

A Case Study on Landscape High Conservation Value Mapping in West Kalimantan, Indonesia

Gary Paoli and Philip Wells

1. Introduction

This case study discusses landscape features of methods, findings and main conclusions from a High Conservation Value (HCV) assessment of an oil palm estate in West Kalimantan, Indonesia, owned by Wilmar International Limited. Wilmar is a member of the Round Table on Sustainable Palm Oil (RSPO) and has committed to achieving full compliance with the RSPO standard for sustainability in its oil palm operations. In line with this commitment, in November 2007 the company imposed a voluntary moratorium on development for all of their West Kalimantan estates to conduct HCV full assessments and to implement management plans to maintain HCVs present. Daemeter Consulting was commissioned to perform HCV assessments for a set of Wilmar estates in Landak District, and a selection of results from one assessment is presented here (Figure 1).¹

The revised HCV Toolkit for Indonesia (2008) was used to guide this assessment. The revised Toolkit defines six HCVs comprising 13 sub-values (Table 1). The case study is presented in two parts, beginning with a discussion of methods, data and conclusions from a landscape level analysis of HCV 3, followed by an explanation of how landscape findings were used to guide site level analyses that followed.

2. Landscape-level HCV Assessment

Desired outcome: To define and describe (a) the variety and arrangement of biophysical, ecological and social elements forming the landscape milieu of the management unit (MU), (b) provide an understanding of ecological and other key linkages between the MU and elements of its surrounding landscape and (c) define and delineate rare or endangered ecosystems (HCV 3) at landscape spatial scales.

Final Product: Pursuit of this outcome resulted in (a) maps and descriptions of key elements forming the landscape context of the MU, including a historical/temporal perspective on forest cover change within and near the MU, and (b) explicit, information-based and methodologically consistent determinations of HCV 3 ecosystems throughout the landscape of which the MU forms a part.

¹ The assessment took place from February to August 2008, utilising independent experts and assistants, including specialists in a variety of disciplines. The original draft of the assessment report was peer reviewed by ForestCarbon and presented to stakeholders during a public consultation with local community members and others in Landak District in August 2008. The resulting management plan and delimitation of management areas are being used today to guide development of the estate. A public summary of the full report may be downloaded at www.daemeter.org. A copy of the full report may be obtained through Wilmar International; contact Daemeter directly for more details (info@daemeter.org)

2.1 Defining the landscape

Most practitioners of the HCV concept agree that some degree of 'landscape level analysis' is required properly identify HCVs at any spatial scale. This is true not only for values such as HCV 2, which by definition exist at the 'landscape scale', but also to identify many other HCVs whose detection at the MU depends fundamentally on placement of the MU within its proper 'landscape context'. An example of how *site-level blinders* - or failure to consider the surrounding landscape - can lead to invalid conclusions might be: a population of three Clouded leopards in a proposed oil palm estate might be considered too small to merit HCV 1.3 status, whereas in fact the animals are part of a larger 'landscape level' population that qualifies as HCV 1.3.

Despite the clear importance of landscape considerations for identifying HCVs, such an analysis is more easily said than done. This is true because:

(1) The delimitation of landscape boundaries defies global definition. The appropriate 'landscape' for identifying HCVs varies not only among sites, but also among HCVs within a site, and even among different dimensions of the same HCV. For example, Critically Endangered Sumatran tigers can move across large areas throughout a mosaic of habitats, including heavily degraded elements such as shrub land; and some protected butterflies and birds may persist indefinitely as meta-populations across a highly fragmented landscape with only small patches of remnant forest in a matrix of farms; whereas the Endangered Clouded leopard is a mature forest specialist, rarely observed outside tall forest. Assessing population viability for all three of these taxa under HCV 1.3 would require three different forms of landscape boundary, which further complicates a challenging HCV analysis.

(2) There are data limitations on a landscape analysis due to cost, time and technical issues. There is an inevitable trade-off between the quality and spatial extent of a dataset and its analysis, requiring that a compromise must be made to balance the two. The spatial resolution of outputs - e.g., forest cover mapping from satellite imagery - may be adequate for use at large spatial scales across 10^2 - 10^3 square km, but not at smaller scales within a single MU. Making an informed decision on this trade-off and drawing conclusions within the constraints of the data requires constant vigilance and a firm grasp of relevant technical issues.

Fortunately, dealing with the complexity of delimiting landscape boundaries and sourcing appropriate data is not required for all HCVs. In the majority of settings, landscape considerations are most important for identification and management of HCVs 1, 2 and 3 (Table 1). Overcoming the landscape challenges to proper identification of *HCV 3 Rare or Endangered Ecosystems* illustrates many of these considerations, and is the focus this case study.

2.2 HCV 3 Identification in Indonesia

Like HCVs 1 and 2, landscape considerations play a role in the identification of rare or endangered ecosystems under HCV 3, but the issues are qualitatively different. Ecosystems can be difficult to define succinctly and to map within a landscape, because operational definitions refer to suites of characters or species that require expertise to identify in the field or remotely. Further, a particular ecosystem can exist in a number of

locations, being rare or endangered in one region, but the dominant ecosystem in another. This suggests that in principle, HCV 3 status should, to a degree, be context dependent. As an international classification of ecosystems and their conservation status does not exist (c.f. IUCN Red List for organisms), a national HCV Toolkit must either produce a definitive map of HCV ecosystems or define a systematic method for assessing HCV 3 that takes into consideration landscape context.

Developing a national method

Developing a national method for defining rare or endangered ecosystems for Indonesia required agreement on (i) how to define ecosystems and (ii) how to determine what is rare or endangered. Three key requirements for a national method were identified during revision of the Toolkit for Indonesia: (1) an ecosystem definition must be sufficiently robust and practical for reliable use throughout Indonesia, and use data resources available for all the major islands of the country; (2) methods for determination of rare or endangered status must be systematic, transparent, replicable and rely on data sources that are widely available at reasonable cost - it shall be insufficient to declare an ecosystem rare or endangered without justification; and (3) a robust method must take into account location of an assessment area to capture natural geographic variation in ecosystems types.

The revised Toolkit for Indonesia developed an interim approach meeting these criteria by reference to the land classification system RePPPProT (Regional Physical Planning Programme for Transmigration), produced by the Government of Indonesia during the 1980s and early 90s. The RePPPProT program described and mapped 414 land systems throughout Indonesia at a scale of 1:250000 (125m resolution). Land systems are a classification of landform based on specific associations between lithology, climate, hydrology, topography, soils, geographic location and organisms. These same environmental factors affect the distribution of natural ecosystems, and with some modification (explained in the revised Toolkit) enable use of RePPPProT classes as proxies for ecosystem typing.² An example of RePPPProT classes throughout the assessment area is shown in Fig. 2b. During the revision, existing ecosystem definitions and maps produced by NGOs, government and scientists for Indonesia were deemed inadequate for defining HCV 3 status due to insufficient clarity of methods, incomplete geographic coverage and/or insufficient spatial resolution and geographic accuracy of mapping.³

RePPPProT also provided a means to account for geographic context, by sub-divided the major islands of Indonesia into Physiographic Regions (PR). The PRs of RePPPProT contain predictable patterns of terrain types and land form, suggesting 'natural geographic units' of an island. Boundaries of the PR defined by RePPPProT were modified slightly by the Toolkit revision team to account for biogeography and to improve geographic accuracy. A total of 22 PRs are delimited for Kalimantan; the assessment area fell within the Western Plains and Mountains (WPM) region (Fig. 2a).

² Detailed guidance for using RePPPProT as an ecosystem proxy is provided in the revised HCV Toolkit for Indonesia (2008).

³ For example, the WWF Ecoregion approach classifies Bornean lowland evergreen forest as a priority endangered ecoregion, but defines this ecoregion as all non-swamp, non-kerangas, non-ultramafic terrestrial forest habitats below 1000m. While few would disagree that this WWF ecoregion faces severe threats, this classification is too coarse to aid priority setting or mapping of HCV 3 areas.

The resulting HCV 3 method and modified RePPPProT classes as an ecosystem proxy, and boundaries of the one or more PR where the assessment area is found to delimit the landscape boundary of analysis. Rare or endangered status of an ecosystem within a PR is defined on the basis of *past*, *present* and *future expected* distribution following steps and criteria described below.

Test for Rare or Endangered ecosystems

Within each PR, the historical extent of natural ecosystem types are 'reconstructed' by overlaying a historical forest cover map, derived from e.g. Landsat 1, 2 & 3 imagery, on the modified RePPPProT land systems. It is generally possible to map historical forest cover for the early to mid 1970s. The past distribution of ecosystem types is the historical benchmark against which current and future expected extent of ecosystems is compared to assess rare or endangered status. The present distribution of ecosystem types is created similarly using the most recent available imagery at a suitable resolution (e.g., Landsat 5 & 7 if available, otherwise MODIS). The future extent is created using current provincial government land use plans, which designate forest or other natural areas permitted for conversion to non-forest. For analysis of future extent, it is assumed that all forest areas permitted for conversion will be converted to non-forest. Combining maps of past, present and future expected natural ecosystem types, the following tests are applied to determine which if any ecosystems are rare or endangered.

1. If the current extent of a natural ecosystem has declined by >50% of its historical distribution, then the ecosystem is endangered.
2. If the future extent of a natural ecosystem is expected to decline by >75% of its historical distribution, then the ecosystem is endangered.
3. If the current extent of a natural ecosystem type is less than 5% of the total extent of all natural ecosystems, then it is considered rare.

Data requirements for identifying HCV 3

Data requirements for HCV 3 are summarized in Table 2. They include past, present and future expected forest cover; land use planning maps; and the modified RePPPProT map for ecosystem proxies in Indonesia.

The spatial resolution of the HCV 3 assessment reported here for the Western Plains and Mountains is ca. 125m. This was deemed acceptable given the large spatial extent and the goal of identifying rare or endangered ecosystem types across the entire WPM region.

2.3 Findings for HCV 3 in the Western Plains and Mountains

The WPM region is, and has been for perhaps more than a century, a human dominated mosaic of vegetation comprising swidden agricultural fields, secondary forests, rubber agro-forestry and isolated remnant of natural forests (Fig. 3). Only a small number of large forest blocks >20000 ha remain. Mature forest cover has been low for many decades, and declined by an estimated 47% since 1973. Temporal patterns of forest loss since 1973 were not constant, however, with >50% of forest loss occurring after 2000, coincident with expansion of oil palm.

To identify HCV 3 throughout the WPM, past, present and future expected extent of forest and ecosystem types were mapped (Figs. 3 & 4). The decline of present and future expected ecosystem extent was measured and compared to criteria as described above. Of the 25 land systems in the WPM, all were found to have declined in extent, except for those in montane forest areas. Twelve of 25 types suffered a decline of >50% since 1973, thus meeting criteria for HCV 3 (Fig. 4a,b & 5a). A further two land systems are expected to become endangered (>75% decline in the future) given current provincial land use plans (Fig. 4c, 5b), and three of the 12 land systems identified as currently endangered are expected to become totally extinct. The current extent of all endangered ecosystems was mapped in Fig. 5b. All natural forest occurring on these RePPPProT types in the WPM is considered HCV 3.

Based on data used for this landscape analysis, forest cover of the MPT and TWH land systems present in the MU to be assessed declined by 56% and 68%, respectively, since 1973. These types are expected to decline by up to 74% and 68% across the PR based on current land use plans. Both of these RePPPProT land systems (ecosystem proxies) are therefore considered endangered ecosystems. All remaining natural forest on these RePPPProT classes within the MU is to be considered HCV 3.

2.4 Conclusions & Data Limitations

Three main conclusions are drawn from the landscape analysis of HCV 3 described above.

1. The 'landscape' of the MU is a continuous mosaic of human dominated vegetation types with small isolated fragments of mature forest. In this context it is very difficult to delimit landscape boundaries in a logical way.
2. The severity of deforestation since 1973, combined with current provincial land use plans, renders most naturally occurring ecosystems rare or endangered under HCV 3.
3. Careful attention must be paid during the MU assessment to delimit remnant natural areas in this distinctive biogeographic sub-unit of Borneo. The severity of forest loss means that all remaining areas take on special importance for biodiversity conservation. For some RePPPProT land systems, very few replicates remain in this biogeographic sub-unit of Borneo.

Four limitations to this approach were identified during the first year of application.

1. The modified RePPPProT classes are a reasonable ecosystem proxy, but apart from limited ground verification in Kalimantan it is largely an untested hypothesis.
2. The spatial resolution of this analysis (c. 125m) will not be sufficient for MU assessments in all sectors (especially in conversion settings). Consequently, ground based survey work or high resolution aerial photography will be required to delimit actual HCV 3 boundaries at finer resolution.
3. RePPPProT classes do not capture special ecosystem types potentially present at finer spatial scales within the MU (eg, orchid rich kerangas forests on raised benches of white sand). Such rare HCV 3 ecosystems must be identified through field survey.
4. More accurate data on peat land extent and depth are badly needed to map peat swamp ecosystems more accurately.

3. Site-level HCV Assessment

Desired outcome: (a) to define and delimit HCV 3 areas within the MU and their connectivity with other landscape elements inside and adjacent to the MU, (b) to verify a land cover classification based on aerial photography and the status of identified HCV 3 areas in the MU and (c) to develop management recommendations to maintain or enhance HCV 3 and other HCV areas within the MU.

Final Product: Pursuit of this outcome resulted in (a) accurate delimitation of HCV 3 ecosystems within the MU at a spatial resolution appropriate for guiding operational development within the MU and (b) detailed recommendations for HCV 3 management, including delimitation of the HCV 3 management area (HCVMA).

The landscape level HCV 3 assessment informed the MU assessment in two key ways:

1. It drew proper attention to the regional importance of remnant natural forest areas in the MU, including those of small size and imperfect condition. This in turn necessitated careful ground and aerial survey to map these areas precisely in the field.
2. It clarified that remnant natural forests in the MU itself are isolated from larger forest blocks by many tens of km, and surrounded by areas currently planned for conversion to oil palm by Wilmar or other companies. Though by no means always the case, the landscape analysis of vegetation cover and land use indicated that prospects for linking the MU into larger, well managed remnant forest areas were low. This further emphasized the importance of managing remaining forest remnants and

The MU (or site-level) assessment also illustrated that data of one type and spatial resolution may be suitable at large spatial scales for one purpose (e.g., to identify which ecosystem types are rare or endangered), but insufficient at smaller spatial scales for other purposes (e.g., to delineate accurate boundaries of these ecosystems on the ground within a MU). The landscape HCV 3 assessment identified the RePPPProT land systems (polygons) within which all natural ecosystems would constitute HCV 3. But spatial resolution of the Landsat imagery for landscape analysis was insufficient to map where such natural areas exist on the ground within the MU. Ground and aerial survey at the MU showed that the fine scale mosaic of vegetation types, and the small size of remnant natural forest blocks, required much higher resolution imagery to delimit natural remnant and develop a management plan to maintain them. To overcome this limitation, high resolution (0.2 m) aerial photographic data were provided by Wilmar to support the assessment within the estate boundaries and a surrounding 1 km buffer.

Land cover maps of the MU produced from aerial photographic data illustrate the need for different levels of data quality at different spatial scales. The maps of HCV 3 areas from Landsat differ markedly from those based on aerial photography, due to both the small size of forest remnant and complexity of surrounding vegetation (Fig. 6.)

The MU contains a number of small remnant forest fragments totalling ca. 500ha on the MPT and TWH RePPPProT classes identified as HCV 3 ecosystems in the landscape analysis. Most of these areas would have been incorrectly classified as non-HCV 3 had the MU assessment been conducted using Landsat alone. Fortunately, Wilmar was willing to provide the high resolution data required to overcome this problem.

4. Conclusions

The analytical framework for determining HCV 3 status in the revised HCV Toolkit for Indonesia holds across spatial scales, but the data resources required for mapping it do not. Landsat imagery (30m resolution) is sufficient for determining which ecosystems are rare or endangered throughout the Physiographic Region studied, but it is too coarse to determine the occurrence and precise boundaries of such areas within a MU that involves conversion of natural ecosystems. Accurate delineation of such boundaries is critical in conversion settings. A two-tiered perspective on data is therefore required, for matching appropriate data resources with multiple needs at different spatial scales of analysis.