# METHODOLOGIES OF TROPICAL FOREST CARBON MONITORING: DEVELOPMENT AND THE STATE-OF-THE-ART FOR REDD+

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REDD+ is the first challenge of human being to mitigate the trend of deforestation and forest degradation (DD) in a global scale. In this context of mitigating DD, the role of forestry has greatly changed. In the far past, forestry mainly worked for how to harvest forest products efficiently. Afterwards forestry was required to work for enhancing other forest functions also in particular environmental conservation, and very recently, mitigation of the climate change effects. Linking forestry to other sectors in particular agriculture, grazing, and mining should be considered among the sectors to establish forest land as an indispensable element of land use. Foresters are also required of contribution to realizing the balanced land use in economies and in resource conservation.

Contents of my speech will be "How human being changes the tropical forest?", "Methods for estimating forest carbon stock" including choices and a case study of estimating nationwide forest carbon stock in Cambodia, and "Requirements for the methods used in REDD+".

1. The balance of nature (incl. art) is a key to the REDD+. REDD+ does not only conserve forest, but also replace people's land-use systems with different systems to make GHG emission reduction/removals.

*Considering requirements for carbon monitoring methods for REDD+,*

2. $CO_2$ emissions from biomass are important in the dry land forest, while in the peat swamp forest, $CO_2$ emissions from drained soil organic matter are important. Estimates of such emissions with large emission potential are indispensable to reduce overall uncertainty of estimates effectively.

3. A practical method for estimating $CO_2$ emissions from DD is the calculation of total carbon stock change by monitoring forest land and periodically summing the forest area and its carbon stock per land area for important forest types.

4. For monitoring forest area, spaceborne optical and microwave (PALSAR) sensors are partly or partially available. In case both approaches are not appropriate, airbone media are considered to be an only alternative.

5. For monitoring carbon stock per land area, airborne media and/or ground-based measurement are the practical approaches. 6. As a feasibility study, we estimated the nationwide forest tree

biomass carbon stock and required number of sample plots in Cambodia. By repeating this calculation, we can monitor the (historical) trend of forest carbon stock on a national scale and such data are useful to make generic reference (emission) level.

6. More varied field data must be collected for improving methods.

*A "Cookbook - How to measure and monitor forest carbon" compiles our latest knowledge in forest carbon measurement and is under preparation by FFPRI.*