoring and verification systems will be quite different. At this point in time, one challenge is to identify issues for monitoring and verification across a range of possible REDD constructions, so as to inform the negotiation process and promote REDD readiness at country level.

It is likely that a REDD mechanism would draw on established IPCC guidance for national reporting on greenhouse gas emissions and land use change. Decision 2/CP.13 also encourages Parties to apply the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry. The IPCC guidance provides advice on estimation methods at three levels of confidence (tiers 1 to 3). This indicates that monitoring and verification systems can vary in quality, and also that the performance of these systems could be upgraded over time.

Satellite remote sensing technologies are currently widely tested and suggested as a tool in REDD monitoring, assessment and verification. Along with scientific programmes and field tests, there is also a debate as to the overall feasibility and cost-benefit ratio of remote sensing approaches, depending on the wide range of ecosystem and land use conditions as well as the range of approaches to carbon credit accounting.

This Issues paper draws from findings of the workshop on monitoring, assessment and verification organized by the UN-REDD Programme in Washington DC 16-17 September 2008 to:

- Emphasize the needs for satellite remote sensing in a REDD mechanism;
- Highlight areas of satellite remote sensing opportunities, limitations and knowledge gaps in relation to REDD monitoring, assessment, reporting and verification;
- Propose immediate actions to enhance the contribution and benefits of satellite remote sensing for REDD, including to generate knowledge and experience for the UNFCCC negotiations process.

The UN-REDD Programme will, during it pilot phase through 2009 and beyond, work actively to address the issues raised in this paper and to support developing countries in establishing robust and cost-efficient monitoring systems.

The paper also aims to stimulate actions by organizations, countries and other stakeholders, as well as wide collaboration, to address these issues. The task to build confidence, capacity and operations for monitoring of forest resources and land use has perhaps never been more challenging.

ISSUE 1: Define the role of satellite remote sensing

Robust, transparent, replicable and long-term monitoring systems are needed for REDD. Satellite remote sensing technology is expected to play a significant role depending on the specific requirements. This role, as part of a broader monitoring, assessment, reporting and verification context, needs to be better articulated, understood and agreed.

Key Considerations

- REDD monitoring requirements will be defined at national/strategic levels for overall accounting and policy interventions, as well as at local/operational levels for verification and implementation of payment schemes. The needs and solutions will be different across these scales and purposes;
- Buyers of reduced emissions - whether operating in compliance or voluntary environments - seek assurances that accounting is accurate & precise and can be verified as close to real-time as possible. The strength of these assurances will influence the volume of the market, as well as the price that buyers (whether in a market or non-market scenario) are going to be willing to pay.
- REDD monitoring needs to include aspects beyond carbon accounting and reporting *per se*. Achieving reduced emissions will require careful design and implementation of policies and regulations. These will depend on reliable information, including from monitoring of the environment, land use and livelihoods (i.e. including co-benefits and drivers of deforestation/forest degradation). There are also considerable potential for synergies with monitoring needs outside the REDD context;
- Expected/chosen accuracy and precision in carbon reporting, as defined by IPCC guidelines – especially the conservativeness principle – are key parameters when designing appropriate monitoring systems. Periodicities of carbon reporting and accounting will also be a critical factor;
- Combining data sources is necessary, i.e field measurements and observations, varieties of satellite remote sensing data, and airborne remote sensing data;
- Replicability, long-term stability, cost-efficiency and accepting gradual improvement over time are key overarching principles for investments in REDD monitoring, assessment, verification and reporting.

Proposed Immediate Actions

- Review comprehensively the experiences (success stories, constraints and limitations) of operational use of satellite remote sensing in national and sub-national policy and planning processes for forestry and natural resources management to support the REDD developments.
- Convene cross-cutting dialogue between leaders in policy and planning for rural development, environmental and socio-economic monitoring, natural resources

management and economics, and remote sensing to analyse and define how satellite remote sensing can, seen from a policy and decision-making perspective, contribute to the information requirements in a REDD process.

ISSUE 2: Clarify technical opportunities and limitations

Progress in remote sensing science and operations need to be better clarified and linked to opportunities, applicability and limitations for establishing robust national monitoring systems. It is important to provide REDD stakeholders with clear and widely agreed knowledge on the performance of satellite remote sensing for investment decisions related to monitoring.

Key Considerations

- Satellite remote sensing is an essential data source providing regular data that contribute to estimations of state and trends, including historical trends, of land use / land cover and carbon density in the landscape.
- Science provides increasing insight and evidence of the potential of remote sensing for REDD monitoring. Bringing these results to serve robust and long-term monitoring at the national level is critical. This includes clarifying applicability of case studies over larger expanses and varying circumstances, issues of up-scaling methodologies for operational use, and the applicability of findings across different data sources, satellite systems and over the long term. It also includes feeding back experiences of operational monitoring systems to science.
- Inherent limitations in information content of available satellite remote sensing data (across resolutions and data types) in relation to monitoring of ecosystem carbon pools and land use change should be better documented. It is particularly important to clarify performance across ranges of biomes, vegetation cover, topography/ land forms, seasons, and land use patterns that occur across developing countries.
- The frequency of potential observations/measurements, theoretically and in reality, from satellite remote sensing systems should be better clarified, including possible complementarities with airborne remote sensing technologies;
- Basic approaches to monitoring for REDD are still being debated, including full-cover vs. sampling approaches, possible gains from stratification, focussing on hot-spots, and the balance between remote sensing and representative field sampling. Design considerations need to be clarified, including documentation of areas where consensus is difficult to reach;
- In monitoring applications, including scientific studies, satellite remote sensing data are combined with field sampling and other data sources. Models of varying complexities are used for estimating e.g. trends in carbon pools. Robust models that combine data sources need to be developed for the wide range of operational monitoring situations expected under REDD. This includes considering manual or more automated methods for remote sensing estimations;

Proposed Immediate Actions

- Commission in-depth review of the technical performance, including availability and compatibility, of satellite remote sensing for REDD monitoring;
- Needs analyses for the use of remote sensing in operational monitoring in REDD countries, and mobilizing international expertise to fill methodological gaps

ISSUE 3: Secure adequate and relevant data supply

Using remote sensing in operational national monitoring systems for REDD defines new requirements for reliable and efficient remote sensing data supply over the long term. An improved infrastructure for data supply to countries and other stakeholders is needed. This includes arrangements with data suppliers; established data standards, storage, processing and delivery; and clarified roles of inter-governmental organizations as well as government agencies and private sector.

Key Considerations

- Despite efforts and investments by governments and space agencies, the access to comprehensive and recent satellite remote sensing data is still cumbersome and expensive to many users in developing countries. Successful REDD monitoring systems depend on a well functioning data supply infrastructure, including minimizing the direct cost of obtaining and pre-processing data – in particular for developing country governments;
- Data need, in most cases, to be pre-processed internationally by leading institutions to prepare for low thresholds, low overall costs and immediate use of data in national monitoring systems. This may include appropriate and standardized geometric and radiometric adjustments, as well as preliminary automated classifications of land cover / land use and changes over time;
- The data supply infrastructure should include the variety of satellite systems that are recording data, and should be open for inclusion of future data sources;
- Long-term commitments and arrangements with data suppliers and sponsors should be established or enhanced;
- Standards for data processing and storage, as well as distribution over internet, need to be established or enhanced;
- Inter-governmental organizations, in particular the UN system, have a key role in operationalizing a data supply infrastructure. The experience of weather-related satellite data and the role of WMO in providing the infrastructure is an important and successful example.

Proposed Immediate Actions

- Establish collaborative programme, through existing inter-governmental organizations (e.g. FAO) for developing and maintaining, a remote sensing data supply infrastructure that supports REDD monitoring;
- Engage data suppliers in long-term arrangements for providing pre-processed data; engage governments to invest in low cost or free access to the data.
- Dialogue within and between countries on data supply specifications and functionality.

ISSUE 4: Enhance Technical and Institutional capacities

Technical and institutional capacities to develop and implement monitoring systems, including the use of satellite remote sensing technology is insufficient in many countries.

Key Considerations

- Countries are different. Their size, economic and socio-cultural situations, environmental conditions, development priorities, REDD ambitions and institutional capacities, will determine needs for capacity building. However different, it is generally true that REDD countries request support to enhance technical and institutional capacities for REDD monitoring, assessment, reporting and verification;
- Several countries have national monitoring systems in place, which provide an important basis for REDD monitoring efforts, meeting specific requirements of an eventual REDD mechanism;
- Capacity and resources are limited – there is a need for prioritising the most essential aspects at the beginning and gradually build capacities and strengthen implementation of monitoring systems;
- Full national ownership of REDD monitoring systems is crucial. This includes involvement of stakeholder groups, the buy-in from local levels and engaging science and research;
- International, regional and south-south collaboration is essential for capacity enhancement and for developing a critical mass of competence;
- There must be expressed political commitment and motivation at the highest level to invest in national monitoring systems. Many examples exist where national monitoring efforts have been implemented without such political support – experience shows that the efforts could not be sustained.

Proposed Immediate Actions

- Needs assessments to determine country-specific requirements;

- Training in remote sensing technologies and monitoring, assessment, reporting and verification for REDD;
- Regional meetings and dialogue;
- Establishment of national stakeholder processes for monitoring, assessment, reporting and verification.

ISSUE 5: Be flexible as REDD requirements are not known

Preparations for a REDD mechanism are moving ahead in several countries. Current investments in monitoring systems should consider that the details and parameters of an eventual mechanism are not known. Flexibility and ability to adapt monitoring, assessment, reporting and verification are necessary.

Key Considerations

- Basic credit accounting parameters for REDD are not known, e.g. how forest degradation is to be incorporated.
- The economic potential for REDD credits is not known. Nor are possible premiums arising from higher quality/accuracy in accounting, which in turn will determine appropriate levels of investments in monitoring systems;
- Technological and methodological options should be kept open with respect to accuracy, precision, periodicity and other aspects that will determine the level of investment required;
- Within-country implementation of REDD may lead to, yet unknown, requirements for monitoring and reporting at local levels. Preparations for REDD should take these optional requirements into account;
- The place of co-benefits within the REDD mechanism, and the monitoring needs that may be associated with them, is not known.

Proposed Immediate Actions

- REDD readiness country programmes to take a flexible approach to designing monitoring systems, while acknowledging the need for proper testing and capacity building in the preparatory phase;
- REDD readiness country programmes to facilitate a dialogue on internal monitoring and verification requirements for REDD implementation.

MRV Working Paper series

WP Nr.	Title	Date
01	*Role of satellite remote sensing in REDD by Peter Holmgren*	13 October 2008