IDENTIFICATION OF HIGH CONSERVATION VALUE FOREST (HCVF) IN NATURAL PRODUCTION FOREST TO SUPPORT IMPLEMENTATION OF SFM CERTIFICATION IN INDONESIA USING REMOTE SENSING AND GIS

Y. B. Sulistioadi Y. A. Hussin A. Sharifi

Department of Natural Resources, The International Institute for Geoinformation Science and Earth Observation (ITC), Hengelosstraat 99, 7500 AA, Enschede, Netherlands, Fax: (31)53-4874-388, Sulistioadi@itc.nl, Hussin@itc.nl, Alisharifi@itc.nl

PS WG VII/2:

KEY WORDS: Forest Certification, HCVF, Tropical Forests, Indonesia, Remote Sensing, GIS

ABSTRACT:

Indonesian forests are in critical situation. Very high rate of forest degradation resulted from unsustainable forest management, rampant illegal logging, forest area encroachment, conversion and natural disaster, *i.e.* fire, all together urges rapid improvement of management system of Indonesia's forest resources. Forest certification is one tool that can support the achievement of sustainable forest management goal. Under current operation of Joint Certification Protocol between FSC and LEI in Indonesia, forest management units must be able to show the required (process and) performance indicated in LEI Criteria and Indicators as well as FSC Principles and Criteria to attain certification of their products. Nevertheless, the gap between current practices and performance required by forest certification schemes is still enormous. The management of High Conservation Value Forest is one of FSC principles for sustainable forest management. However, some difficulties were found when forest management unit tries to identify the HCVF, since the definition, terms and available guideline for HCVF identification are necessarily generic and global. Therefore, this study tries to implement a detailed method for identification of High Conservation Value Forest (HCVF) in a natural production forest using remote sensing and GIS.

1. INTRODUCTION

Indonesia is in the third rank of countries with largest tropical rain forest area in the world, after Brazil and Congo. Varies from mangrove, swamp and riparian forest to hilly dipterocarp forest, Indonesia's forest serves as host for unique composition of biodiversity. As the direct effect from over utilization of forest resources, fire disaster and forest area conversion, Indonesia is now facing very high rate of deforestation.

Considering the high rate of environmental damage as well as social impact caused by large-scale commercial forest utilization, the paradigm of forest management had been shifted from sustainable yield oriented to sustainable resources oriented. In simple words, forest management operations should be able to maintain the condition and function of forest as it is, moreover, forest should be maintained so that its social functions kept intact. In spite of that restriction, forest management should also be able to produce sustainable timber products to gain sufficient economic benefits. These three aspects, *i.e.* environmentally sound, socially accepted and economically feasible; then establish the pillars of Sustainable Forest Management.

As committed in Agenda 21 in UN Conference on Environment and Development (UN-CED) Summit in Rio de Janeiro 1992, a number of international and regional initiatives has been started to develop a set of standard to be complied by forest management operations. From this point then the issue of forest certification emerged, while some certification scheme also established in international and national level. The idea behind forest certification is that consumers, with concern to deforestation and forest degradation, will prefer to buy timber products from well-managed forests.

FSC (Forest Stewardship Council) is a council established by a group of timber users, traders, and representatives of NGOs and formally launched at October 1993. One year after its assembly, FSC released a definitive set of Principles and Criteria, which will be used for assessment of sustainable forest management operations.

One FSC principle is the management of High Conservation Value Forest (HCVF). This is relatively new principle, which has been developed to replace the previously used concept of old growth or virgin forest. Therefore, the identified HCVF has large consequences for management options and should be taken into consideration in establishment of forest management plan. Further, meeting the conservation requirements of FSC certification scheme requires full integration of HCVF and conservation strategies into overall management plans and field operations.

Since HCVF is a spatial phenomenon, spatial information is very useful to support the process of HCVF identification. The use of remote sensing and GIS to support this field of study is definitely potential. Since the initial step in the identification of different landscapes and forest types occur in the study area, and at the later stage, the resulted landscape and forest type map can be analysed with the existing spatial data to assess the spatial distribution, status and threats to identified HCVF. At the end, the forest management unit shall establish a spatial conservation strategy according to findings in HCVF identification and later on integrate it with existing forest management plan. Application of several image classification methods to obtain landscape and forest type map and spatial analysis in determination of the spatial distribution, status and threats of identified HCVF are some of potential techniques to support the identification of HCVF.

Overall objective of this research is to identify the presence of High Conservation Value Forest (HCVF) in Natural Production Forest, using optical satellite data, different image classification techniques and spatial analysis, to support Sustainable Forest Management Certification process.

2. STUDY AREA

Forest area managed by PT Hutansanggam Labanan Lestari (previously PT Inhutani I Labanan) is situated in the Berau District, part of East Kalimantan Province in Indonesia. Previous management of PT Hutansanggam Labanan Lestari, which is PT Inhutani I, also manages some other sites surrounding. Geographically, the forest management unit lies between 1˚ 45' to 2˚ 10' N, and 116˚ 55 and 117˚ 20' E (Figure 7 in page 19). The land use status of PT Hutansanggam Labanan Lestari is presented in table 1 (Smartwood 2001)

Being managed by PT Inhutani I since 1976, most of the natural forest in Labanan area has been logged. Logging activities have been done under Indonesian selective cutting and planting system (TPTI). According to TPTI system, the forest management unit can only harvest commercial timber species with diameter (DBH) ≥ 50 cm in the production forest. Logging intensity in this site ranges from 42-173 m^3/ha (Fauzi 2001). The annual allowable cut for PT Inhutani I is approximately 50000 m^3 per year within a rotational logging block of approximately 1500 ha. However, the company is implementing conservative logging regime, resulting in the average timber harvest rate as low as 31208 m^3 per year (Smartwood 2001). Threats to the forest management unit are illegal logging and conversion of forest to agriculture as implication of area opening by the forest management unit. Up to now, there are two villages inside the Labanan concession boundary; both are under spontaneous resettlement promoted by the government. The forest areas are increasingly converted to agriculture field (Fauzi 2001). Labanan forest is managed under adaptive collaborative management (ACM). PT Inhutani I, local cooperatives, district government and provincial government are the shareholders. However, PT Inhutani I is responsible for all technical aspects related to forest management operations (Wastono 2003).

The title should appear centered in bold capital letters without underlining, near the top of the first page of the paper. The font type Times New Roman with a size of twelve (12) points is to be used. Use more than one line if you wish, but always use single-spacing. After one blank line, type the author(s) name(s), affiliation and mailing address (including e-mail) in upper and lower case letters centered under the title. In the case of multi-authorship, group them by firm or organization as shown in the title of these Guidelines.

3. METHOD

3.1 Preliminary Assessment of High Conservation Value Forest (HCVF)

Assessment of High Conservation Value Forest comprises preliminary assessment and full assessment. Preliminary assessment emphasis on the *identification* of (*spatial*) occurrence of forest containing High Conservation Values (HCV). This process involves analysis of spatial information. Full assessment refers to *verification the identified HCV*. However, the full assessment is beyond the scope of this study, since it requires the preliminary assessment of HCVF to be done first. Because of the limitation of this study, only HCV elements related to soil and water conservation are assessed. Information requirements and output maps representing these elements are described in Table 1.

3.2 Identifying Forest Areas Function as Unique Sources of Drinking Water

Some of the regulatory functions of forest, related to water conservation, are absorption, storage and release of water, which are extremely important. In situation that a particular forest area protects and maintains water supplies for people or communities, without any other alternative sources of drinking water (*i.e.* unique), then the forest areas are critical and should be considered as High Conservation Value Forest, as presented in Figure 1. The sources of drinking water means also water for other essential daily needs. However, an exception should be made when the communities have access to a ready replacement source of water that not influenced directly by the existence of forest area within the forest management unit (*e.g.* supplied by local drinking water company that use other source of water intake, that can fulfil communities' needs in reliable way and at an acceptable cost).

3.3 dentifying Forest Areas as part of Critical Major Catchments

If a forest area comprises large proportion of a catchment, then it has critical role in maintaining water quality and quantity. According to the similar HCVF study, forest area comprises 38% of a critical catchments was defined as HCVF. As the importance of the catchment increased, in terms of flooding or drought risk or water usage, the services provided by the forest become more critical. According to the HCVF guideline, all forest areas lies within super-priority catchment and priority catchment areas (*i.e.* in Indonesia's case are catchment priority I and II) should be considered as High Conservation Value Forest. In case of Indonesia, major catchment prioritisation was done by Ministry of Forestry of Indonesia, in particular by Directorate General of Reforestation and Land Rehabilitation. The decision scheme in identifying the presence of HCV element 4.2 is described in the flowchart in Figure 2. Spatially and operationally, vector editing and table operation functions were extensively used to select water catchment partitions that fulfil the criteria to be assigned as areas containing HCV elements 4.1 and 4.2. The spatial analysis done to determine the presence of HCV elements 4.1 and 4.2 are described in Figure 3.

3.4 Identifying Forest Areas Critical to Erosion Control

Dominant soil in the tropical rain forests in Indonesia is the red-yellow *podzolic (Acrisols)*, which is highly vulnerable to erosion. Exposed tropical soils degrade quickly due to leaching of nutrients, burning of humus, laterisation of minerals and accelerated erosion of top soil. Forest areas, which are important in maintaining terrain stability (*i.e.* to control excessive erosion, which can lead to landslides and serious siltation), in an area where the consequences are severe, should be considered as HCVF. In this study, an estimation of potential erosion risk in the study area was carried out to identify the areas with high erosion risk. To spatially estimate the potential erosion risk, distribution of rainfall intensity, slope length and slope steepness factor derived from Digital Elevation Model (DEM), soil map and land cover map were used to establish a map of potential erosion risk. A universal model developed by USDA-ARS, Universal Soil Loss Equation (USLE) (Weischmeier and Smith 1978) is used to estimate the erosion risk of the study area. Figure 4 illustrates the general process in estimating relative soil loss in GIS environment.

4. RESULTS

4.1 Identification of High Conservation Value Forest (HCVF)

4.1.1 Forest Areas Function as Unique Source of Drinking Water (HCVF 4.1)

Considering major and minor river systems in the study area, stream network map and division of river systems in Berau area, the delineated catchment partitions then were grouped based on river system where the flow of the catchments accumulate. The major river systems are Segah and Kelay River, while the minor river systems are Sidu'ung and Siagung River. The grouped catchments partitions with the river systems were identified. The catchment partitions within these particular villages are also considered as important for unique source drinking water. The areas functions as unique source of drinking water are presented in Figure 5.

4.1.2 Forest Areas as part of Critical Major Catchments (HCVF 4.2)

According to the result of the prioritisation of major catchments throughout the East Kalimantan Province, which is done by Ministry of Forestry, the priority scale to major catchments in the study area are all in level III. Based on the definition given by the Ministry of Forestry, priority scale I and II are given to *critical catchment* that need immediate action with regard to land rehabilitation and soil conservation, while priority III does not need such immediate rehabilitation, therefore the study area **does not contain HCVF 4.2 elements**.

4.1.3 Forest Areas Critical to Erosion Control (HCVF 4.3)

Factors contributing to annual soil loss estimation were determined using a Spatial Modeler, resulting in raster maps of rainfall erosivity (R factor), soil erodibility (K factor), slope length and steepness (LS factor) and vegetation cover and management (C factor). Since the identification of HCVF 4.3 requires the erosion risk in the forested area, then the resulted erosion risk map was masked with land cover type map and resulting in the map of estimated soil erosion risk in the forest area. Annual soil loss of 11 $ton.ha^{-1}.yr^{-1}$ was adopted as the threshold to differentiate high erosion risk with low erosion risk, therefore a reclassified map of forest area with high soil erosion risk is also produced and presented as orange and red pixels in Figure 6. By having the map of **forest area with high soil erosion risk**, the **HCVF 4.3 is identified**.

4.2 The identified HCVF related to soil and water conservation

Considering the ultimate objective of this research, which is "identifying high conservation value forest related to soil and water conservation", a final map as compilation of the identified HCVF in the study area is presented in Figure 7. As can be seen in this final map, the concentration of forest areas function as unique source of drinking water for local communities (HCVF 4.1) are in the northern and northeastern part, exactly in the center and the eastern part of the FMU. Forest areas critical to erosion control (HCVF 4.3) are highly concentrated in the steep-hilly forest in the southern part of the FMU and sparsely concentrated in the eastern part of the FMU as well. Considering the current logging operations of the FMU, which is located within the boundary of identified HCVF 4.1 in the northeastern part of the FMU, special attention should be paid to minimize the logging impact to the supply of drinking water for communities in the transmigration settlement (Trans SP6).

5. CONCLUSIONS

Remote sensing and Geographic Information System had proved to be useful to support the identification of High Conservation Value Forests (HCVF) in the study area.
The Digital Elevation Model derived from a contour line map is an essential input for analyses of physical hydrological features. The analyses are including catchment delineation, automatic derivation of stream network, flow routing and calculation of flow accumulation.

Visual interpretation and manual digitising process allow delineation of several catchments simultaneously, while automatic catchment delineation provided by most GIS software concentrates to one catchment. Therefore, manual delineation is preferable to use.

The national guideline for identification of HCVF in Indonesia, which provided by Proforest, is found very useful in building up the framework of preliminary HCVF identification.

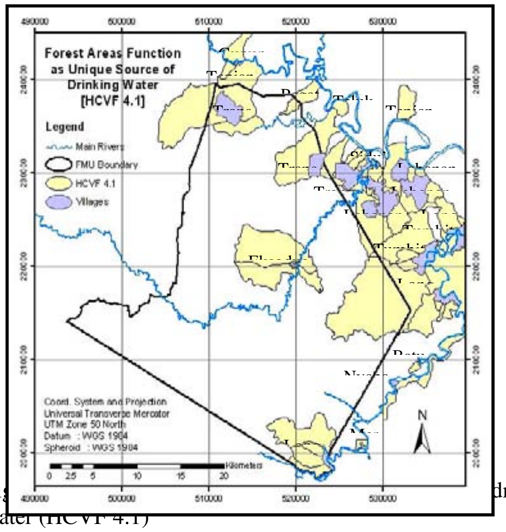
6. REFERENCE

Fauzi, A. (2001). Remote sensing for detection tropical logged forest (A case study of Labanan Concession, East Kalimantan, Indonesia). ITC Enschede. Unpublished M.Sc Thesis. 91.

Smartwood (2001). Smartwood Certification Assessment Report for: PT Inhutani I Labanan. Jakarta.

Wastono, D. H. (2003). Interview Towards Common Perception of HCVF Guideline. Y. B. Sulistioadi. Labanan, East Kalimantan.

Weischmeier, W. H. and D. D. Smith (1978). Predicting Rainfall Erosion Losses: A guide to conservation planning. Washington DC, US Department of Agriculture.



Fi… drinking water (HCVF 4.1)

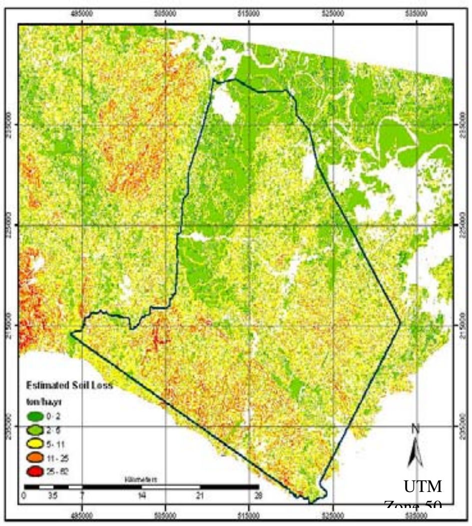


Figure 6. Soil erosion risk in the study area, forest areas with soil erosion risk > 11 ton/ha.yr comprise HCVF 4.3.

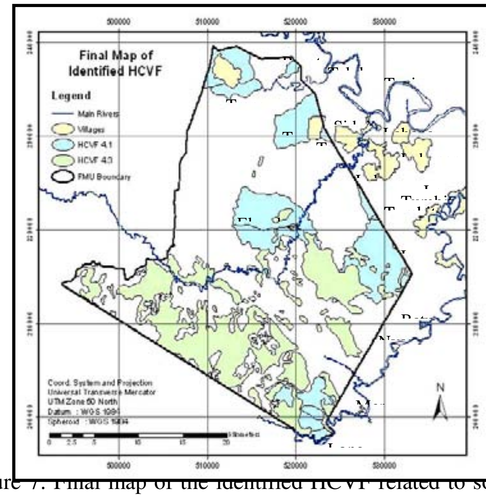


Figure 7. Final map of the identified HCVF related to soil and water conservation in the study area

Table 1. Information requirements for assessing HCVF elements related to soil and water conservation

No	High Conservation Value and Elements	Information Requirements [Identification Task]	Output [Pre Assessment]
HCV 4	Forest areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion control)		
4.1	Forest functions as unique source of water for drinking water	Officially designated, important or legally protected water catchments Communities depend upon drinking water	Map of forest areas function as unique source of drinking water for local communities
4.2	Forest as part of critical major catchments	Areas with high risk of flooding or drought, critical watershed for reservoirs, irrigations, river recharge or hydroelectric schemes	Map of forest areas contribute to critical major catchments
4.3	Forest critical to erosion control	Spatial information on areas that had serious erosion, landslide or avalanches	Map of forest areas critical to erosion and terrain stability

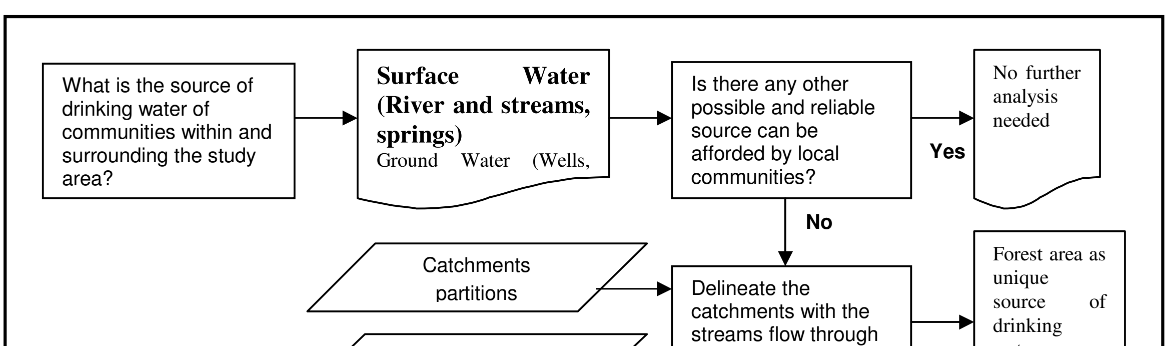


Figure 1. Decision scheme to identify forest area functions as unique source of drinking water for communities

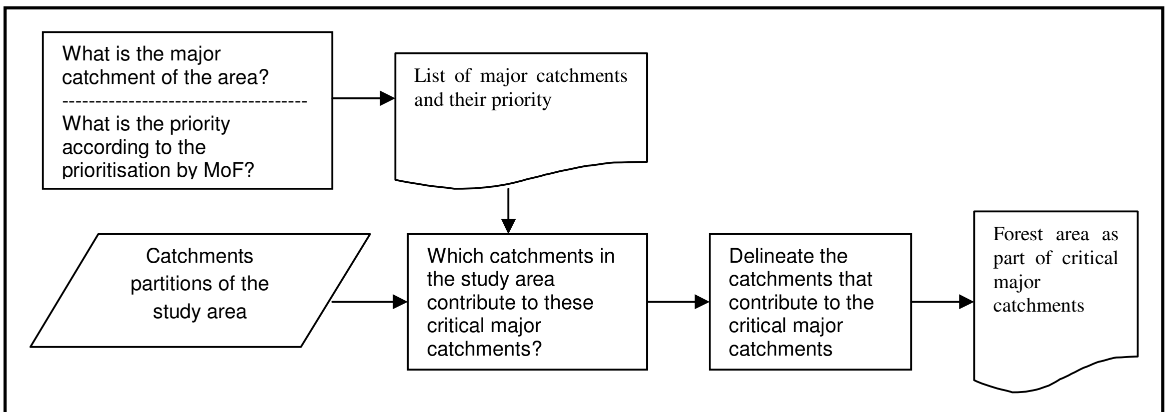
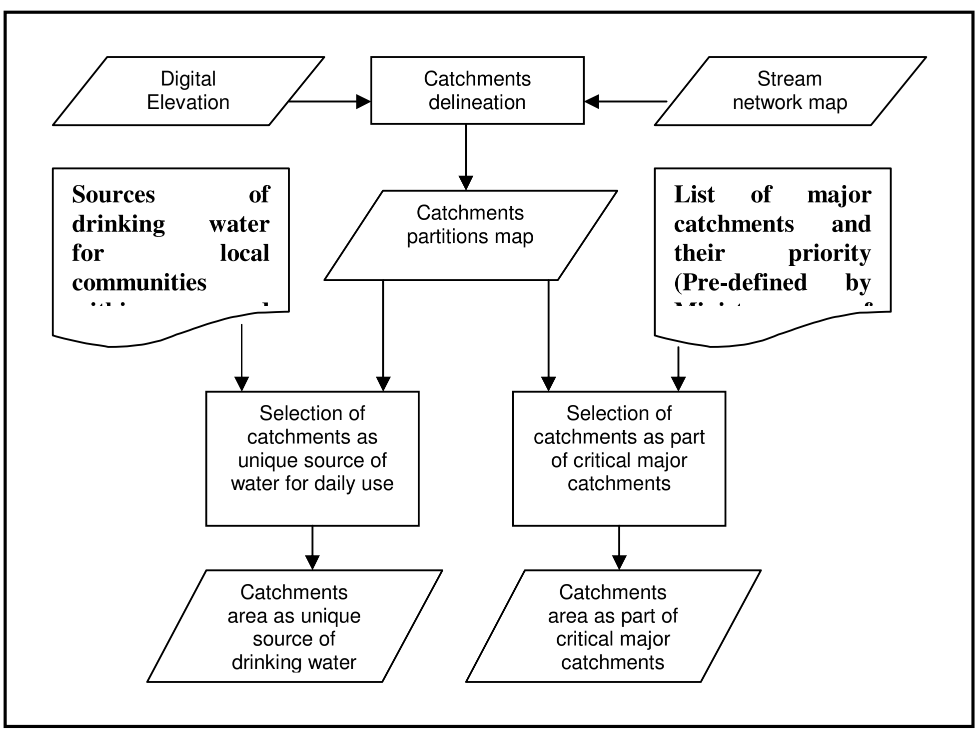


Figure 2. Decision scheme to identify forest area as part of critical major catchment



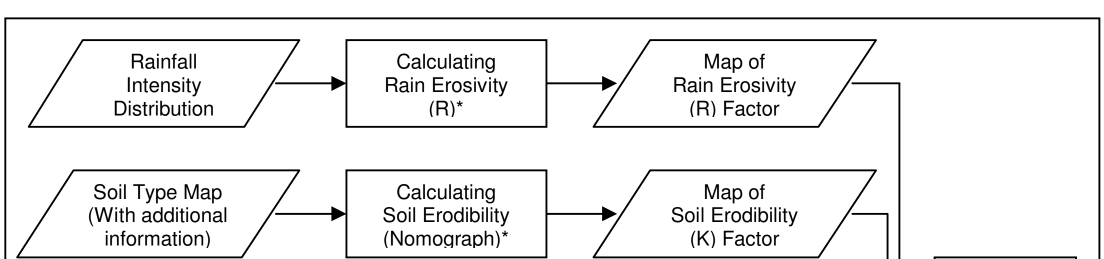


Figure 4. Calculating relative soil loss by rain erosion using USLE in GIS environment