

## Abstract

Nugroho, M., 2006. *Integration of Multi Remotely Sensed Data and Geodatabases for Forestry Management in Indonesia*. Ph.D thesis, Wageningen University, The Netherlands.

A high rate of deforestation is the major problem in Indonesian forests. The 1997 economic crisis has triggered decentralisation of forest management. This new situation caused additional problems. The rate of deforestation increased because of inattentive forestland conversion, forest fires caused by the strong 1997/1998 ENSO event, and illegal logging activities. Multi-stakeholders, ranging from the forest management unit level, the district level, the provincial level, to the national level, require up-to-date forestry information, especially on the annual state of forest cover. The MoF and Wageningen University has installed a SPOT-Vegetation medium resolution system in the WebGIS for limited users or multi-stakeholders to provide three monthly information of Indonesian forest cover. New methodologies for multi-resolution and multi-temporal optical and synthetic aperture radar (SAR) data have been investigated to comply with information requirements from multi-stakeholders at various management levels. Three major forest monitoring systems are introduced. The first is the National Forest Observation System, which uses medium resolution SPOT-Vegetation data to monitor large Indonesian tropical forest areas and to provide annual information on the state of Indonesian forests. An intact forest concept is introduced and applied in the algorithm for forest cover analyses using SPOT-Vegetation data. The second system uses multi-temporal high-resolution optical and synthetic aperture radar (SAR) data to perform regular forest monitoring activities and to minimise the cloud cover problems. This second system introduces new object segmentation methodologies for fusing and processing all high-resolution remotely sensed data types (i.e. panchromatic, multi-spectral, and SAR). Combining all high-resolution data can track forest changes through time. The third system is intended to investigate the very-high resolution optical and interferometric SAR (InSAR) data for individual tree mapping and tree grouping. Ikonos data can identify an individual tree based on the sun-spot and the tree-crown shadow point feature concept using the object segmentation methodology. The use of InSAR data can provide 3D-tree mapping and tree grouping conditions in order to assess the forest-tree qualities. Forest conditions can be assessed by the degree of tree-clumping. These three systems are integrated into an Executive Spatial Information System (ESIS). Requirements of ESIS resulted from the investigation of the forestry Management Information System (MIS) of Indonesian Ministry of Forestry (MoF). A user friendly interface for ESIS in WebGIS format has been presented to MoF. This WebGIS can assist MoF and other multi-stakeholders to achieve sustainable forest management at the forest management unit level, the district level and the provincial and national levels.

*Keywords:* optical, synthetic aperture radar, interferometric, multi-temporal, multi-resolution, multi-sensor, object-segmentation, geographic information system, tropical forest.