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## Assessing capacities of non-Annex I countries for national forest monitoring in the context of REDD+

Erika Romijn<sup>a,\*</sup>, Martin Herold<sup>a</sup>, Lammert Kooistra<sup>a</sup>, Daniel Murdiyarto<sup>b</sup>, Louis Verchot<sup>b</sup>

<sup>a</sup>Laboratory of Geo-Information Science and Remote Sensing, Wageningen University, P.O. Box 47, 6700 AA Wageningen, The Netherlands

<sup>b</sup>Center for International Forestry Research, Jl. CIFOR, Situgede, Bogor 16115, Indonesia

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### ABSTRACT

Countries participating in REDD+ need to prepare to report on their forest carbon stocks changes. Remote sensing and forest inventories are key tools and data sources for monitoring but the capacities within non-Annex I countries needed for reporting to the UN Framework Convention on Climate Change (UNFCCC) vary considerably. The purpose of this study was to assess the status and development of national monitoring capacities between 2005 and 2010 in tropical non-Annex I countries. Different global data sources were integrated for the comparative analysis of 99 countries. Indicators were derived for four main categories: national engagement in the REDD+ process, existing monitoring capacities, challenges with respect to REDD+ monitoring under particular national circumstances and technical challenges for the use of remote sensing. Very large capacity gaps were observed in forty nine countries, mostly in Africa, while only four countries had a very small capacity gap. These four countries show a net increase in forest area with 2513 ha × 1000 ha, while all other countries together have a forest loss of 8299 ha × 1000 ha in total. Modest improvements were observed over the last five years, especially with regard to carbon pool reporting. Based on the different circumstances and current capacities of each country, general recommendations are made for the design and planning of a national REDD+ forest monitoring system and for capacity development investments. The four countries with good capacities for both monitoring of forest area change and for performing regular forest inventories could have an important role in South-South capacity development.

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### 1. Introduction

At the 16th session of the Conference of Parties to the United Nations Framework Convention on Climate Change (UNFCCC COP16), held in Cancún in December 2010, agreements were made to confront climate change including a decision on 'Policy approaches and positive incentives on issues relating to reducing emissions from deforestation and forest degradation in developing countries; and the role of conservation, sustainable management of forest and enhancement of forest carbon stocks in

developing countries', also known as REDD+. The agreement states that Parties should collectively aim to slow, halt and reverse forest cover and carbon loss, thereby addressing the five above mentioned activities of REDD+. To achieve these goals, countries are requested to develop a national strategy or action plan and to determine a national forest reference emission level. For monitoring, reporting and verification (MRV) of REDD+ activities countries need to set up a robust and transparent national forest monitoring system which is appropriate for their national circumstances (UNFCCC, 2010). In this paper we further use the term non-Annex I

\* Corresponding author. Tel.: +31 317 481 904; fax: +31 317 419 000.

E-mail addresses: [erika.romijn@wur.nl](mailto:erika.romijn@wur.nl), [erika.romijn@gmail.com](mailto:erika.romijn@gmail.com) (E. Romijn).  
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countries, as recognized by the UNFCCC, to indicate developing countries.

Methodological approaches for REDD+ monitoring were outlined at the COP15 in December 2009 (Decision 4/CP.15) and emphasized that the national monitoring system should use a combination of remote sensing and ground based forest carbon inventory approaches for measuring forest area changes and forest carbon stocks and changes (UNFCCC, 2009a). Furthermore, countries may adopt a step-wise approach to implement REDD in three phases. Phase I involves development of national strategies or action plans, policies and measures, and capacity-building. For Phase II countries have to demonstrate that through their monitoring system their demonstration activities are result based, while for Phase III countries are requested to address all requirements of MRV as stated in Decision 1/CP.16 (UNFCCC, 2010). MRV of greenhouse gas (GHG) emissions should be done in accordance with requirements from the Intergovernmental Panel on Climate Change (IPCC) guidance and guidelines and the five reporting principles of consistency, comparability, transparency, accuracy and completeness (UNFCCC, 2009b). According to the IPCC (2006) guidelines estimations of changes in carbon stocks need to be reported for five carbon pools in forests: above-ground biomass, belowground biomass, dead wood, litter, and soil organic matter (IPCC, 2006).

A common approach for calculating carbon emissions is as follows (Maniatis and Mollicone, 2010; IPCC, 2006):

$$\text{Emissions} = \text{AD} \times \text{EF} \quad (1)$$

AD means activity data, which refers to the area of forest change (in hectare), e.g., forest converted to grassland or forest converted to cropland, etc. and EF means emission factor which relates to the carbon stock change estimations per unit of activity (in carbon per hectare).

The IPCC provides three Tiers for reporting with different level of detail and accuracy. For Tier 1 emission factors are based on global default values, for Tier 2 on country specific data and for Tier 3 more detailed methods, including process-based models are used for carbon stock change estimation and reporting (IPCC, 2003, 2006). The IPCC recommends using higher Tiers for the measurement of significant sources and sinks. For this Tier 2 or 3 methods would provide the desired level of accuracy for important components of the GHG inventory. However, higher Tier methods require more data and are more expensive, because they involve monitoring of local variables (Streck et al., 2008). For less important carbon pools, the Tier 1 approach using default values for carbon estimates will be sufficient (GOC-GOLD, 2010).

When the idea of REDD+ became formal as stipulated in the Bali Action Plan (UNFCCC, 2008b), governments started to elaborate their national strategies. A challenge is to develop and implement efficient approaches to monitor forest area and carbon stock changes, which is in accordance with the IPCC GPG and guidelines for national GHG inventories (Corbera and Schroeder, 2011; DeFries et al., 2007). The main difficulty is to develop carbon emission estimates for all five activities of REDD+ (deforestation, forest degradation, conservation, sustainable management of forest and enhancement of forest

carbon stocks) in such a way, that the estimates comply with the land use categories as determined by the IPCC. To do so, Maniatis and Mollicone (2010) proposed a stratification of forest land into managed and un-managed land and a further subdivision into forest management practices and forest types to operationalize and implement national forest inventories for REDD+. Another approach of regrouping the five activities of REDD+ under the land use categories used by the IPCC GPG to set up systems for MRV for REDD+ is proposed by Herold and Skutch (2011). Satellite remote sensing is seen as a key tool for measuring and monitoring deforestation, because it is the only practical means to cover the large area of forest for national level monitoring in developing countries (DeFries et al., 2007; Böttcher et al., 2009; Goetz et al., 2009). Since an agreement on REDD+ has been reached, there is the need to develop recommendations for non-Annex I countries and to help the international community in setting investment priorities for implementing national forest monitoring systems for MRV of GHG emissions (FAO, 2011).

Developed countries are encouraged to help strengthen the capacities of non-Annex I countries for estimating their emissions (UNFCCC, 2009a). Most non-Annex I countries have limited experience in implementing national forest monitoring systems and the particularities of the REDD+ mechanism create additional requirements that are beyond the experience of national forest services. Capacity is lacking at technical, political and institutional levels to provide a complete and accurate estimation of forest area change and to attribute GHG emissions to these changes (Forest Carbon Partnership Facility, 2008, 2010). This shortage in capacity can be due to a number of factors including: limited engagement in the UNFCCC REDD process, lack of experience in application of the IPCC guidelines, shortage or lack of access to available useful data and limited estimation and reporting of national inventories (Hardcastle et al., 2008; Herold, 2009; Wertz-Kanounnikoff et al., 2008). Therefore, capacity building is a key necessity for non-Annex I countries to participate in the REDD+ mechanism, but the nature of the capacity building need is country specific since the types and size of the existing capacity gaps vary as do the REDD+ implementation priorities. To efficiently allocate resources to these activities, it is essential to investigate where and to what extent capacity building is needed and how the needs vary regionally.

This paper presents the current status and recent changes in non-Annex I countries' capacities for monitoring forest area change and carbon stock change with respect to MRV for REDD+, in accordance with REDD+ implementation Phase III. While all REDD+ countries start with Phase I based on their current (varying) monitoring capacities, it is assumed that the MRV system will be fully operational for Phase III. We perform a global comparative assessment of forest monitoring capacities and challenges given REDD+ monitoring requirements for 99 tropical non-Annex I countries by integrating different global data sources. Furthermore, we assess the recent changes in capacities for monitoring forest area and carbon stock changes based on FAO/FRA country reports from 2005 to 2010. Special emphasis is on remote sensing capacities that are required for regular monitoring of activity data.

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