Central Kalimantan High Conservation Value Provincial Assessment

Identification and Mapping of High Conservation Values 1.1, 2.1, 2.2, 3, and 4.2

Protected Areas, large natural landscapes, transition ecosystems, rare or endangered ecosystems, and areas prone to erosion

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This study identifies High Conservation Value areas in Central Kalimantan, based on a systematic assessment process carried out by lecturers and students in the Palangka Raya Institute for Land-use and Agricultural Research (PILAR), a Center of Excellence within the Faculty of Agriculture, University of Palangka Raya.

The study forms part of a collaboration under the Production-Protection Initiative between PILAR, Climate Policy Initiative (CPI), and the Government of Central Kalimantan. The Production-Protection Initiative aims to help transform the Central Kalimantan regional economy through more efficient management of land and natural resources to deliver inclusive and sustainable development. The program underlying this study is based on an agreed program in collaboration with the Central Kalimantan Provincial Government under Governor Decree No. 188.44/265/2013 on the REDD+ and Production–Protection Working Group. Activities were funded by the Norwegian Agency for Development Cooperation (Norad). Technical support was provided by the Indonesia-based consultancy Daemeter, through training for the PILAR Program team and technical assistance throughout the entire process.

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The team would also like to express its hope for the report to bring benefit to all stakeholders in their positive endeavors to analyze, design, and manage landscapes in Central Kalimantan, at the macro, meso, and micro scales.

ABOUT

Palangka Raya Institute for Land and Agricultural Research (PILAR) is a research foundation that supports local experts, researchers, and students at the University of Palangka Raya to conduct analysis on land use optimization in Central Kalimantan. PILAR has a particular focus on supporting the development of high-productivity, sustainable oil palm, while conserving valuable ecosystems in Central Kalimantan. The results of PILAR analyses are used to develop recommendations for local policymakers and business investors.

Climate Policy Initiative works to improve the most important energy and land use policies around the world, with a particular focus on finance. An independent organization supported in part by a grant from the Open Society Foundations, CPI works in places that provide the most potential for policy impact including Brazil, China, Europe, India, Indonesia, and the United States. In Indonesia, CPI partners with the Ministry of Finance and the Palangka Raya Institute for Land-use and Agricultural Research at the University of Palangka Raya in Central Kalimantan.

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EXECUTIVE SUMMARY

Central Kalimantan is at a crucial juncture for sustainable land use. The region is in the middle of a mid-term regional development planning process and has the opportunity to make choices that benefit its communities and businesses into the future. Strong, evidence-based information on land values can inform the Strategic Environmental Assessment which feeds into the provincial spatial plan (Rencana Tata Ruang Wilayah Provinsi or "RTRWP").

This analysis, the 'Central Kalimantan: High Conservation Value Provincial Assessment,[1] produced by the Palangka Raya Institute for Land Use and Agricultural Research (PILAR), a center of excellence under the Faculty of Agriculture, University of Palangka Raya, in partnership with Climate Policy Initiative (CPI), provides a framework to help the Central Kalimantan government, businesses and communities make informed decisions about how to manage land more sustainably. In particular, the report identifies biological, ecological, social, and cultural values considered exceptionally important in Central Kalimantan, and identifies threats to areas where these values occur.

Overall, the study finds that Central Kalimantan has significant tracts of high conservation value (HCV) areas, covering more than half of the province. Nearly two thirds of the HCV areas in Central Kalimantan are at risk from various planned development activities.[2]

The study also identifies concrete opportunities to mainstream these HCV assessment results into regional policy by integrating HCV into spatial plans and business license processes, or by acknowledging voluntary HCV management efforts conducted by concession holders.

A NOTE ON HOW TO READ THIS STUDY

The High Conservation Value Provincial Assessment for Central Kalimantan is meant to inform policy makers, business, and civil society institutions as they optimize economic growth and development in the province. It focuses on five HCV types as a subset of the 13 value types defined in the HCV Toolkit for Indonesia. These five were chosen because they are important, can feasibly be mapped accurately at landscape-scales, and are often poorly delineated when mapped by assessors performing site-level assessments only. They are:

- HCV 1.1 – Protected Areas
- HCV 2.1 - Large natural landscapes
- HCV 2.2 - Transition ecosystems
- HCV 3 - Rare or endangered ecosystems
- HCV 4.2 - Certain environmental services

Each HCV type provides a different lens through which to view land values and make planning decisions. We emphasized that study results should be used in tandem with more detailed field assessments for project-level HCV studies, in order to consider the full suite of HCV types, especially social and cultural values that can only be mapped during site assessments. The methods used for identifying HCV areas are adapted from a similar analysis in East Kalimantan completed in 2010 (see Wells, Paoli and Suryadi, 2010).

1 The analysis was based largely on methods defined in the HCV Toolkit for Indonesia, which can be found at: https://www.hcvnetwork.org/resources/national-hcv-interpretations/Toolkit%20HCVF%20English%20version_final-26Jan10.pdf (English version). https://www.hcvnetwork.org/resources/national-hcv-interpretations/HCVF%20Toolkit%20Final%20%28revised%20version%29%2C%20Bahasa%20Indonesia.pdf (Bahasa version)

2 In reference to the Ministry Forestry Decree Number 529 Year 2012 on the designation of 15,300,000 ha as forest area in Central Kalimantan.

KEY FINDINGS

Our analysis highlights that Central Kalimantan has a wealth of high-value natural landscapes – with important ecosystems covering 60% of the province's land area. The full extent of HCV areas in the province is no doubt larger than this, and will be identified in the future through supplementary district level and/or project site-level assessments to map other values defined by the HCV approach.

The Districts of Katingan, Murung Raya, Gunung Mas, Kapuas, and Seruyan emerge as notably important owing to the extent of HCV areas present. Murung Raya supports by far the largest area of cumulative HCV, at nearly 2.1 million ha; Katingan ranked in the top three districts for all five HCV types studied. Taken as a group, these top five districts together comprise 56-75% of province-wide area for each HCV category and 62% of total HCV areas overall. This suggests that making progress in these districts to incorporate protection of HCV areas as part of sustainable development planning could lay a solid foundation for balancing environmental and development goals for the province as a whole. Cross district collaboration could help advance this agenda.

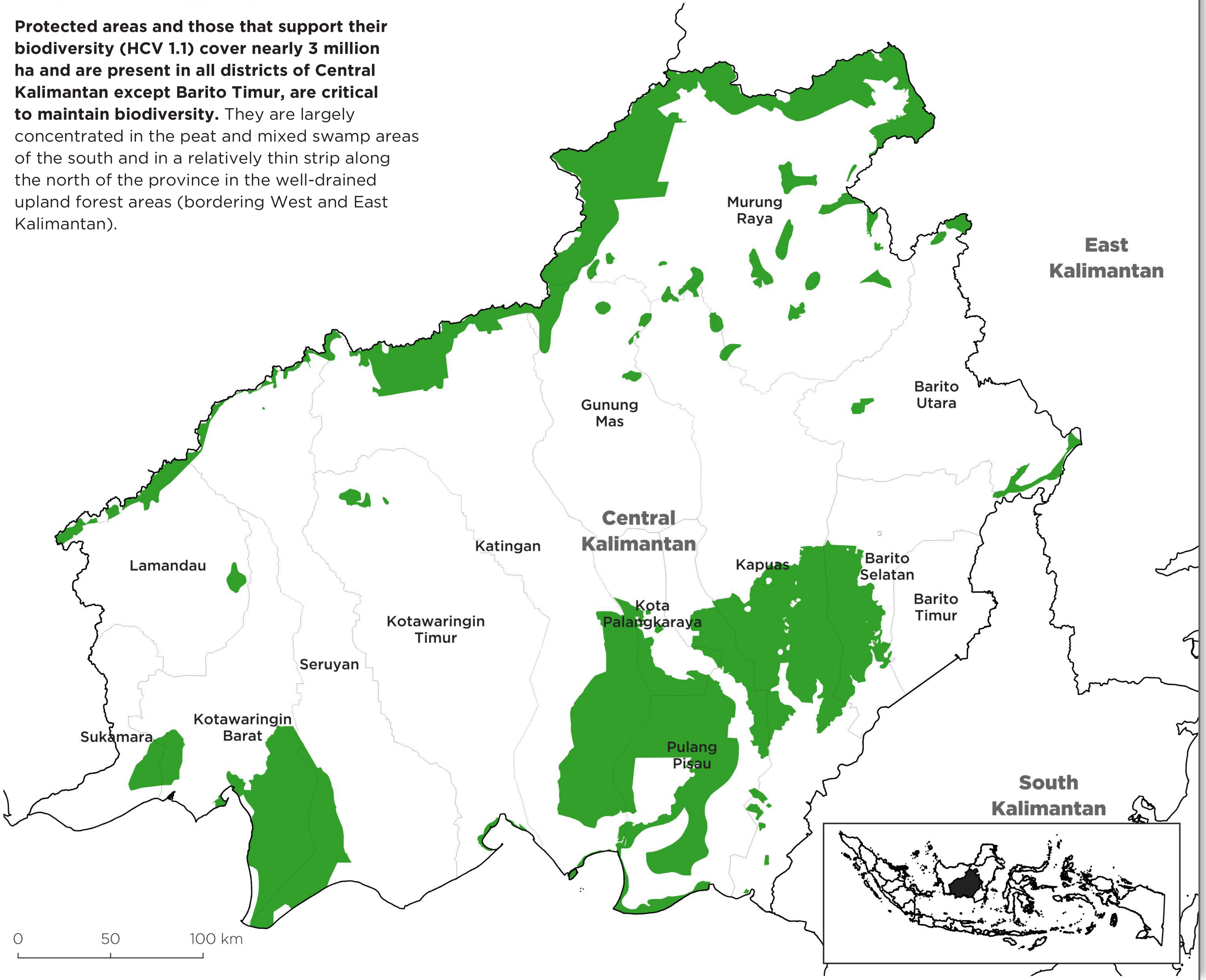
High-value natural landscapes are in decline, particularly forests. Forest cover in Central Kalimantan declined by 4 million ha (or by 32%) between 1973-2012, a rate of nearly 100,000 ha per annum. This change in forest cover was related to a surge of extractive industrial activities starting in the early 1970s. In 2012, remaining forest area was just over 8.1 million ha, equivalent to nearly 50% of the provincial area. Levels of deforestation varied across the province and were most severe in Kotawaringin Timur and Seruyan Districts in the southwest of the province, and the southern and northern parts of Katingan district. Of the 8.1 million ha of remaining forest, we project a risk of further planned deforestation of nearly 1.1 million ha, based on spatial planning and the extent of forested land allocated for conversion.[3]

CATEGORY	HCV 1.1	HCV 2.1	HCV 2.2	HCV 3	HCV 4.2	TOTAL AREA
TOTAL HCV AREA	2,990,049	3,205,190	4,552,125	1,726,764	4,488,485	9,405,716
AREA THREATENED BY ONE OR MORE FACTORS	212,207	1,232,060	2,426,351	1,189,928	3,139,343	5,790,466
% OF HCV AREA THREATENED	7.1	38.4	53.3	68.9	70.0	61.6

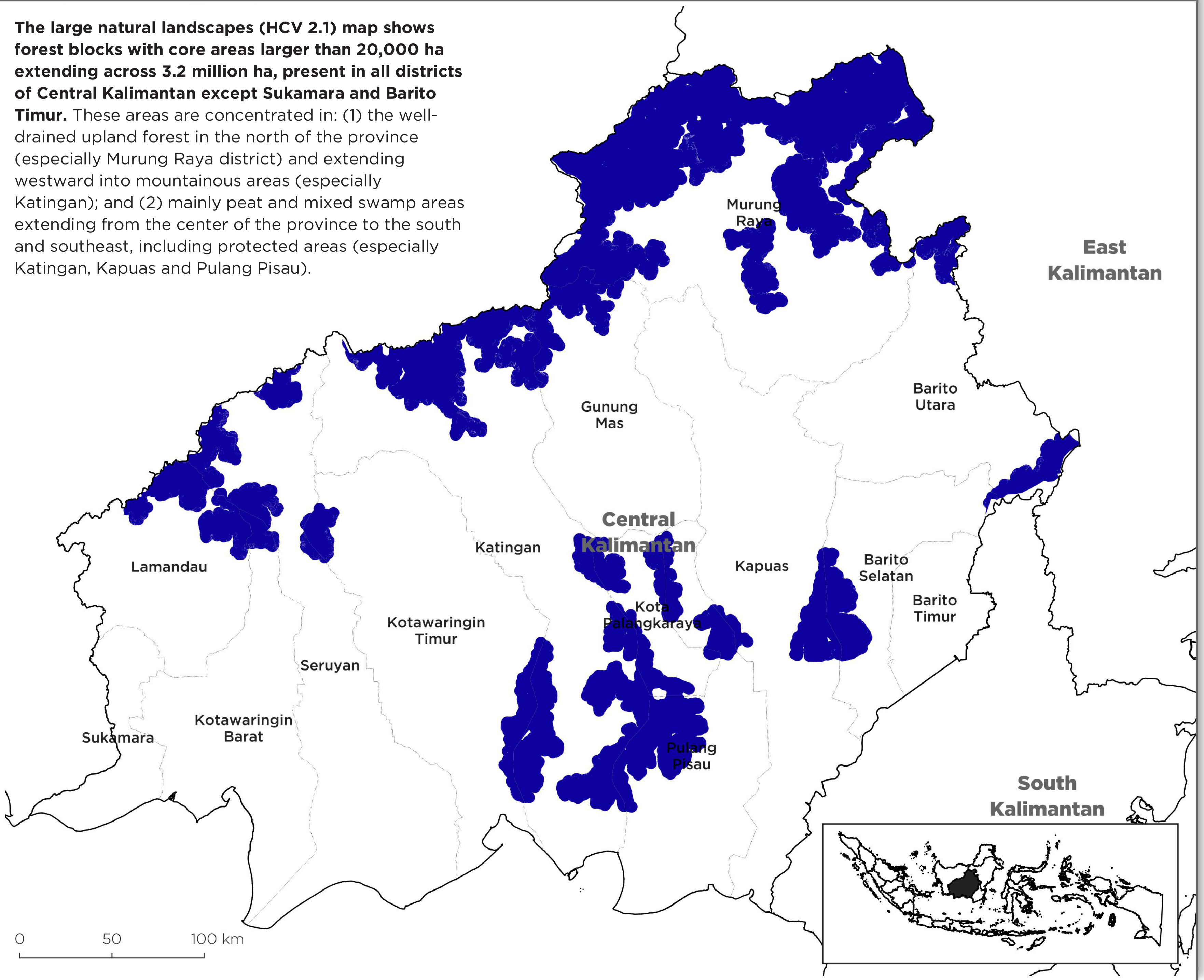
Nearly 62% of mapped HCV areas are potentially threatened with adverse impacts. Planned forest conversion due to spatial planning potentially affects nearly 18% of mapped areas, logging nearly 35%, and fiber and other plantations more than 17%.

3 Idem

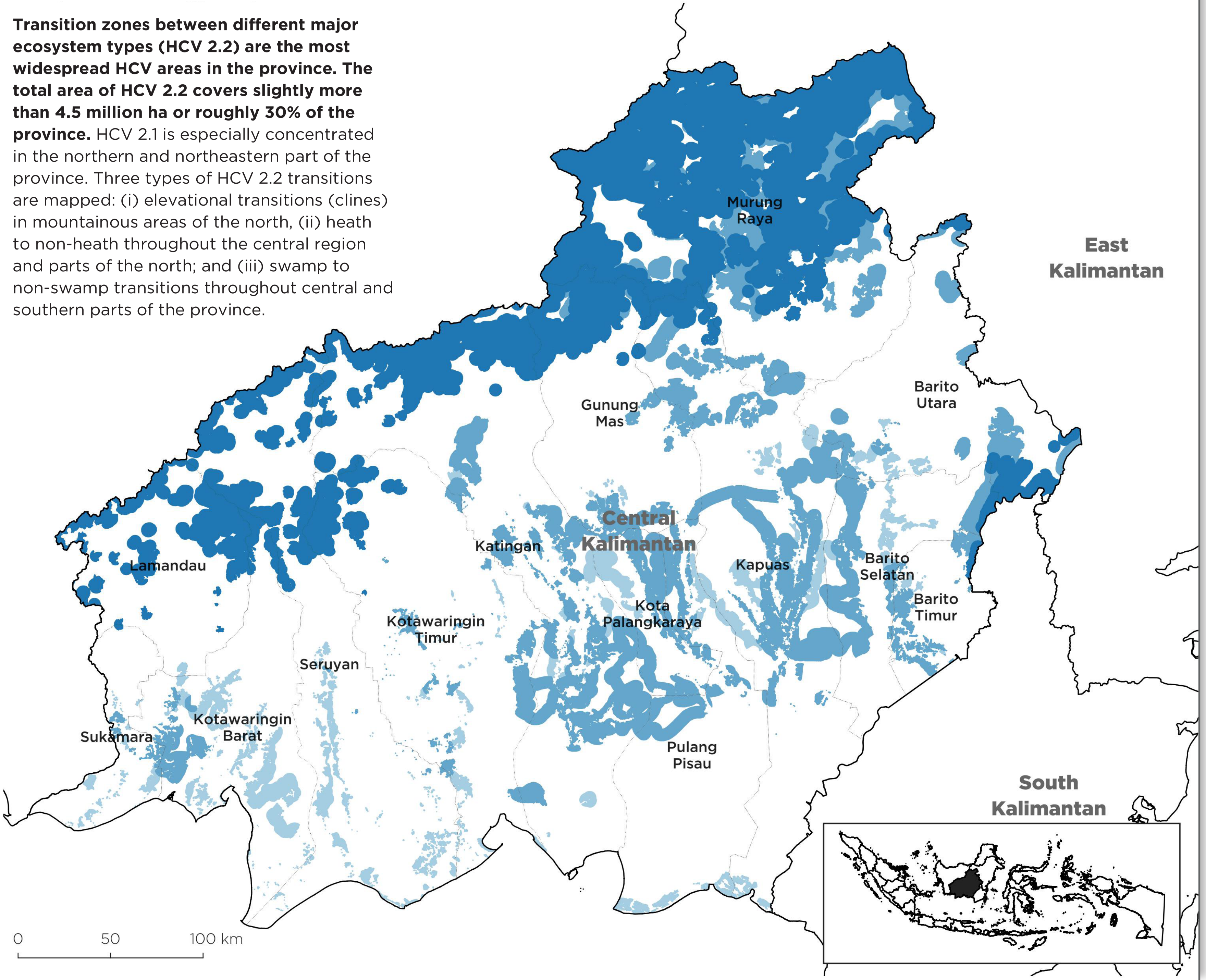
Protected areas and those that support their biodiversity (HCV 1.1) cover nearly 3 million ha and are present in all districts of Central Kalimantan except Barito Timur, are critical to maintain biodiversity. They are largely concentrated in the peat and mixed swamp areas of the south and in a relatively thin strip along the north of the province in the well-drained upland forest areas (bordering West and East Kalimantan).



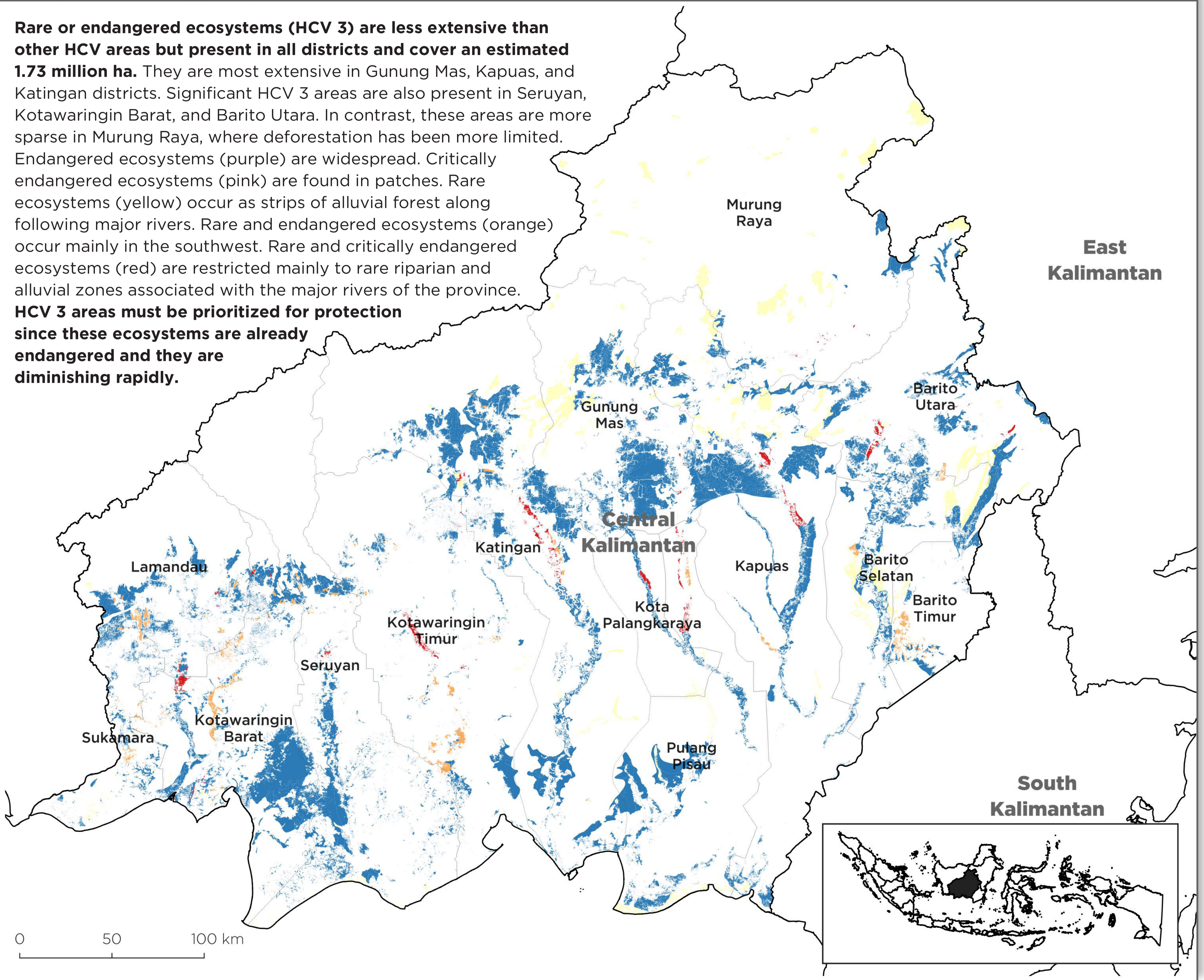
The large natural landscapes (HCV 2.1) map shows forest blocks with core areas larger than 20,000 ha extending across 3.2 million ha, present in all districts of Central Kalimantan except Sukamara and Barito Timur. These areas are concentrated in: (1) the well-drained upland forest in the north of the province (especially Murung Raya district) and extending westward into mountainous areas (especially Katingan); and (2) mainly peat and mixed swamp areas extending from the center of the province to the south and southeast, including protected areas (especially Katingan, Kapuas and Pulang Pisau).



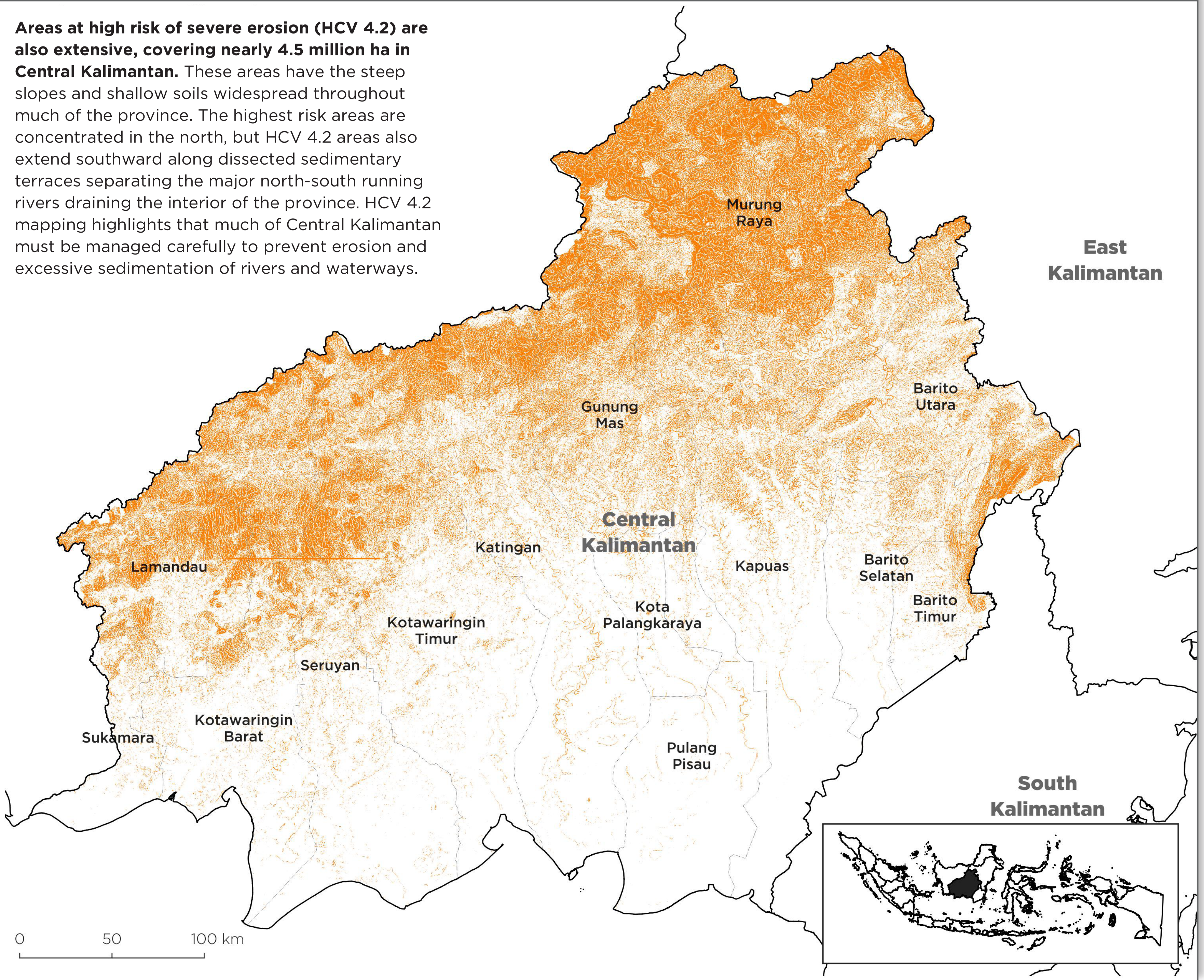
Transition zones between different major ecosystem types (HCV 2.2) are the most widespread HCV areas in the province. The total area of HCV 2.2 covers slightly more than 4.5 million ha or roughly 30% of the province. HCV 2.1 is especially concentrated in the northern and northeastern part of the province. Three types of HCV 2.2 transitions are mapped: (i) elevational transitions (clines) in mountainous areas of the north, (ii) heath to non-heath throughout the central region and parts of the north; and (iii) swamp to non-swamp transitions throughout central and southern parts of the province.



Rare or endangered ecosystems (HCV 3) are less extensive than other HCV areas but present in all districts and cover an estimated 1.73 million ha. They are most extensive in Gunung Mas, Kapuas, and Katingan districts. Significant HCV 3 areas are also present in Seruyan, Kotawaringin Barat, and Barito Utara. In contrast, these areas are more sparse in Murung Raya, where deforestation has been more limited. Endangered ecosystems (purple) are widespread. Critically endangered ecosystems (pink) are found in patches. Rare ecosystems (yellow) occur as strips of alluvial forest along following major rivers. Rare and endangered ecosystems (orange) occur mainly in the southwest. Rare and critically endangered ecosystems (red) are restricted mainly to rare riparian and alluvial zones associated with the major rivers of the province. **HCV 3 areas must be prioritized for protection since these ecosystems are already endangered and they are diminishing rapidly.**



Areas at high risk of severe erosion (HCV 4.2) are also extensive, covering nearly 4.5 million ha in Central Kalimantan. These areas have the steep slopes and shallow soils widespread throughout much of the province. The highest risk areas are concentrated in the north, but HCV 4.2 areas also extend southward along dissected sedimentary terraces separating the major north-south running rivers draining the interior of the province. HCV 4.2 mapping highlights that much of Central Kalimantan must be managed carefully to prevent erosion and excessive sedimentation of rivers and waterways.



RECOMMENDATIONS AND NEXT STEPS

The analysis offers guidance to inform discussions on how to mitigate threats and manage HCV areas through revised development planning, policy making, and impact mitigation measures for specific land uses where one or more HCVs is present.

HCV areas identified and mapped in the study will help further inform land management strategies and Strategic Environmental Assessments (Kajian Lingkungan Hidup Strategis or KLHS) as a part of future provincial or district level development policy making and planning processes. Results of the study could help shape management and monitoring plans to maintain or enhance the HCV areas identified, based on an assessment of the major threats to HCV land and options for addressing them. Part of the management and monitoring plan itself could also be to require site-level assessments to identify and map other site-level HCVs in selected priority areas (e.g. priority districts or concession areas).

Specific next steps include:

1. The HCV assessment results will be used as a basis for the Central Kalimantan Production-Protection Working Group to produce recommendations and a policy paper that will be submitted to the Central Kalimantan Government to help support their ongoing sustainable development efforts and to inform policy decisions and development of an HCV area management plan. In light of the new administration and the process of mid-term regional development planning in the province, the HCV assessment could provide a sound scientific foundation for decision making, including for Strategic Environmental Assessment.
2. Building on identification of HCV areas and the 2015 provincial spatial planning plan, Palangka Raya Institute for Land Use and Agricultural Research (PILAR) and Climate Policy Initiative (CPI) have identified the scope and design of a Natural Capital Assessment (NCA) analysis to be conducted at district level to quantify in economic terms these values and other important social values. This work will assist policy makers in making decisions on how to ensure optimum land use in Central Kalimantan to maximize production gains and design appropriate natural resources protection strategies.
3. Combined with the analysis carried out under PILAR-CPI's other three work streams – including business investment, financial frameworks and mechanisms, and socio-economic benefits – this land use analysis will inform the development of an integrated approach aimed at helping Central Kalimantan to meet its economic development, social and environmental goals concurrently. Through the Production–Protection Approach to Landscape Management (PALM) Program, PILAR and CPI will support government, business and community partners to test the approach at the district level.

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Section 1: Introduction

This report presents results of a High Conservation Value (HCV) assessment to map select landscape-scale HCV categories across the Province of Central Kalimantan, Indonesia.

The HCV assessment framework was first developed in 1999 by the Forest Stewardship Council (FSC) as a key criterion of its forest certification standard. Its original objective was to support improved environmental and social sustainability of production forests at the forest management unit scale through a two-step process: (1) identifying areas with unique or significant social, cultural, or environmental attributes; and (2) implementing a system to manage and monitor those areas to ensure maintenance of their values. The framework has since been adapted and incorporated into a number of other sustainability standards, including the Roundtable on Sustainable Palm Oil (RSPO). More recently, HCV frameworks have been developed to support the application of these tools at larger scales, including as part of landscape-wide spatial planning at national and sub-national levels in some countries.

To provide guidance on how to apply the HCV framework, HCV Toolkits were developed for various countries to provide national interpretations of how the global framework for HCV can be applied to local conditions. An Indonesian Toolkit was first developed in 2003 and was later revised in 2008. This study followed guidance defined in the latest version of the Toolkit (Toolkit for Identification of HCVs in Indonesia, 2008, called "Toolkit" throughout this study).[4] The HCV categories defined in the Toolkit are shown in Box 1.

While the Indonesian HCV Toolkit is already applied in a wide range of sectors, including logging, plantation fiber, oil palm, and mining, HCV areas often transcend the borders of a typical management unit (such as a logging concession or a plantation). Managing threats to such areas can be especially problematic when they are linked to larger-scale planned developments, such as mining or roads, which cannot be influenced by a particular management unit. This condition has led to criticisms that HCV area management that is based on individual management units is insufficient to ensure the protection of landscape-scale HCV areas critical to long-term biodiversity conservation and provision of ecosystem services. Instead, effective management requires large-scale mapping to identify HCV areas across larger spatial scalesthat can then shape and inform development planning and conservation priorities. Large-scale mapping of landscape-scale HCV areas also provides a foundation for additional rounds of HCV area identification at finer spatial scales at the local level, including through ground surveys and engagement with communities.

By first identifying and mapping a selection of HCV types across the province, this study aims to provide a foundation for a phased approach to HCV area management that can be used both to inform large-scale, government-led development planning and also for further local, site-based HCV assessment.

Landscape HCV mapping across larger spatial scales, such as this study, identifies ecosystems that warrant careful management. For example, there may be ecosystems that provide important biodiversity support functions to protected areas (HCV 1), or that are naturally rare or have become endangered (HCV 3). In addition, there may be larger remnant forest areas with potential to deliver ecosystem services (HCV 2), or areas at severe risk of erosion and sedimentation (HCV 4.2) that must be managed carefully to maintain environmental quality and water resources. Finally, landscape HCV mapping can also provide an understanding of the historical and ecological context of remaining forest patches, which in turn helps to assess their value within a richer landscape context.

This stated, it should also be noted that the presence of one or more of the HCV types mapped in this study across a landscape does not automatically require strict protection of that entire area, nor does it necessarily prohibit any form of development. Rather, the presence of an HCV category within a tract of land can help to inform the government in their planning or licensing decisions, business in their concession-wide development planning, and communities in their decisions about how to manage territories that form a part of larger, landscape-scale HCV areas. In this way, HCV maps enable all parties to make informed decisions on the uses of the land over which they have management authority and develop appropriate management and monitoring strategies to best manage the region's natural capital and land resources. Stated simply, the HCV approach provides a planning tool for decision makers at multiple levels to balance environmental, social, and economic objectives at multiple scales.

Results of this study can be used by policy-makers, businesses, and communities to develop a landscape-scale HCV management plan that effectively allocates,

4 English version of the toolkit: https://www.hcvnetwork.org/resources/national-hcv-interpretations/Toolkit%20HCVF%20English%20version_final-26Jan10.pdf, Bahasa version: https://www.hcvnetwork.org/resources/national-hcv-interpretations/HCVF%20Toolkit%20Final%20%28revised%20version%29%2C%20Bahasa%20Indonesia.pdf

manages and monitors land resources across the province. Further, the spatial data generated through this study can be used by businesses and their technical partners to support site-based assessments of HCV areas, especially to help companies meet sustainability standards that rely on the HCV framework. Finally, these data could be used by civil society and communities to monitor the management of HCV areas, or to assess how policies, plans, business activities, and development programs may be impacting local HCV areas and environmental quality.

About this study

This study is presented in four parts. Section 1 provides an introduction to the study. Section 2 outlines the methodological approach we adopted. Section 3 provides an overview of results of HCV identification and mapping, across the province. Section 4 describes identified threats to HCV areas, proposed management options to mitigate these threats and broader policy recommendations.

The Toolkit defines 13 HCV types organized under six major HCV categories. These six HCV categories, in turn, can be organized under three headings: Biodiversity (HCVs 1-3), Environmental Services (HCV 4), and Social (HCV 5-6). In this report, we map a subset of values that can be reliably identified at landscape scales, including HCV 1.1, 2.1, 2.2, 3 and HCV 4.2 (highlighted in red).

BOX 1: HIGH CONSERVATION VALUES (HCV) DEFINED IN THE HCV TOOLKIT FOR INDONESIA (2008).	
HCV 1. AREAS WITH IMPORTANT LEVELS OF BIODIVERSITY	
1.1	Areas that contain or support biodiversity in protection or conservation areas Example: national park
1.2	Critically endangered species Example: Orangutan distribution area
1.3	Areas that contain habitat for viable populations of endangered, restricted range, or protected species Example: Komodo dragons' natural habitat
1.4	Areas that contain habitat for temporary use by species or congregations of species Example: Wetlands that remain wet during dry season, used by water birds
HCV 2. NATURAL LANDSCAPES AND DYNAMICS	
2.1	Large natural landscapes with capacity to maintain natural ecological processes and dynamics Example: intact natural forest with core areas larger than 20,000 hectares
2.2	Areas that contain two or more contiguous ecosystems Example: transition areas of wetland and non-wetland
2.3	Areas that contain representative populations of most naturally occurring species Example: large and unfragmented landscapes with diverse ecosystem types
HCV 3. RARE OR ENDANGERED ECOSYSTEMS	
3	Rare or endangered ecosystems Example: remaining heath forests
HCV 4. ENVIRONMENTAL SERVICES	
4.1	Areas or ecosystems important for the provision of water and prevention of floods for downstream communities Example: mountainous water catchment areas
4.2	Areas important for the prevention of erosion and sedimentation Example: steep mountain regions
4.3	Areas that function as natural barriers to the spread of forest or ground fire Example: Intact wetlands
HCV 5. BASIC NEEDS	
5	Natural areas critical for meeting the basic needs of local people Example: water sources
HCV 6. CULTURAL IDENTITY	
6	Areas critical for maintaining cultural identity of local communities Example: sacred forest

Section 2: Study methodology

Here we describe the methodology and data sets used in our study to identify and map HCV types. The analysis was carried out primarily through a desktop study using primary and secondary spatial data sets. The approach and methods were based on the previously published methodology used by Daemeter (Wells, Paoli and Suryadi 2010) to conduct a similar study in East Kalimantan.

This section is divided into three sub-sections. Part 1 describes the general scale and scope of the study and offers a short overview of the identification process. Part 2 describes the data sets used in the study. Part 3 describes in more detail the process of HCV site identification and mapping.

2.1 Scale and Scope of the Study

2.1.1 SCALE OF STUDY

The target area of the study was the entire jurisdiction of Central Kalimantan province. This significantly affected the way the team used and interpreted the HCV Toolkit because the HCV Toolkit is originally designed for assessing smaller sites. The team assessed HCV areas within nine physiographic regions within the province as seen in Figure II-4.[5]

2.1.2 SCOPE OF STUDY – CHOOSING HCV CATEGORIES FOR DESK-BASED, LANDSCAPE-SCALE MAPPING

To properly identify and map the six HCV types defined in the Toolkit requires different forms of data, and different modes of data collection and decision making. For instance, while some HCVs can be reliably identified in a desktop landscape mapping exercise (e.g. HCV 2.1 Large Landscapes), others cannot (e.g. HCV 5 Basic Needs). Since this study is primarily a desktop exercise to map HCV regions that extend over large areas, we do not map all six HCV types outlined in the Toolkit. Instead, this report focuses on identifying five HCV types critical for biodiversity conservation and environmental services that can be reliably mapped in a desktop study:

- HCV 1. Areas with important levels of biodiversity
  - » Areas that contain or support biodiversity in protection or conservation areas (HCV 1.1)
- HCV 2. Natural landscapes and dynamics
  - » Large natural landscapes with capacity to maintain natural ecological processes and dynamics (HCV 2.1)
  - » Areas that contain two or more contiguous ecosystems (HCV 2.2)
- HCV 3. Rare or endangered ecosystems
- HCV 4. Environmental services
  - » Areas important for the prevention of erosion and sedimentation (HCV 4.2)

5 This is a slightly modified version of Physiographic Boundaries previously made by the Regional Physical Planning Program for Transmigration (RePPProT, 1990). More information about RePPProT can be found in Section 2.2.2. of this report.

A brief overview of how we decided which HCV types to map

HCV categories 1-3 focus on a landscape's biodiversity attributes. Biodiversity is defined as the diversity of terrestrial and aquatic organisms and the complexity of their ecological interactions. In the data assessment phase of this project, the team found that spatially explicit biodiversity information was only available for a subset of species, such as the orangutan, and was not sufficiently comprehensive to map all components of HCV 1 across the studied area. Rather than using incomplete data to map HCV types and risk creating misleading impressions about areas where data gaps prevented accurate mapping of the spatial distribution of individual species (e.g. as required under HCV 1.2 and 1.3), the team decided instead to focus analysis on identifying important habitats that meet the conservation needs ofmost species in Central Kalimantan. This led us to focus biodiversity assessment efforts on HCVs 1.1, 2.1, 2.2 and 3.

HCV 4 aims to ensure the continued provision of key environmental services affected directly or indirectly by management operations within a landscape. This HCV type can be broken down into three sub-categories: areas or ecosystems important for the continued provision of clean water and prevention of floods (HCV 4.1), areas important for the prevention of severe erosion and sedimentation (HCV 4.2), and areas that form natural breaks to the spread of wildfire (HCV 4.3). Neither HCV 4.1 nor HCV 4.3 are well suited to analysis at the landscape-level scale of Central Kalimantan (>15 million ha), due to data limitations and analytical constraints. For example, identifying HCV 4.1 at such a large scale requires sophisticated modeling of water flow and hydrological impacts of land use change under different land use scenarios. While such an analysis is theoretically possible, and could be pursued in follow up studies, it was not within the scope of this project. Identifying HCV 4.3 requires more detailed site-level investigation of areas chronically affected by fires and the land use and ecosystem features surrounding them. As such, HCV 4.3 mapping is appropriate for site-level assessments but not jurisdiction wide mapping over millions of hectares. For HCV 4.2, practical analytical methods at landscape scales had already been developed and tested by Wells et al. (2010) for nearby East Kalimantan, using available data from Digital Elevation Model (DEM) and other data sources to estimate erosion factors. It was decided this could be readily applied across Central Kalimantan as a whole.

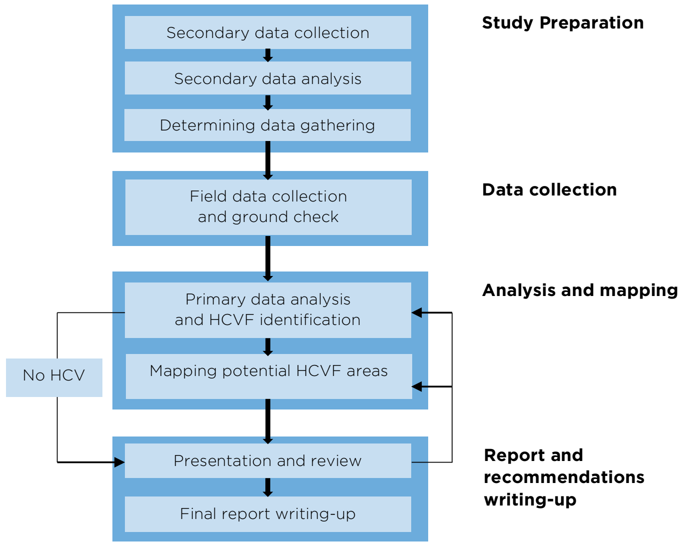
It is important to bear in mind this assessment does not estimate other land biodiversity values included in HCV types 1.2-1.4, nor does it include social or cultural values outlined in HCV 5 types and 6. The areas prioritized under HCV types 5 and 6 are not necessarily defined by ownership rights alone. They are defined more broadly to include use rights wherever they are legitimately asserted. Given that establishing the presence of these HCV values would require site-level identification through direct consultation with communities, they were omitted in this landscape-scale assessment. It was not possible to consult comprehensively with the thousands of communities present across the province, nor are spatial data resources on customary lands there sufficiently comprehensive to produce indicative maps of these areas. We note there are many existing efforts by community, civil society, and government actors to clarify land tenure for indigenous (adat) rights recognition, and this could be considered source data for indicative HCV 5 or 6 mapping, but such information is not yet comprehensive or consistently documented at a provincial scale. These values must, therefore, be identified in the future during site-based assessments at more local scales in direct consultation with communities.

2.1.3 HCV AREA IDENTIFICATION PROCESS

Figure II-1 summarizes the steps followed in the HCV type assessment process in this study. It is derived from the HCV Toolkit for Indonesia (2008). Because this study covers a provincial landscape scope rather than a site-based one, slight modifications were made in this study, such as restricting field data collection to verification of conflicting datasets only. But overall, the study follows the process outlined in the Toolkit.

As part of the study preparation phase (persiapan studi), the team received training on the HCV categorization process and identified the spatial and temporal information needed to assess each HCV category. In the data gathering phase (pengumpulan data) data was compiled and each data set was assessed to determine whether it met the requirements outlined in the HCV Toolkit. In the analysis and mapping phase (analisa dan pemetaan),

Figure II-1: HCV type assessment process



Source: Wells, Paoli and Suryadi (2010)

the team identified the HCV areas using Geographic Information System (GIS) software from ESRI, with definitions and methods based largely on the Toolkit (with some modifications as described below). Then, in the reporting and recommendation phase (penyusunan laporan dan rekomendasi) the team drafted this report, assessed the potential risks to identified HCVs from current or planned land use or other relevant activities, and then developed recommendations for mitigating threats, as described in Sections 4 and 5.

The technical processes used to identify each of the HCV sub-categories covered in this study is described in further detail in Section 2.

2.1.4 METHODOLOGICAL LIMITATIONS

This study has methodological limitations that could be incrementally improved in the future. Some of these limitations are as follows:

1. This study was predominately a desktop study. Therefore, further on-the-ground verification of ecosystem types and forest cover must still be performed when results of this study are used for site-level HCV assessments in oil palm, logging concessions or other sectors.
2. The modifications made to apply the HCV Toolkit to a landscape scale are relatively new and as such would benefit from further discussion and debate among the technical community.
3. As outlined above, not all HCVs are identified, so this study does not reflect a complete assessment of all HCV areas within the landscape.

2.2 Overview of Relative Strengths of Available Datasets

2.2.1 FOREST COVER

Forest cover information provides the foundation for identifying HCV areas, since most of the Indonesian lowland terrestrial ecosystems are forested, apart from lakes, open swamps, marshes, and grasslands and mixed savannah (e.g. in eastern Indonesia). In this section, information is provided on the components of the forest cover data compiled or produced for the study.

Present Forest Cover

We obtained two candidate forest cover datasets that offered recent, wall-to-wall coverage of forest cover and deforestation across the province: Belinda Margono et al. (2014)[6] and INCAS (2012).[7] The data of Margono et al. (2014) are derived from multi-source remotely sensed imagery (especially Landsat), and use sub-pixel analysis and classification procedures based on algorithms developed at Global Land Analysis and Discovery (GLAD). The Margono et al. (2014) data on forest cover and forest loss are reported on an annual time step from 2000-2012. The data from INCAS (Indonesia National Carbon Accounting System) present forest loss/gain data sets generated by the Indonesian Ministry of Forestry (MoFr) and LAPAN (Indonesia's National Space Agency), mainly from Landsat and applying methods adapted from Australia's national accounting system. This INCAS data also covers the same time period (2000-2012) and covers the entire province, making them directly comparable.

The study team selected which of the two data sets to use by conducting verification through overlaying the two maps to identify commonalities and differences. Some areas where the classification differed between the two datasets served as the basis for field verification conducted by the study on 6-7 October 2014. The team used GPS to locate the exact spot and collected data by direct observation from a total of 14 sample plots, which were located at a distance of 10–250 meters from roads used for access. The main conclusions of field verification are presented in Table II-1.

Results showed that the interpretation of Margono et al. (2014) is more consistent with actual field conditions and satellite comparisons than the interpretation of INCAS (2012). All field examinations of areas that Margono classified as forest found them to be forested, whereas some areas classified

6 http://www.nature.com/nclimate/journal/v4/n8/full/nclimate2277.html

7 http://lcs-rnet.org/pdf/lcs_rnet_presentations/6th/P3.B-2_Krisnawati.pdf

Table II-1. Disagreement in Forest Cover Classification between Margono et al. (2014) and INCAS (2012) and Results of Field Verification

DATA CONFLICT	RESULTS
Forest according to Margono et al. (2014) but Non-Forest according to INCAS (2012)	• Margono's forest classification is a better fit to the actual field conditions. • Map of forest class by Margono represents natural forests only and distinguish non-natural forests class from natural forest better than INCAS.
Non-Forest according to Margono et al. (2014) but Forest according to INCAS (2012)	• INCAS' map of forest class is not a fit to the actual field conditions. • INCAS tends to overestimate forest. • Areas being mapped as forest by INCAS include mixed plantations detectable on Landsat from the presence of rubber.
Natural forests that are not identified as forests by Margono et al. (2014)	• There are small patches of natural forest found within mixed plantations that are excluded by Margono.

by INCAS (2012) as forest were instead community rubber plantations mixed with dense canopy coverage and remnant forest trees that had not been cleared. Based on these findings and other considerations, Margono et al. (2014) was chosen as the preferred forest cover layer for the study.

Margono et al. defined forest as tree cover of at least 30% with a minimum height of 5 meters and canopy cover extending over more than 5 ha. This forest cover map was then further edited to remove plantations and adjust for other forest types that could not be identified as non-forest using their pixel based classifier, but could be identified as non-forests in photo-interpretive contexts. The resulting forest layer was then split into primary intact and primary degraded (secondary) forest using a systematically applied buffering approach around mapped intact forest landscapes.

Natural Ecosystems and Water Bodies Contained within Forest

The HCV Toolkit provides guidance on assessing not only forested natural ecosystems but also non-forest ones. Natural ecosystem identification in this report uses Margono's forest classification as a point of departure for mapping natural forest ecosystems because this dataset maps natural primary and secondary forest areas (not plantations). Although secondary forests are degraded natural forest, it is still classified as natural ecosystem because: (i) Most of the ecosystem processes still function and species are still present; and (ii) Logged forest is capable of returning to its natural state given enough time.

In addition to knowing the extent of natural forests, mapping natural ecosystems also requires mapping water bodies and (if necessary in the assessment area) natural non-forest areas. For this, the SRTM Water Body Data set (SWBDv2.0)[8] published by NASA was used, after editing and augmenting using decadal Landsat orthorectified datasets to ensure that all the major rivers were included. This modified SWBD (Daemeter 2010) was used as the base map for Kalimantan. It is assumed that the water bodies and coastline are constant over time, an assumption that is not true in a strict sense but allows direct comparability between the 1970s and the present.

The modified SWBD map was augmented further by using water body information from Margono's data. Irregularities between the two data sets were negligible, with vast majority in agreement within +/- 30m, but where there was disagreement between the two, we used the following decision tree to decide: (i) If classified as water by SWBD but forest by Margono then we classified it as forest, otherwise water; (ii) If classified as water by Margono, we classified it as water). Margono had a greater number of water bodies and rivers on the whole, but this is to be expected given the higher resolution, multi-spectral data and more structured, supervised analysis of their dataset.

Historical Forest Cover

Historical forest cover is drawn from the results of a study by Gaveau et al. (2014), who analyzed forest cover across Kalimantan using historical Landsat imagery dating from 1973. Gaveau et al. mapped and reported forest cover and deforestation trends in Kalimantan from 1973 to 2010. This wall-to-wall coverage of historical forest loss enabled province-wide analysis of historical losses for different ecosystem types, a critical input to mapping HCV 3 (Rare or Endangered Ecosystems), which requires mapping of the past and present distribution of natural ecosystems.

Future Projected Forest Cover

The team estimated future projected forest cover using a simplified but realistic approach recommended in the Toolkit. Estimating future forest cover is necessary for identification of HCV type 3 as well as assessment of threats to other HCVs mapped in the study. Under the Toolkit approach, the most recent legal provincial land use plan (RTRWP) is used to: (i) delineate areas that are legally permitted for conversion from forest to non-forest; and (ii) remove areas permitted for conversion for forest to non-forest on the assumption that they will be converted at some point in the future. Subtracting any currently forested areas permissible for conversion from the "current forest cover" produces a working hypothesis of future expected forest cover under what might be called a full conversion scenario.

Ideally, projecting future forest cover using this approach would use the most recent, legal provincial land use plan (RTRWP) for the area of analysis. In the current study, however, several factors prevented this, and we instead used the latest maps enacted by the Indonesian Ministry of Forestry's (MoFr) Decree in 2012 to delineate areas potentially available for conversion. This is because:

1. The physiographic regions assessed in Central Kalimantan (Figure II-3) spread into parts of East, West, and South Kalimantan so that RTRWP would be required for all four regions.
2. The RTRWP has not been completed for any of the four provinces.

It is expected that the final RTRWP of Central Kalimantan will increase the amount of land allocated for conversion, and that situation would ultimately increase threats to HCVs mapped in this study. We list the Decrees of the Ministry of Forestry used in Table II-2 and provide the map of the Decree for Central Kalimantan in the annex of this report.

Table II-2. Ministry of Forestry Decrees, 2009-2013, Used to Estimate Future Projected Forest Loss in Kalimantan

NO.	PROVINCE	THE DECREE OF MINISTRY OF FORESTRY
1.	West Kalimantan	SK Menhut No.936 year 2013
2.	Central Kalimantan	SK Menhut No.529 year 2012
3.	South Kalimantan	SK Menhut No.435 year 2009
4.	East Kalimantan	SK Menhut No.942 year 2013

Based on the MoFr maps, the study identified forest area categories where forest conversion is permitted and where it is not (Table II-3). It should be noted that in areas where forest conversion is not permitted, loss of natural forest may still occur through either: (i) planned conversion of natural forest to plantations that are legally defined as "forest" (such as fiber or rubber plantations), or (ii) unplanned deforestation due to smallholder farm encroachment or fire.

This MoFr map was also used to designate the boundaries of Protected Areas, Protection Forest and other Conservation Areas for mapping under HCV 1.

2.2.2 ECOSYSTEM MAPPING

An ecosystem can be defined as a community of plants, animals, and physical environments that interact and function as an interdependent unit. The

8 The NASA Shuttle Radar Topographic Mission (SRTM), available from: http://srtm.csi.cgiar.org/

Table II-3. Forest Zoning Codes According to Decrees of Ministry of Forestry (listed in Table II-2)

LAND USE PLANNING TYPE	CODE	POTENTIALLY AVAILABLE FOR CONVERSION	PROTECTED AREA
Nature Reserve Area / Nature Protection Area	KSA/KPA	No	Yes
Protected Forest	HL	No	Yes
Production Forest	HP	No	No
Limited Production Forest	HPT	No	No
Production forest that can be converted	HPK	Yes	No
Utilization area	APL	Yes	No

concept of ecosystem fundamentally covers many things, from a drop of water to the entire planet Earth. In general, the types of terrestrial ecosystems at a particular place depend on a number of abiotic factors, including climate, soil, hydrology, forms of land and fire, as well as biotic factors that interact in complex ways.

The Toolkit defines an analytical approach for identifying and mapping rare or endangered ecosystems under HCV 3. The analytical method requires rare or endangered status to be evaluated within physiographic sub-units of the major Indonesian islands, as shown for Central Kalimantan in Figure II-4. The aim of the analytical approach is to compare the past, present and future projected extent of individual ecosystems within a physiographic region to determine their current and future extent, what ecosystem types are considered rare and which under threat today or at risk in the future.

RePPProt Land System Mapping

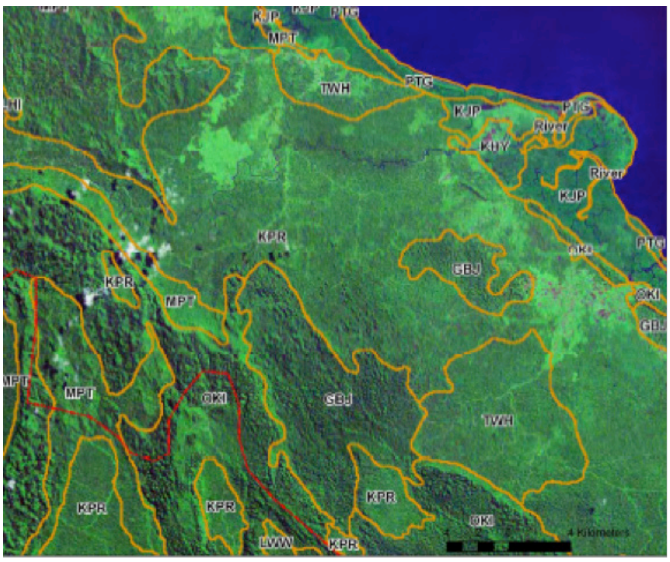
To map ecosystem types, we used an ecosystem proxy map derived from Regional Physical Planning Program for Transmigration (RePPProT, 1990), following methods defined in the Toolkit. In the 1980s, Indonesia started the ambitious Regional Physical Planning Program for Transmigration (RePPProT) to evaluate development potentials of each province. The foundation of the project was the mapping of land systems, a concept based on ecological principles and the interdependent relationships between topography, elevation, lithology, drainage, climate and soil and organisms.

In total, 414 land systems were mapped for the entire territory of Indonesia by RePPProT. Of these, 49 are found in Kalimantan, most of which are present in Central Kalimantan. The mapping of land systems in RePPProT was intended to evaluate the suitability of the land for agricultural food production but it can also be used for ecosystem mapping because the factors used to define the land system are the same as factors affecting the formation of ecosystems types and sub-types. RePPProT grew out of the scientific tradition that uses land systems as an objective tool for ecosystem-based study (Beier and Brost 2010; Pressey and Logan 1995; Gong et al. 1996). RePPProT used these land systems for descriptive purposes to support development planning, but the Toolkit recommends their use for mapping ecosystem types, as well as geographic sub-units of the major islands (physiographic regions) within which past, present and future projected extent of ecosystems can be contextualized to understand rare or endangered status. An example of how RePPProT land systems differentiate among ecosystem types is shown in Figure II-2 from coastal Kalimantan (Daemeter 2010).

Physiographic regions consist of a number of land systems grouped by their similarities and geographical positions. Physiographic regions are an intuitive concept that group land systems into categories that share recurring characteristics that distinguish them from other regions similar to the way that geographers subdivide a country for descriptive purposes. RePPProT uses these physiographic regions for descriptive purposes, but the HCV Toolkit uses its approach to understand the large-scale biophysical variation of the province and to provide a basis for localized, more detailed assessment ofthe rare or endangered status of ecosystems under HCV 3 to improve planning.

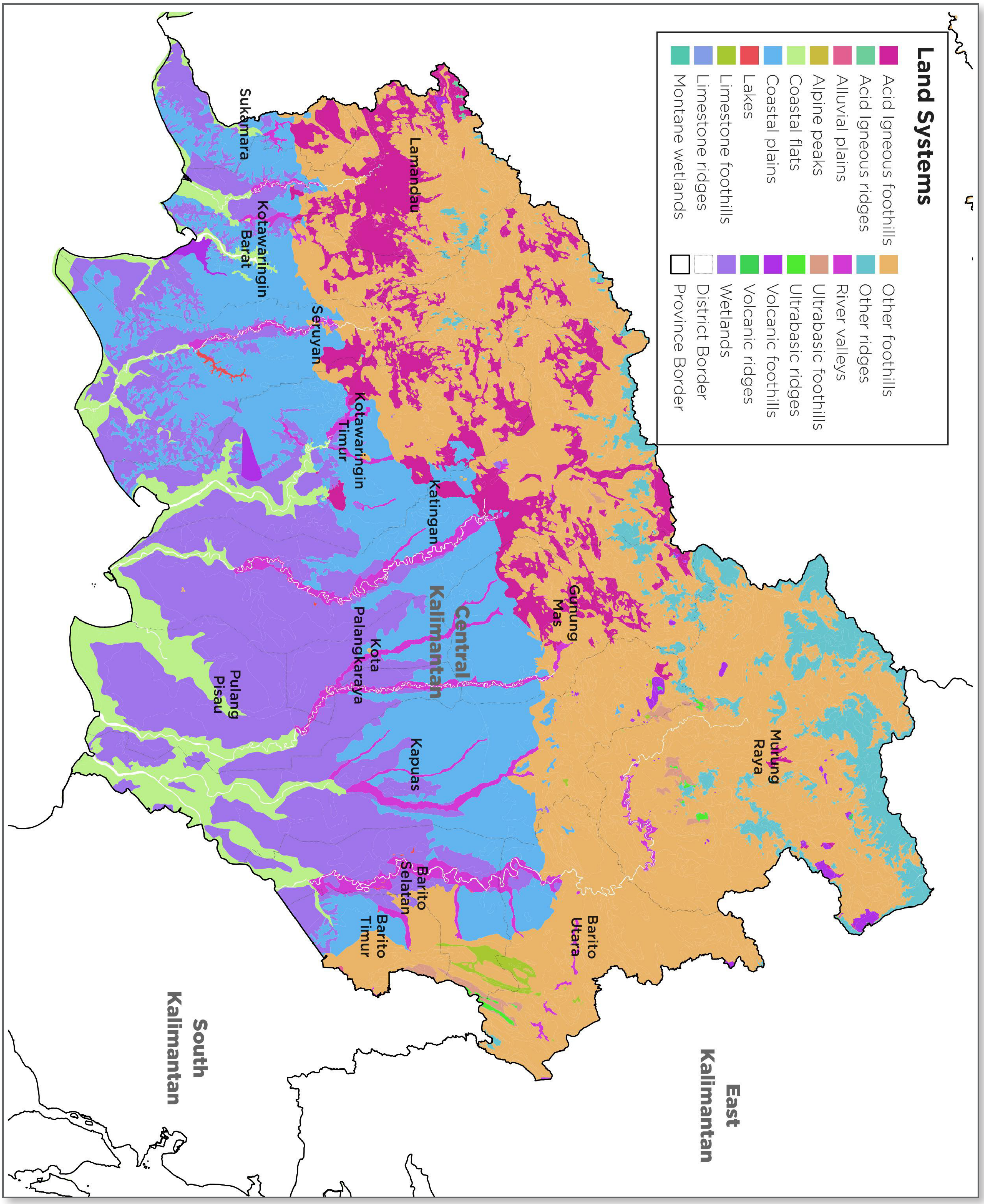
Benefits of using the sub-island scale of physiographic

Figure II-2. Example of ecosystem mapping using RePPProT land systems



Source: Daemeter (2010)

Figure II-3. The Map of Land Systems Used for Ecosystem Mapping across Central Kalimantan.



Derived from RePPProT (1990). A fuller description of vegetation types preset in Central Kalimantan is provided in Annex 2 of this report, together with mention of how ecosystem proxies defined by RePPProT correspond to conventional ecosystem classification.

regions to define the area in which HCV 3 status is evaluated include:

(i) It transcends administrative borders, which bear limited relationship to ecological patterns.

(ii) It promotes the maintenance of similar ecosystem types in geographically distinct but contiguous locations, which reduces the overall risk of extinction, and increases the likelihood of maintaining local genetic adaptations or unique species that might not otherwise be achieved through an island-wide approach or the management of other HCV types.

(iii) It gives special consideration to ecosystem types that may be locally rare or unusual, with special ecological significance, such as isolated hilly areas within lowland swamp landscapes.

To define boundaries of physiographic regions, we used the revised boundaries derived from RePPProT and made available in the Toolkit. Figure II-4 shows the map of physiographic regions present in Central Kalimantan. These are: (1) Central Kalimantan Lowlands, (2) Interior Hill and Plains, (3) Interior Terraces, (4) Mahakam Lowlands, (5) Meratus Mountains, (6) Muller Mountains, (7) Northern Mountain Ranges, (8) Schwaner Mountains, and (9) Southern Coastal Lowlands.

The Interior Hills and Plains (red; 3.15 million ha), Interior Terraces (dark green; 2.6 million ha), and especially Southern Coastal Lowlands (medium green; 6 million ha) are the most extensive in the province. Combined, these three regions cover 76% of the province.

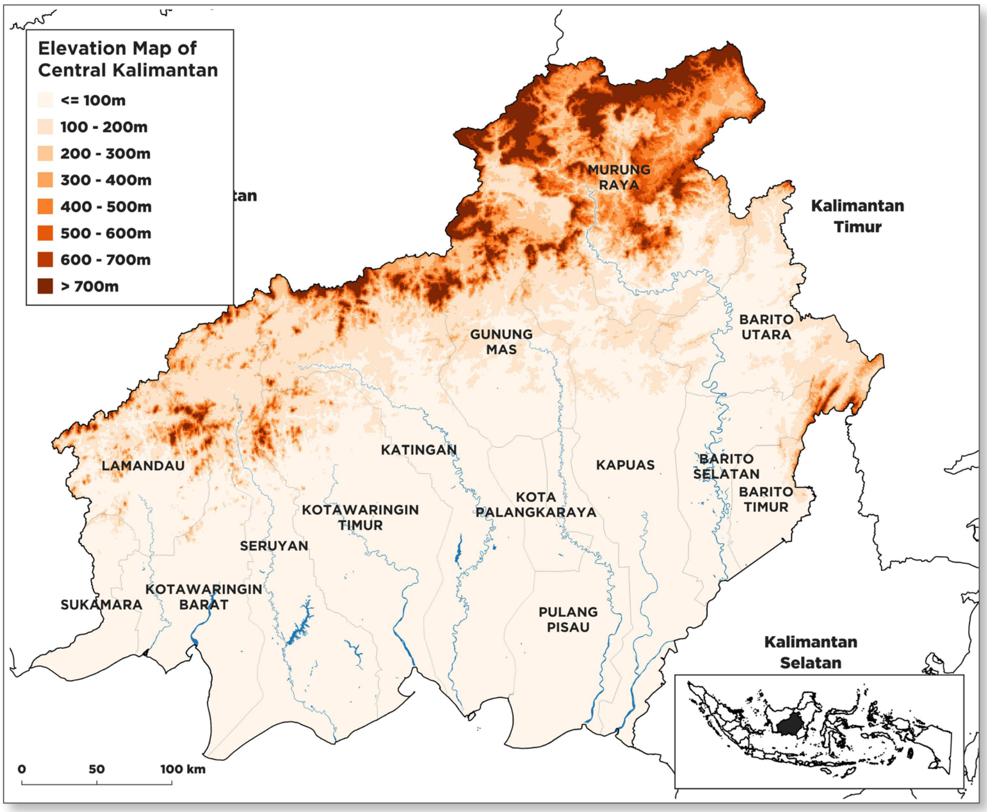
Digital Elevation Model

Identifying areas important for prevention of erosion under HCV 4.2 requires information on various parameters for assessing erosion risk across Central Kalimantan. We obtained this data from the Digital Elevation Model (DEM), which in turn was taken from the NASA Shuttle Radar Topographic Mission (SRTM) M V.04.90.[9] The DEM map for Central Kalimantan is shown in Figure II-5. DEM measures the highest points or elements that are located under a satellite flying above the earth's surface. DEM is a representation of topography and/or elevation of an area or regionin pixel by pixel basis within a raster format, using a digital number (DN) contained in each DEM pixel. Areas with the same height values in the overall region are assigned a similar color to "smooth" these point based measures into groups of similar elevation.

Field verification was conducted also for the slope class of Shuttle Radar Topographic Mission (SRTM) in selected areas to cross check data sets against actual conditions on the ground where data sets appeared to have uncertainties or provided conflicting land classifications compared to, e.g., RePPProT. The verification was conducted in October 2014 at the same time as field verification of present forest cover was completed. Results of the field verification are presented below:

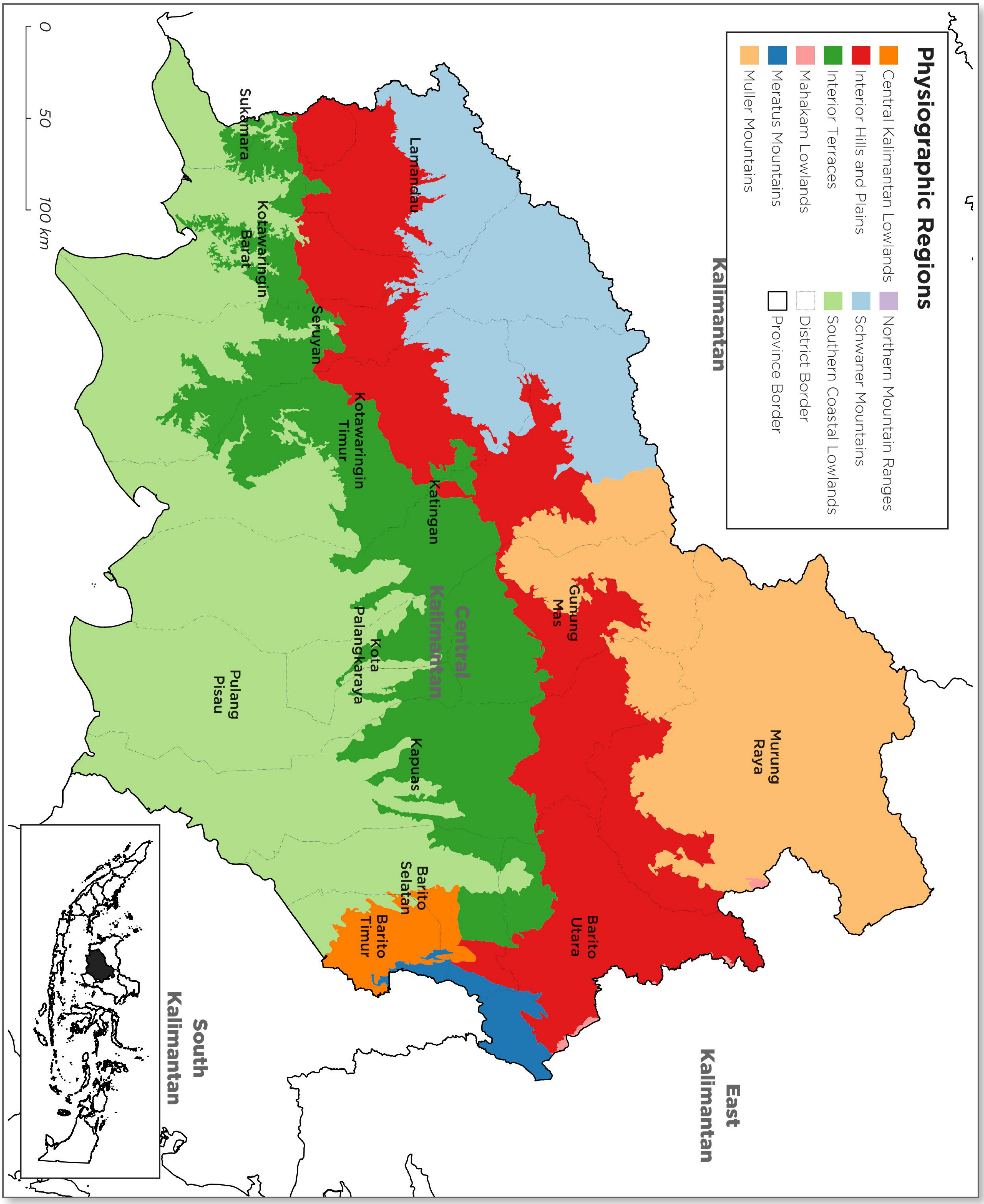
DATA CONFLICT	RESULTS
High to very high slope classes appear in SRTM but not in other datasets	• The slope of SRTM 1 tends to underestimate actual slope conditions on the ground, due to averaging. • By using SRTM as the slope estimator, erosion rates also tend to be underestimated.

Figure II-5. Elevation of Terrain in Central Kalimantan



9 The NASA Shuttle Radar Topographic Mission (SRTM), available from: http://srtm.csi.cgiar.org/

Figure II-4. The Nine Physiographic Regions in Central Kalimantan.



Division of the province into physiographic sub-regions that share in common a defined set of biophysical characteristics improves general understanding of the large-scale biophysical variation of the province. It also provides a basis for localized, contextual evaluation of the rare or endangered status of ecosystems under HCV 3.

2.2.3 DATA LIMITATIONS IN HCV IDENTIFICATION

This assessment is aimed at quickly enabling broad landscape planning and identifying priority HCV areas for further evaluation. Consequently, this mapping exercise sacrifices a degree of precision and accuracy. Data limitations of note include the following:

- **The diversity of tools, methods and platforms used by different parties for interpreting land cover and land use requires adequate verification in the field.** The limited amount of ground verification in the present study means some aspects of HCV 2.1, 2.2, and 3 mapping are imprecise and/or inaccurate.
- **Our maps of HCV 4.2 areas are conservative and likely underestimate the true extent of erosion prone slopes.** We used DEM data with 90 m resolution in identifying HCV 4.2. The resolution from SRTM of 90 m underestimates slope in variable terrain area and thus underestimates erosion risk.
- Landscape-scale HCV mapping can inform jurisdictional-scale development and conservation planning processes. However, many sub-provincial administrative boundaries are still in flux and will need to be clarified before full advantage can be made of this study's analysis.
- In our threat analysis, the dataset for business licenses to develop land is incomplete and outdated. We were unable to obtain a more recent, official dataset from government sources covering all of the districts in the province. This could be explored in a future re-appraisal of threats to HCV areas mapped here.

2.3 HCV Identification - Technical Definitions

2.3.1 HCV 1.1: PROTECTED AREAS AND THOSE THAT SUPPORT THEIR BIODIVERSITY

HCV 1.1 focuses on the management of protected and conservation areas in an effort to protect culture, ecological functions, and/or biodiversity. According to HCV 1.1 guidance in the Toolkit, an area may be identified as HCV 1.1 if it meets either of the following criteria:

- *The Management Unit (MU) contains a protected or conservation area that was established, at least in part, to maintain terrestrial and aquatic/marine biodiversity functions*
- *The MU is thought to provide an important supporting function to a protected/conservation area that is near but outside the MU (e.g., the MU acts as a buffer zone to the protected area)*

2.3.2 HCV 2.1: LARGE NATURAL LANDSCAPES THAT MAINTAIN NATURAL ECOLOGICAL PROCESSES AND DYNAMICS

HCV 2.1, as defined in the HCV Toolkit, aims to identify and protect large natural landscapes that have the capacity to maintain their natural ecological functions and dynamics. The areas are delineated as contiguous mosaic landscapes comprising mostly natural ecosystems with a size and configuration defined as:

- *A core area of >20,000 ha, where internal fragmentation is absent or relatively limited,*
- *Where core is defined as internal forest area surrounded by a three kilometer buffer of vegetation extending from the core zone towards the landscape edge.*

The process for identifying HCV 2.1 is shown in the flowchart of Figure II-6. The detailed step wise instructions provided in the Toolkit and visualized in the flowchart were followed to map HCV 2.1.

Notably, the report made important interpretations in developing the "effective process area" (i.e. the second stage in the flowchart) by filling gaps from the forest cover map with the following assumptions:

(i) Bodies of water (e.g. rivers and lakes) do not reflect gaps in the ecosystem and are considered part of the natural ecosystem if bordered by other natural ecosystems.

(ii) Small gaps might occur because of road presence for logging or small clearings with a width of less than 60 m (two pixels, each 30 m) but will have little to no effect on wildlife. The threshold of 60 m is made arbitrarily but considered plausible, because small gaps like this are not expected to weaken the ecological integrity of a landscape.

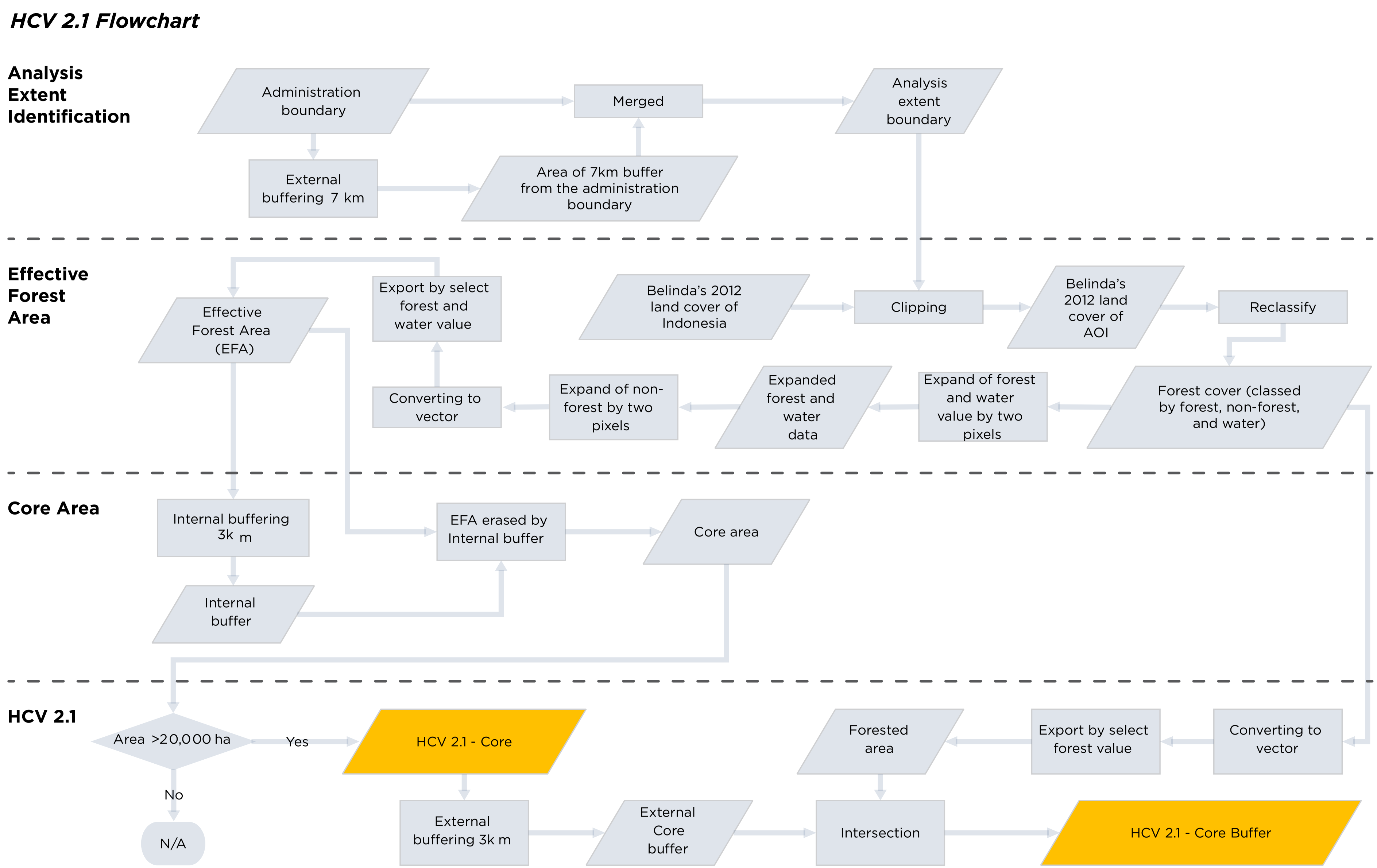
(iii) For gaps in large forest blocks that were left unfilled, if there was a concentration of gaps that would interrupt internal natural conditions and likely altered natural dynamics too severely, such gaps were treated as non forest and affected the delineation of core area and buffers accordingly.

2.3.3 HCV 2.2: AREAS THAT CONTAIN TWO OR MORE ADJACENT ECOSYSTEMS

This section outlines the identification of HCV 2.2, which is defined as a natural landscape including:

- *Two or more adjacent ecosystems that share intact transitional boundaries, especially ecotones between various types of swamp and non-swamp, or non-heath and heath.*

Figure II-6. The Identification Flowchart of HCV 2.1



(Source: HCV Toolkit for Indonesia, 2008).

- *Forested mountain slopes including distinct types of ecosystems distributed along the gradient of altitude, especially the transition areas from lowland forest to sub-montane forests and mountains, with their distinctive plant species and ecological dynamics.*

In this assessment, the three different variables considered in the identification of this HCV are: (i) altitude, (ii) wetland and non-wetland, and (iii) non-heath forest and heath forest. Some main assumptions made for identifying the three transition regions are as follows:

- Elevational transitions are defined as the transitions between classes defined as 0-500 m, 500 -1,000 m, and >1000 m above sea level. It is recognized that the boundary transitions between lowlands, sub-montane and montane will take place at various elevations depending on the microclimate, but these rules are a fair approximation.
- For wetlands, it's assumed that all systems of permanently inundated land, including coastal marsh, swamp forest, and peat bog are wetland and all other land is dry land with narrow phases of transition from wetland to dry land ecosystems.
- Finally, for heath forest, it is assumed that land systems known to support heath forest based on edaphic conditions still support heath forest if that area remains forested.

The flowchart of HCV 2.2 identification is similar to HCV 2.1, only with slight modifications in certain parts. The Toolkit provides limited guidance on ways to map the ecotone for HCV 2.2 or ways to manage it. As the main approach here, a 3 km-wide buffer zone is created centered on the whole transition zone, with overlapping ecotones dissolved into one to avoid double counting. The 3 km-wide buffer will provide more opportunities to maintain natural ecosystem processes. In addition, if the buffer zone can be maintained, it still allows space to accommodate errors made in mapping at this very large spatial scale.

2.3.4 HCV 3: ENDANGERED OR RARE ECOSYSTEMS

According to guidance in the HCV Toolkit for HCV 3 (endangered or rare ecosystems), an ecosystem is considered endangered if it meets one or both of the following criteria:

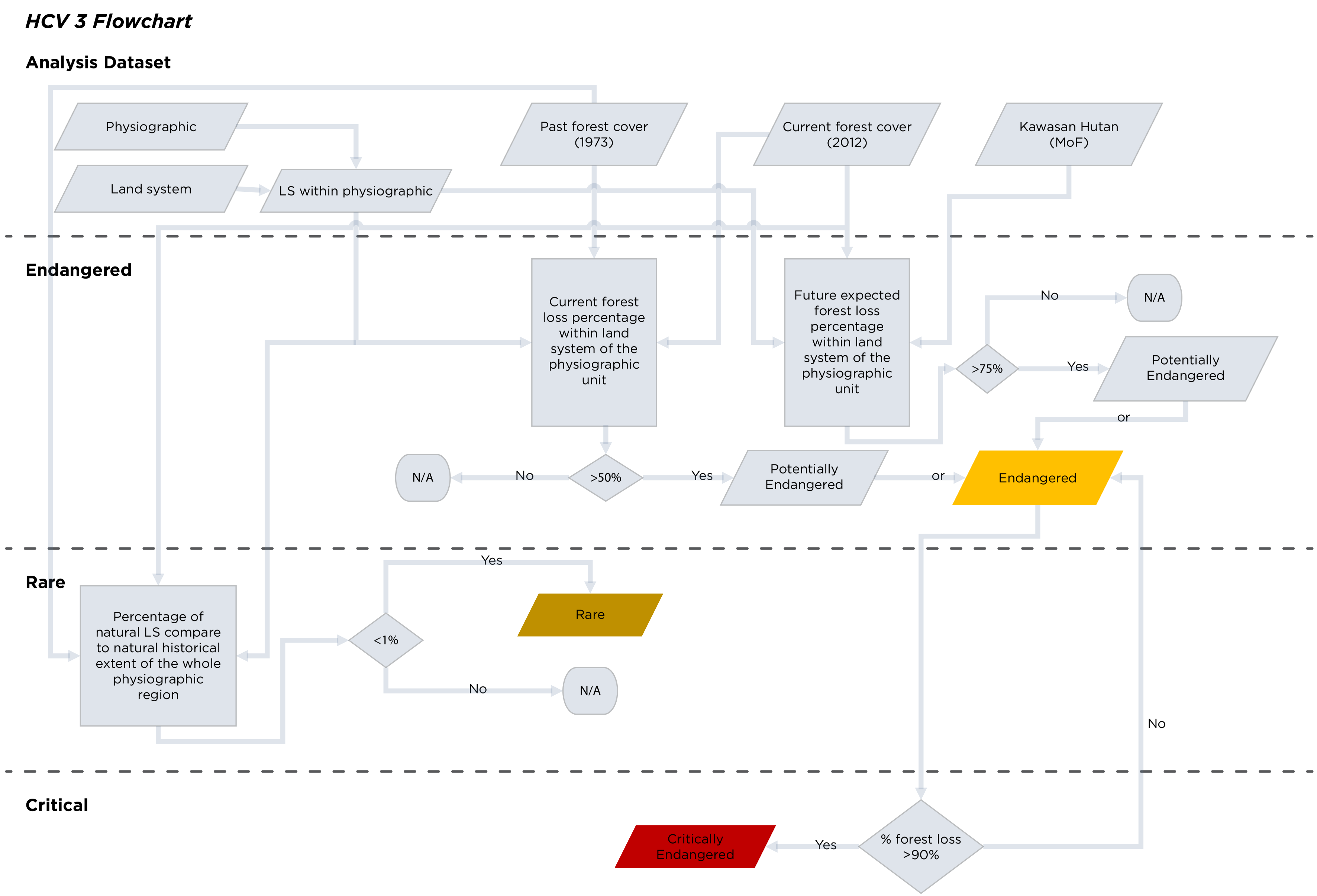
- *The ecosystem has lost 50% or more of its original extent in the physiographic region;*
- *The ecosystem is expected to lose 75% or more of its original extent within the physiographic region, based on the assumption that the entire area is currently allocated for conversion in government spatial plans.*

An ecosystem is considered rare if it meets the following criteria:

- A natural ecosystem that represents less than 5% of remaining natural vegetation cover in the assessed physiographic regions.

The flow process for HCV 3 identification is shown in Figure II-7. Here, we follow Toolkit definitions closely, with a few modifications. First, we propose a new category called "Critically Endangered." Second, the study also proposes changes to the criteria of Rare Ecosystems to reconcile with conditions on the ground. Key proposed changes from the Toolkit are described below (Table II-4). These adjustments better tailor HCV Toolkit guidance specifically for Central Kalimantan.

Figure II-7. The Identification Flowchart of HCV 3



(Source: HCV Toolkit for Indonesia, 2008).

Table II-4. Amendments to the Approach of the HCV Toolkit for Indonesia

EXISTING TOOLKIT CATEGORIZATION	AMENDED APPROACH	RATIONALE FOR AMENDMENT
HCV 3 has two classes of ecosystem: Endangered and rare ecosystems	Introduction of new sub class of critically endangered, with definition of: when the current or projected future extent falls below 90% the original extent.	This additional sub class could be useful for developing a more stringent set of management recommendations for critically endangered ecosystems.
HCV 3 defines rare ecosystems as: An ecosystem that constitutes less than 5% of a physiographic region as a result of natural factors or human intervention	A new definition for rare ecosystems: A natural ecosystem whose historical extent covered less than 1% of natural vegetation cover in the assessed physiographic region.	The current definition uses a proportion of the size of the current natural vegetation in the physiographic region. This could lead to unintended results if the size of all other ecosystems diminishes drastically, while the size of the rare ecosystem remains the same. A physiographic region often has 20 or more types of ecosystems and if they are all the same extent, this equals 5%, and all ecosystems would be considered rare, leading to an overstatement of true scarcity. The amended definition for "rare ecosystems" allows for an ecosystem that has lost significant vegetation cover to be classified as rare regardless of the size of other ecosystems. At the same time, it also ensures that all ecosystems can be considered rare even if they all decrease in size at the same time.
	Simplified categorization: No sub-division of sub-montane and montane ecosystems as distinct from lowland ecosystems.	An ecosystem as defined by land systems already maps mountainous regions as a special class, distinct from others making further subdivision unneccessary. This simplifies the analysis and is a better representation of what HCV 3 aims to capture.

2.3.5 HCV 4.2: AREAS IMPORTANT FOR THE PREVENTION OF EROSION AND SEDIMENTATION

The Toolkit recommends use of the Universal Soil Loss Equation (USLE) formula for predicting potential erosion under HCV 4.2. The formula is defined by Wischmeier and Smith (1978), as follows:

$$A = R * K * LxS * C * P$$

A = Loss of soil expressed in tonnes /ha/year.
R = Rainfall erosivity measured by kinetic energy during specific rainfall or of average annual rainfall
K = Soil erodibility
L = Slope gradient
S = Slope length
C = Land cover (forms of land management)
P = Practices of erosion control

For the purpose of HCV 4.2 identification, which aims to calculate potential erosion (E), a slightly simplified version of this formula is required:

$$E = R * K * L * S$$

Under Toolkit definitions, areas with potential loss of land of >180 metric tons/ha/year are categorized as HCV 4.2. By using GIS, the application of a Universal Soil Loss Equation (USLE) formula can be carried out across a relatively wide area. The estimate of potential erosion is generated in the form of a raster, which is calculated for each pixel on each resolution of the DEM being used (Wells 2008).

Section 3: HCV Identification Findings

This section presents the main results of the study in two parts. Part 1 describes forest cover of Central Kalimantan in the past, present and its future projected extent and provides a visual interpretation of forest condition.

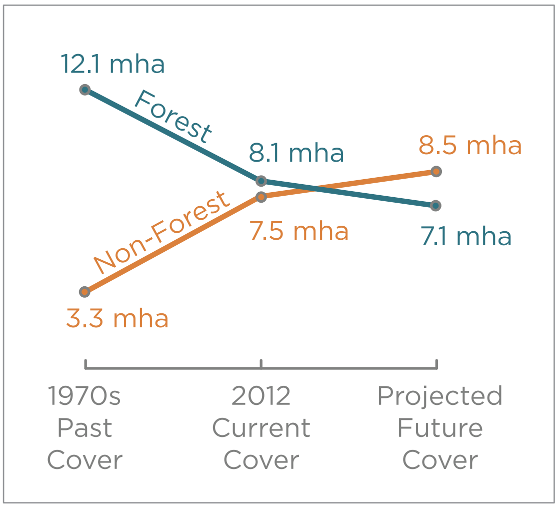
Part 2 describes the HCV areas identified for each of the five HCV types mapped in the study. Recommendations are provided on how to manage the areas. These recommendations should not be viewed as requirements, but rather as inputs to stimulate future multi-stakeholder discussion on expectations for management to maintain landscape-level HCV areas identified in the province.

3.1 Forest Cover: Past, Present and Future

Forest cover is one of the most important indicators to assess ecosystem sustainability. In recent years, there has been a significant decline of forest cover in Central Kalimantan, particularly in the last two decades. Past, present, and future projected forest cover in the province are summarized in Figures III-1, III-2, III-3, and III-4, respectively.

Based on Gaveau et al. (2014), past forest cover in Central Kalimantan (as of 1973) was approximately 12.1 million ha, and non-forest covered just over 3 million ha. For the remaining 272,247 ha of the province, no data were available. Current forest area was mapped using Margono et al. (2014). A comparison between the two (Figure III-1, and III-2 vs III-3) shows there was a decline of 3.98 million ha (32%) over the 40-year period (1973 to 2012).

Figure III-1. Past, Present and the Future Projected Forest Cover in Central Kalimantan



Sources: Past cover from Gaveau et al., (2014); 2012 cover from Margono et al., (2014).

This decline shows that natural forests in Central Kalimantan have experienced considerable loss in forest cover owing to exploitation, fires and conversion to plantations. The decline coincides with the emergence of extensive extractive industrial activities starting in the early 1970s. According to Gaveau et al. (2014), over the past 40 years, Central Kalimantan has lost forest at a rate more than two times higher than total cumulative losses up to 1973, due mainly to fires, plantation expansion on an industrial scale, especially for oil palm, and to a lesser degree intensive logging (around 10% of the total).

Such forest losses were highly variable across the province, with much higher levels of deforestation in some districts than others (Table III-2, Figure III-2). Deforestation was most extensive in Kotawaringin Timur (Kotim, c 870,000 ha) and Seruyan (c 600,000 ha) Districts, together accounting for nearly 38% of province wide losses. Deforestation was also high in Katingan, Kapuas and Kotawaringin Barat Districts (range 320,000-407,000 ha), together accounting for 26% of province wide losses. In contrast, forest losses were much lower in Barito Timur, Barito Selatan, Murung Raya (despite its large size) and Palangka Raya Districts. As a percentage of past forest cover, losses were greatest in Sukamara, Kotawaringin Timur, Kotawaringing Barat, Barito Timur and Seruyan.

Future projected forest cover was estimated based on the assumption, described above, that forest areas currently zoned for conversion under spatial planning will be converted at some point in the future (Figure III-3, Table III-1). Using this approach, forest cover is predicted to decline a further 1,091,997 ha due to planned conversion, declining to just over 7 million ha. As with past deforestation, future projected losses vary across districts and are highest in Katingan, Seruyan, Lamandau, Barito Utara and Kapuas.

Using 1973 as a reference baseline, and combining recent and future projected deforestation across the province, the data suggest a total of 5,061,000 ha has been and/or will be lost in the future. This represents 42% of forest cover that existed in the province as of 1973. As a percentage of past forest cover, and considering both current and future projected losses, deforestation is greatest in Sukamara, Kotawaringin Timur, Kotawaringin Barat, Barito Timur and Seruyan.

Table III-2. Summary of past, present and future projected forest areas and forest loss in each district of Central Kalimantan.

DISTRICT	FOREST COVER CHANGE 1973 - 2012				FUTURE PROJECTED LOSSES OF 2012 FOREST DUE TO SPATIAL PLANNING		
	PAST FOREST COVER (HA)	2012 FOREST COVER (HA)	TOTAL FOREST LOSS FROM 1973-2012 (HA)	% DECREASE IN FOREST COVER (1973-2012)	PROJECTED FOREST COVER (HA)	PROJECTED LOSS (HA)	PROJECTED % DECREASE IN FOREST COVER
BARITO SELATAN	441,435	309,747	131,688	30%	236,937	72,810	46%
BARITO TIMUR	117,301	55,659	61,642	**53%**	26,606	29,053	**77%**
BARITO UTARA	754,660	574,814	179,847	24%	472,802	**102,011**	37%
GUNUNG MAS	796,517	597,598	198,919	25%	510,224	87,374	36%
KAPUAS	1,316,734	981,154	**335,580**	25%	874,553	**106,601**	34%
KATINGAN	1,687,204	1,280,618	**406,585**	24%	1,081,132	**199,486**	36%
KOTAWARINGIN BARAT	605,246	281,966	**323,280**	**53%**	207,971	73,995	**66%**
KOTAWARINGIN TIMUR	1,255,570	387,318	**868,251**	**69%**	338,843	48,476	73%
LAMANDAU	619,436	386,949	232,487	38%	307,344	**79,605**	50%
MURUNG RAYA	2,163,248	2,029,981	133,268	6%	1,971,539	58,441	9%
PALANGKA RAYA	234,136	156,612	77,523	33%	112,835	43,777	**52%**
PULANG PISAU	685,562	396,937	288,625	42%	341,736	55,201	50%
SERUYAN	1,259,869	652,741	**607,128**	**48%**	536,911	**115,830**	**57%**
SUKAMARA	188,564	47,224	141,340	**75%**	35,931	11,293	**81%**
TOTAL			***3,986,163***	***33%***		***1,083,953***	***42%***

Top 5 districts with largest areas of past and projected forest loss, and with the largest percentage of forest loss compared to the past, are highlighted in bold red.

Figure III-2. Map of Central Kalimantan Forest Cover in the Past (Gaveau et al., 2014).
Forest cover is mapped using an array of historical Landsat images obtained from Landsat archives. A mix of dates was used to produce a composite image for province wide classification, but most images centered on 1973. In the aggregate, the forest as of 1973 covered 12.1 million ha or roughly 80% of the province.

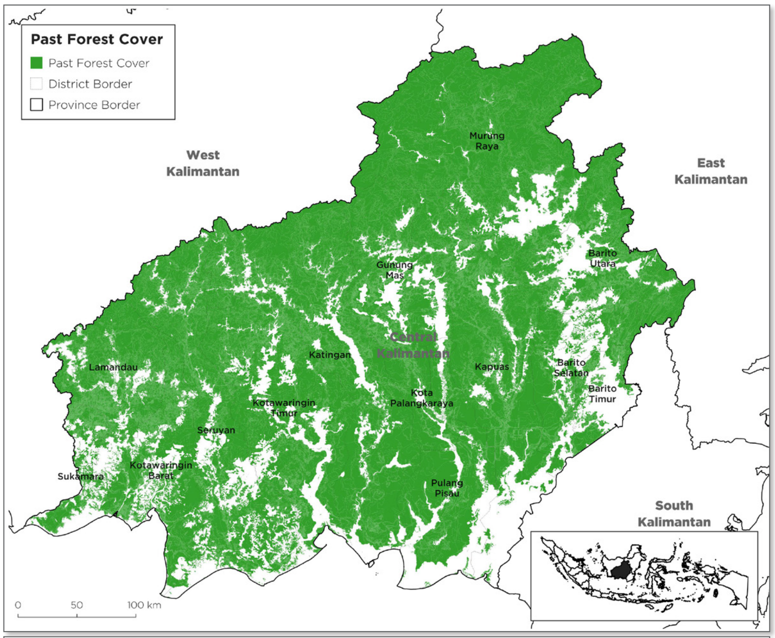


Figure III-3. Map of Central Kalimantan Forest Cover at Present (Margono et al. 2012).
Margono et al. used a sub-pixel analytical technique to classify natural forest across Indonesia, and distinguish primary from logged forest. In this map, primary and secondary forest are combined into one forest cover class, in line with guidance from the HCV Toolkit (2008). Natural forest as of 2012 was estimated to cover 8.1 million ha, just over half the total area of Central Kalimantan. Compared with historical forest cover, this represents losses of just under 4 million ha over the 40-year period, 1973-2012, with average losses of approximately 100,000 ha per annum.

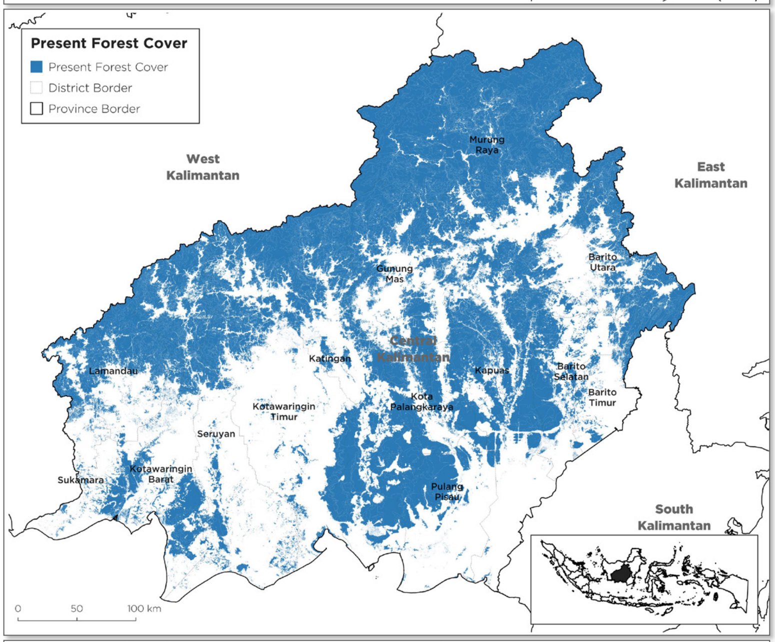
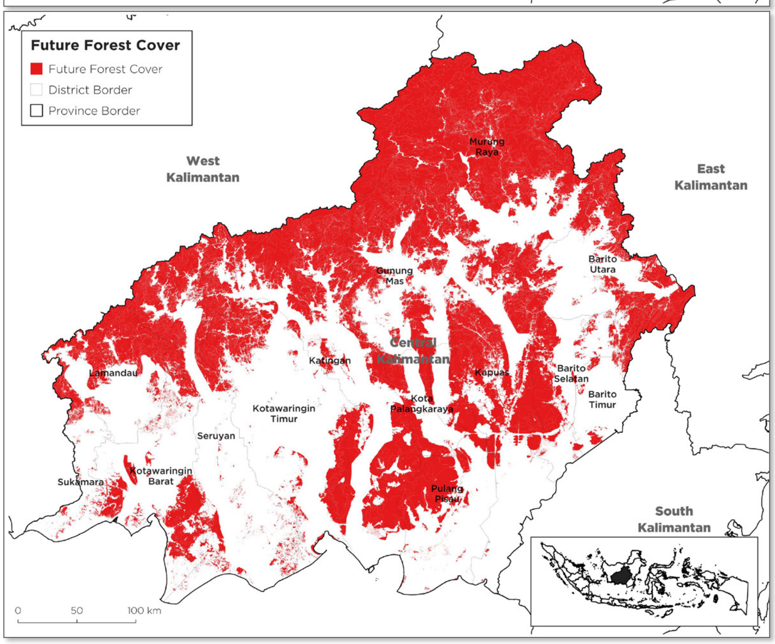


Figure III-4. Map of Future Projected Forest Cover in Central Kalimantan.
This map is derived from 2012 forest cover depicted in Figure III-2, by overlaying spatial planning to identify forested areas that are zoned for conversion. Following Toolkit guidance, we assume that all such forested areas zoned for conversion will be converted at some point in the future. Compared to 2012 forest cover, future projected losses due to spatial planning total an estimated 1.1 million ha. These projected losses, combined with forest losses from 1973-2012, represent total losses of 5,061,000 ha, or 42% of province-wide forest cover over the past 40 years.



3.2 Identified High Conservation Value Areas (HCVA)

Overlaying all of the HCV areas identified in this study, and combining into one layer, shows that roughly 60% of the area of Central Kalimantan supports one or more of the five HCVs mapped in this study (Table III-3). **We emphasize, the occurrence of high conservation value areas (HCVA) does not mean that most of Central Kalimantan province should not be developed.** Rather, it means that large-scale planning and management is required to balance development with the maintenance of key environmental services. Much of this management context is described below in Section 4.

Summaries of HCV findings and area delineations across the province as a whole are shown in Table III-3 and Figure III-5 and for each district in Table III-4 and Figures III-5 to III-10.

Table III-3. Summary of HCV Identification Results that generate HCVA in Central Kalimantan

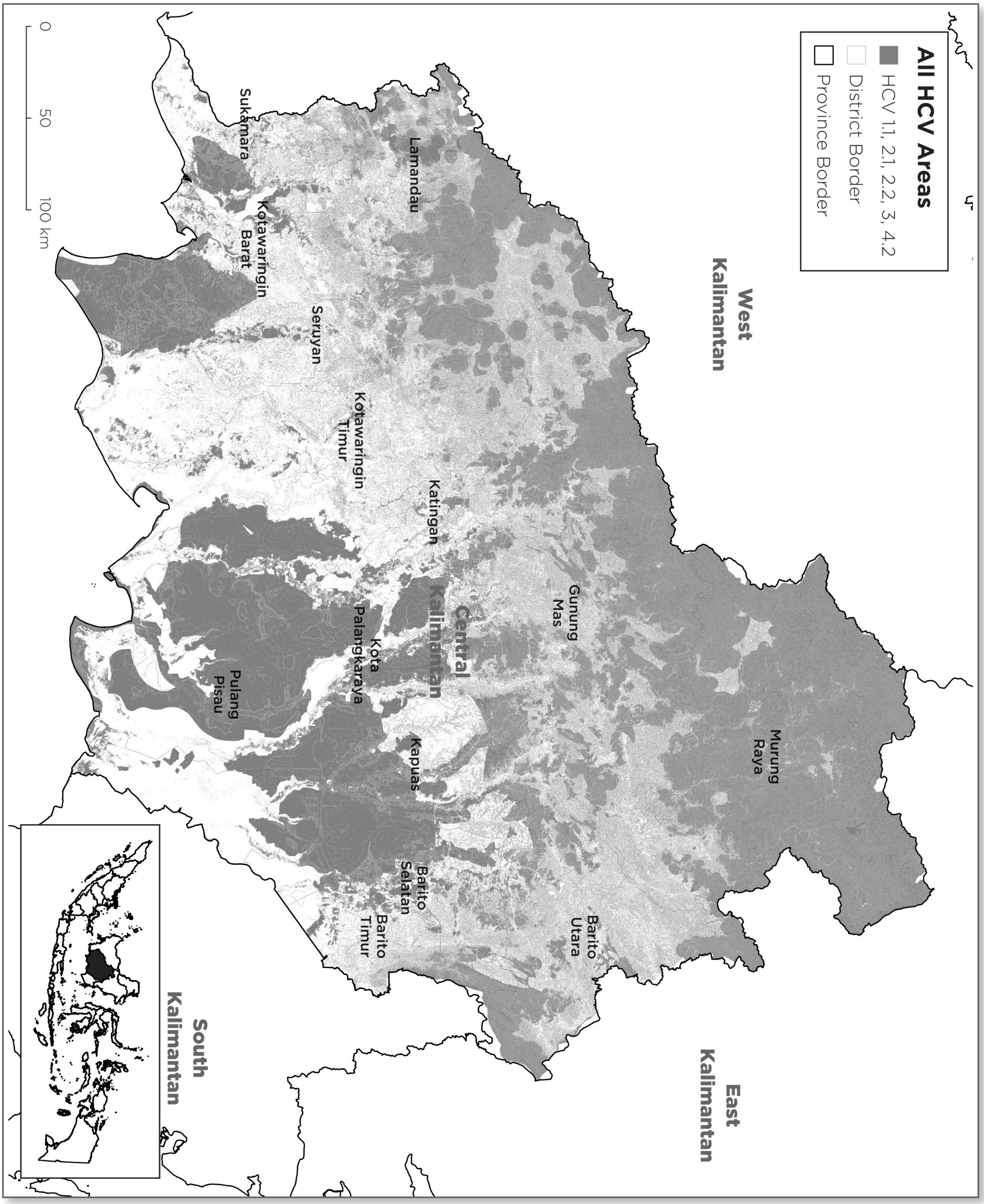
	HIGH CONSERVATION VALUE AREAS	IDENTIFIED SIZE (HA)
1	Areas that contain or provide biodiversity support fuction to protection or conservation areas	2,990,049
2.1	Large natural landscape	3,205,192
2.2	Areas that contain two or more contigious ecosystem	4,552,126
3	Rare and Endangered Ecosystem	1,726,764
4.2	Areas important for prevention of erosion and sedimentation	4,488,486
	Total HCVA (accounting for overlap)	**9,405,716**

Table III-4. Summary of HCV areas in each district (in hectares).

DISTRICT	HCV 1.1	HCV 2.1	HCV 2.2	HCV 3	HCV 4.2	COMBINED HCV AREAS
BARITO SELATAN	180,798	73,071	161,666	118,992	120,051	417,820
BARITO TIMUR			27,182	24,639	54,171	80,260
BARITO UTARA	43,056	118,132	186,771	147,474	383,607	576,505
GUNUNG MAS	88,279	231,501	339,977	**200,339**	**464,454**	754,719
KAPUAS	420,890	118,422	**453,829**	**245,251**	338,113	**1,008,184**
KATINGAN	**466,157**	**557,929**	**539,426**	**254,762**	**453,596**	**1,264,308**
KOTAWARINGIN BARAT	287,857	20,720	181,576	156,245	168,302	540,221
KOTAWARINGIN TIMUR	17,431	107,659	177,396	69,874	344,845	532,266
LAMANDAU	51,991	127,369	224,035	81,540	352,051	515,825
MURUNG RAYA	**687,980**	**1,328,843**	**1,709,053**	98,589	**1,324,521**	**2,097,353**
PALANGKA RAYA	69,028	104,284	107,714	15,276	17,954	170,540
PULANG PISAU	**467,870**	**236,705**	132,647	107,605	33,436	613,013
SERUYAN	177,481	180,557	286,043	174,347	376,284	725,382
SUKAMARA	31,229		24,811	31,831	57,101	109,320
TOTAL	***2,990,049***	***3,205,192***	***4,552,126***	***1,726,764***	***4,488,486***	***9,405,716***

Top three districts with largest areas for each HCV area highlighted in bold red font.

Figure III-5. All HCV areas in Central Kalimantan identified in this study



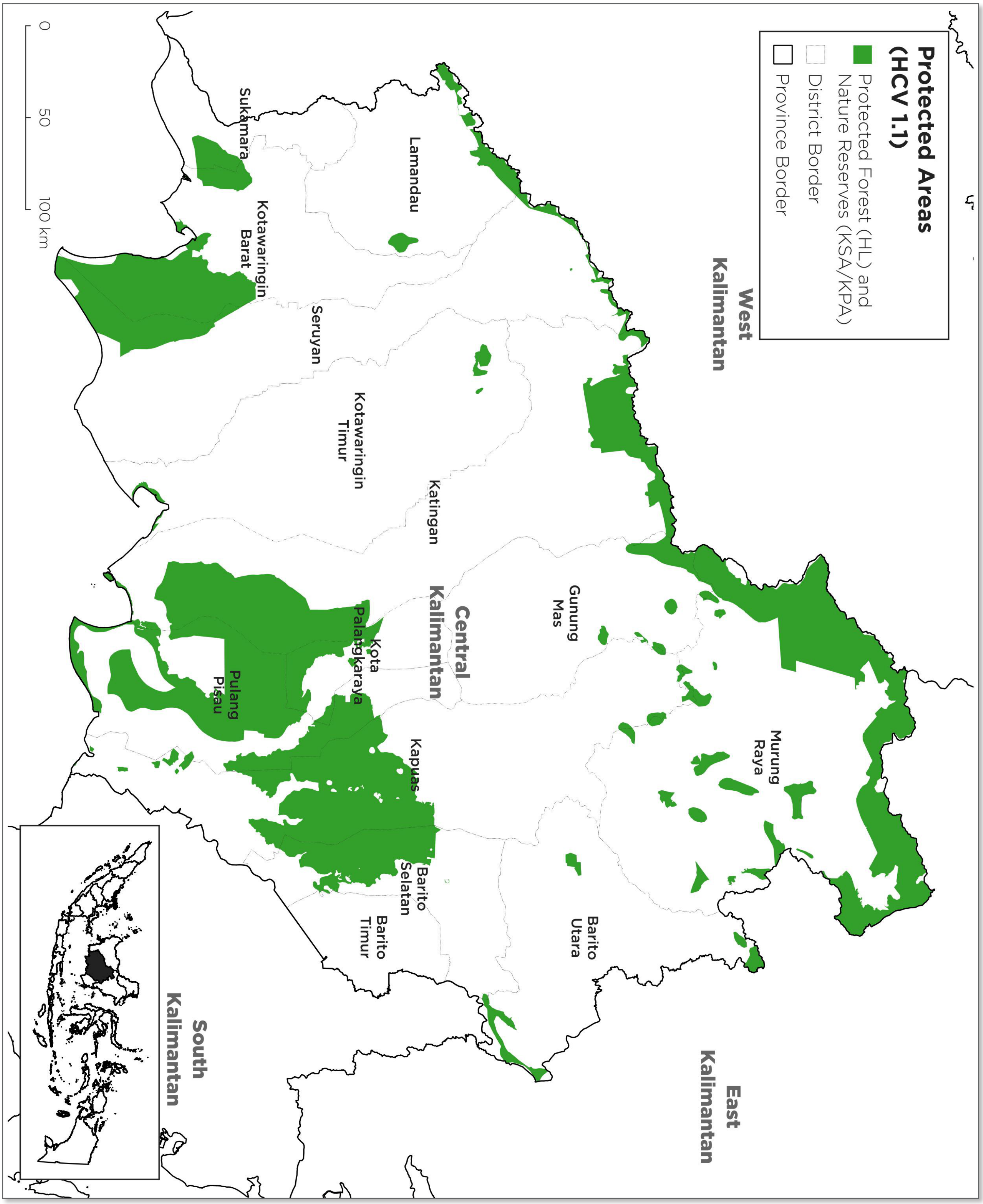
HCV 1.1 – PROTECTED AREAS AND THOSE THAT SUPPORT THEIR BIODIVERSITY

Large areas in Central Kalimantan are designated as conservation areas and or provide an important supporting function to them. Covering nearly 3 million ha (c 20% of the province), these areas are concentrated in the far north and southern portions of the province. A relatively thin band of HCV 1.1 follows the northern borders with West and East Kalimantan, with additional smaller areas throughout Murung Raya in the north. These northern blocks tend to be in mountainous forested areas, designated as Protection forest (Hutan Lindung).

Particularly large concentrations of HCV 1.1 areas can be found in the southern part of the province, including in Katingan, Kapuas and Pulang Pisau (e.g. Sebangau National Park). One relatively large block spans the southern border between Kotawaringin Barat and Seruyan (Tanjung Puting National Park). These southern blocks tend to encompass mainly lowland peat, kerangas (heath), mixed swamp and/or open marsh habitats.

DISTRICT	HCV 1.1
BARITO SELATAN	180,798
BARITO TIMUR	
BARITO UTARA	43,056
GUNUNG MAS	88,279
KAPUAS	420,890
KATINGAN	**466,157**
KOTAWARINGIN BARAT	287,857
KOTAWARINGIN TIMUR	17,431
LAMANDAU	51,991
MURUNG RAYA	**687,980**
PALANGKA RAYA	69,028
PULANG PISAU	**467,870**
SERUYAN	177,481
SUKAMARA	31,229
TOTAL	***2,990,049***

Figure III-6. All HCV 1.1 areas in Central Kalimantan meeting the Toolkit definitions of containing or providing an important support function to a nearby conservation area



HCV 2.1 - LARGE NATURAL LANDSCAPE WITH CAPACITY TO MAINTAIN NATURAL ECOLOGICAL PROCESSES AND DYNAMICS

The map of HCV 2.1 shows that large natural landscapes cover more than 3.1 million ha in total, and are distributed in two major areas. The first area extends across the northern part of Central Kalimantan, from the north-east tip of Murung Raya district bordering East Kalimantan and Malaysia, across to the north-western mountainous area bordering West Kalimantan. The second area is found in the central region of Central Kalimantan, extending to the south and south-east. The second comprises six major sub-units, extending from the central part of the province to the south and the southeast, dominated mainly by large, intact peat and mixed swamp areas, including protected areas (especially Katingan, Kapuas and Pulang Pisau).

HCV 2.1 areas are most extensive in Murung Raya, Katingan and Pulang Pisau Districts, together composing more than two-thirds of the province wide area for this HCV.

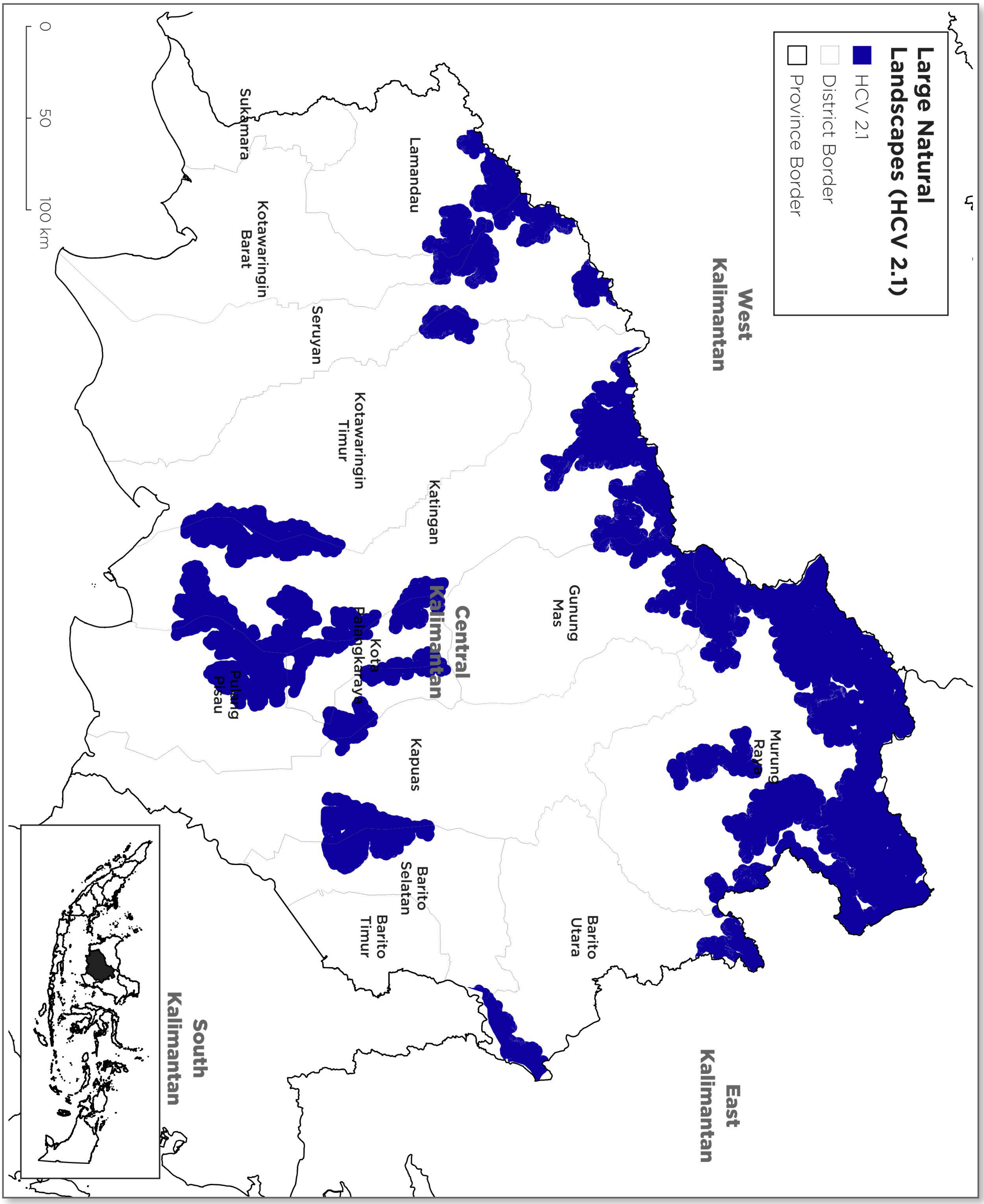
HCV 2.1 is absent from Barito Timur and Sukamara, and is limited in extent in Barito Selatan and especially Kotawaringin Barat, where past deforestation has been severe, and remaining large, intact forest areas are few.

The total area of HCV 2.1 covers nearly 2.8 million ha, just under 20% of the province.

Northern blocks tend to be centered on **mid- to higher-elevation forest** (inset on lower left), whereas southern HCV 2.1 blocks are concentrated on **lowland peat and/or mixed swamp habitats** (inset on lower right). These large, relatively intact forests are some of the most important remaining areas for biodiversity conservation, and should be considered priorities for future government-led, multi-stakeholder reviews of development planning, e.g. as part of future provincial Strategic Environmental Assessment activities or license reviews.

DISTRICT	HCV 2.1
BARITO SELATAN	73,071
BARITO TIMUR	
BARITO UTARA	118,132
GUNUNG MAS	231,501
KAPUAS	118,422
KATINGAN	**557,929**
KOTAWARINGIN BARAT	20,720
KOTAWARINGIN TIMUR	107,659
LAMANDAU	127,369
MURUNG RAYA	**1,328,843**
PALANGKA RAYA	104,284
PULANG PISAU	**236,705**
SERUYAN	180,557
SUKAMARA	
TOTAL	***3,205,192***

Figure III-7. All HCV 2.1 large forest blocks in Central Kalimantan meeting the Toolkit definitions of a landscape with the core, intact forest areas >20,000 ha in extent



HCV 2.2 - AREAS THAT CONTAIN TWO OR MORE ADJACENT ECOSYSTEMS

The transitional ecosystems prioritized under HCV 2.2 (Figure III-8) are spread more evenly throughout Central Kalimantan than other HCVs. These unique areas mark a transition between two or more major types of ecosystems (e.g. between swamp and non-swamp habitats, or between higher elevation montane habitats and lowland ones), and are important for ecosystem energy flux and material flows, and as keystone habitats for wildlife. They also tend to support higher than average levels of biodiversity.

Three major types of transitions are mapped in our study. The first is elevational transitions between montane and lower elevation forests (also called topographic clines). These are represented in dark blue in Figure III-7 and are arrayed in a dense arc across the north part of the province, from Kotawaringin Barat, through Katingan and into Murung Raya.

Wetland ecotones, e.g. from peat swamp to non peat swamp, are represented by light blue on the map and occur in much narrower patches along the major river drainages and coastal areas of Kapuas, Katingan, and Pulang Pisau.

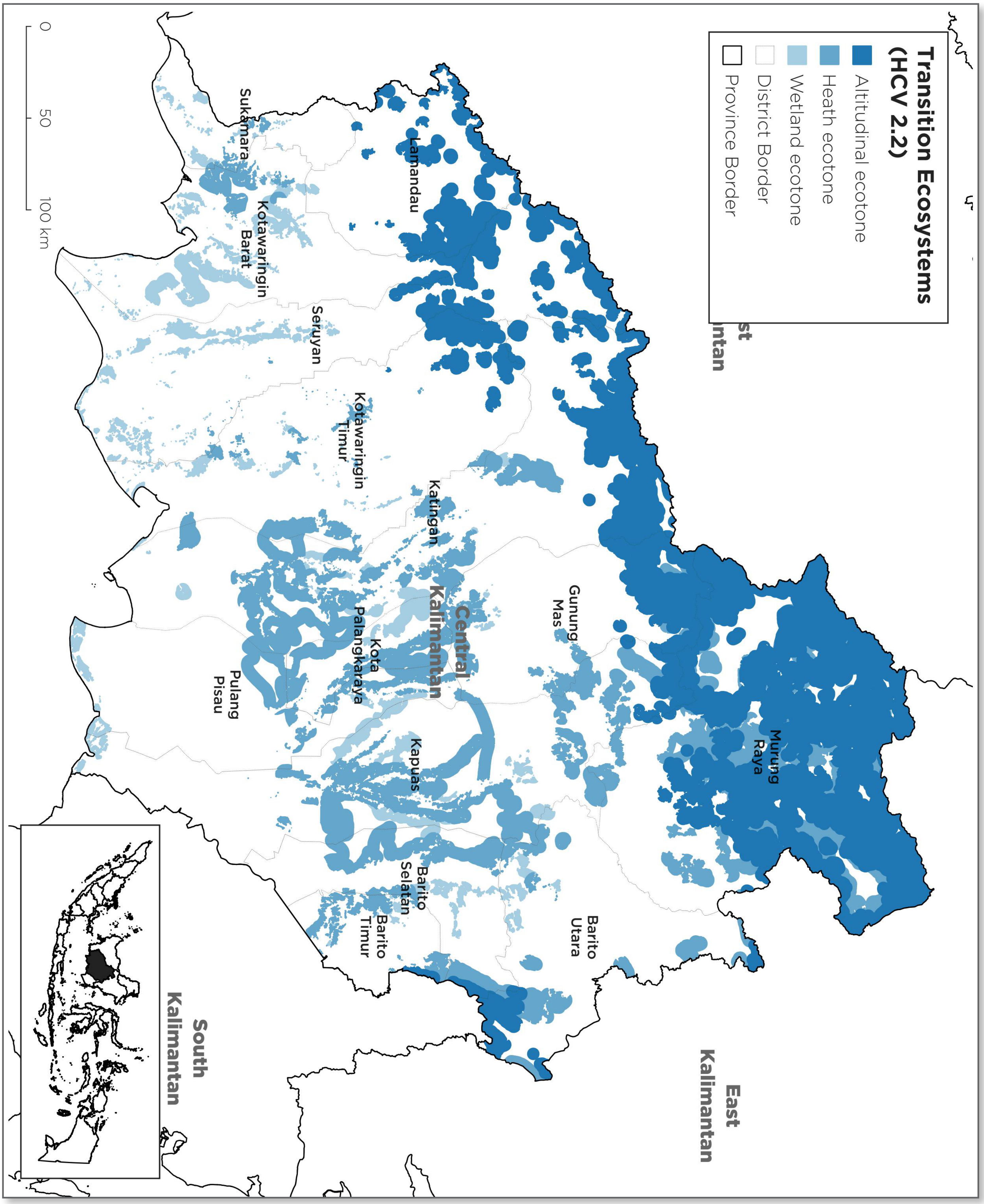
The most widespread ecosystem transition in the province is from heath to non-heath ecosystems. These are shown in sky blue in Figre III-8 and are clustered somewhat in the north, where upland sandstone terraces and cuesta are common, and in a band across the central sandstone terraces region of the province.

HCV 2.2 transitions are most extensive in Murung Raya, Kapuas, and Katingan Districts, and are also widespread in Gunung Mas, Lamandau and Seruyan. They are rare in Sukamara and Barito Timur.

Three major types of transition are mapped: elevational transitions between montane and lower elevation forests (dark blue in the map); heath to non-heath ecotones (blue in the map), and wetland to non-wetland ecotones (red in the map).

DISTRICT	HCV 2.2
BARITO SELATAN	161,666
BARITO TIMUR	27,182
BARITO UTARA	186,771
GUNUNG MAS	339,977
KAPUAS	**453,829**
KATINGAN	**539,426**
KOTAWARINGIN BARAT	181,576
KOTAWARINGIN TIMUR	177,396
LAMANDAU	224,035
MURUNG RAYA	**1,709,053**
PALANGKA RAYA	107,714
PULANG PISAU	132,647
SERUYAN	286,043
SUKAMARA	24,811
TOTAL	***4,552,126***

Figure III-8. All HCVA 2.2 areas that contain two or more adjacent ecosystems with an intact transition zone between them.



HCV 3 - RARE OR ENDANGERED ECOSYSTEMS

HCV 3 areas, defined as rare or endangered ecosystems, are less extensive than other HCVs in our study, but also widespread. They cover an estimated 1.73 million ha (Figure III-9; Table III-5). The extent of HCV 3 areas varies more than tenfold among districts and is most extensive in Gunung Mas, Kapuas, and Katingan Districts. Substantial areas are also present in Seruyan, Kotawaringin Barat, and Barito Utara, where past deforestation has been high but considerable natural ecosystem areas still remain.

The number of ecosystem proxy types that meet HCV 3 criteria in each of Central Kalimantan's nine Physiographic Regions is summarized in Table III-6. Calculations for HCV 3 are summarized in Appendices L1-L9, and descriptions of dominant vegetation types associated with RePPProT land systems are provided in Annex 2 of this report.

As explained above, the Toolkit defines ecosystems as endangered if they meet one or both of the following criteria:

- The ecosystem has lost >50% of its original extent
- The ecosystem is at risk of losing 75% or more of its original extent if forested areas currently zoned for conversion in spatial plans are eventually deforested.

In this study, we added to this Toolkit definition the category Critically Endangered Ecosystems, defined as ecosystems whose current or future projected extent is less than 10% of its original size. Rare ecosystems are defined as natural ecosystems that cover less than 1% of the historical extent of natural vegetation in the physiographic region.

In the map, we distinguish five different types of HCV 3 areas. The first, and by far the largest, is endangered ecosystems (shown in blue in Figure III-9). These are widespread, covering nearly 1.4 million ha (around 9% of the province) with concentrations in the west and southwest, a northward extension arcing through the central inland terraces, and along major rivers. The second is a special subset of endangered ecosystems that meet criteria to categorize them as critically endangered. These are extremely uncommon (<7,000 ha), and mainly present in parts of Barito Selatan and Barito Timur Districts.

DISTRICT	HCV 3
BARITO SELATAN	118,992
BARITO TIMUR	24,639
BARITO UTARA	147,474
GUNUNG MAS	**200,339**
KAPUAS	**245,251**
KATINGAN	**254,762**
KOTAWARINGIN BARAT	156,245
KOTAWARINGIN TIMUR	69,874
LAMANDAU	81,540
MURUNG RAYA	98,589
PALANGKA RAYA	15,276
PULANG PISAU	107,605
SERUYAN	174,347
SUKAMARA	31,831
TOTAL	***1,726,764***

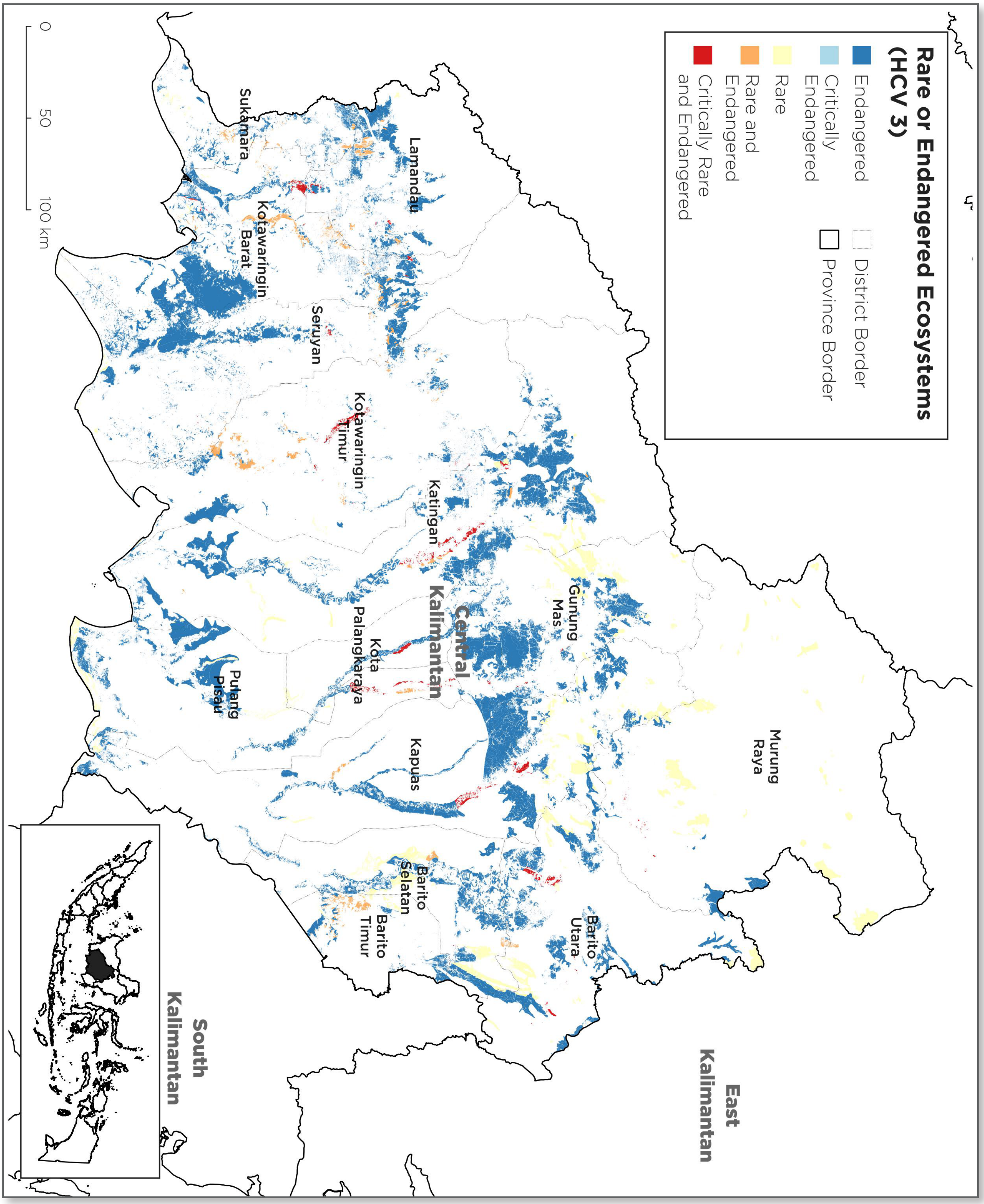
The third category of HCV 3 we mapped is rare ecosystems (highlighted in yellow on the map). Rare HCV 3 ecosystems cover just over 240,000 ha in the province, and are found mainly as patches/strips of alluvial forest along major rivers and riparian zones of the northern, upstream tributaries of major rivers; and in coastal areas of beach vegetation, mangroves and backwater swamps in the south.

The fourth category is ecosystems that meet criteria of both rare and endangered. Such ecosystems are a special priority for protection because they are spatially limited and have suffered significant declines. These are shown in orange on the map, and extend over 58,000 ha, mainly in the southwest. The fifth and final category is a small subset of rare and critically endangered ecosystems that meet criteria for both (shown in red). This category of HCV 3 ecosystem is extremely rare, covering only 31,000 ha, or less 3% of the total HCV 3 area for the province.

Table III-5. Total area of HCV3 ecosystem types present in Central Kalimantan (ha)

TOTAL HCV 3 AREA	(1) ENDANGERED	(2) CRITICALLY ENDANGERED	(3) RARE	(4) RARE AND ENDANGERED	(5) RARE & CRITICALLY ENDANGERED
1,726,764	1,387,678	6,913	242,801	57,982	31,390

Figure III-9. Rare or endangered HCV 3 ecosystems.



Five types of HCV 3 areas are distinguished, covering 1.73 million ha. Endangered ecosystems (purple) are widespread, with concentrations in the west and southwest, a northward extension arcing through the central inland terraces, and riparian associated ecosystems targeted for agriculture. Critically endangered ecosystems (pink) are found in patches with some presence in Barito Selatan District and Barito Timur District in the north and east. Rare ecosystems (yellow) occur as strips of alluvial forest along following major rivers, riparian zones along interior tributaries of these major rivers, and as beach vegetation, mangroves and backwater swamps in coastal areas. Rare and endangered ecosystems (orange) occur mainly in the southwest. Rare and critically endangered ecosystems (red) are restricted mainly to rare riparian and alluvial zones associated with the major river of the province.

Table III-6. Summary of HCV 3 ecosystem types present in different physiographic regions in Central Kalimantan.

PHYSIOGRAPHIC REGION	NUMBER OF LAND SYSTEMS	NUMBER OF RARE ECOSYSTEMS	NUMBER OF ENDANGERED ECOSYSTEMS	NUMBER OF CRITICALLY ENDANGERED ECOSYSTEMS	NUMBER OF HCV 3 ECOSYSTEMS
Central Kalimantan Lowlands	21	14	13	6	18
Interior Hill and Plains	27	18	11	5	22
Interior Terraces	18	15	17	10	17
Mahakam Lowlands	34	30	25	17	34
Meratus Mountains	19	10	5	0	11
Muller Mountains	23	12	0	0	12
Northern Mountain Ranges	24	14	1	0	14
Schwaner Mountains	13	5	1	0	5
Southern Coastal Lowlands	23	15	15	5	20

Note calculations for determining the HCV 3 status of individual land systems are summarized in Appendices L1-L9, and descriptions of dominant vegetation types associated with land systems are provided in Annex 2.

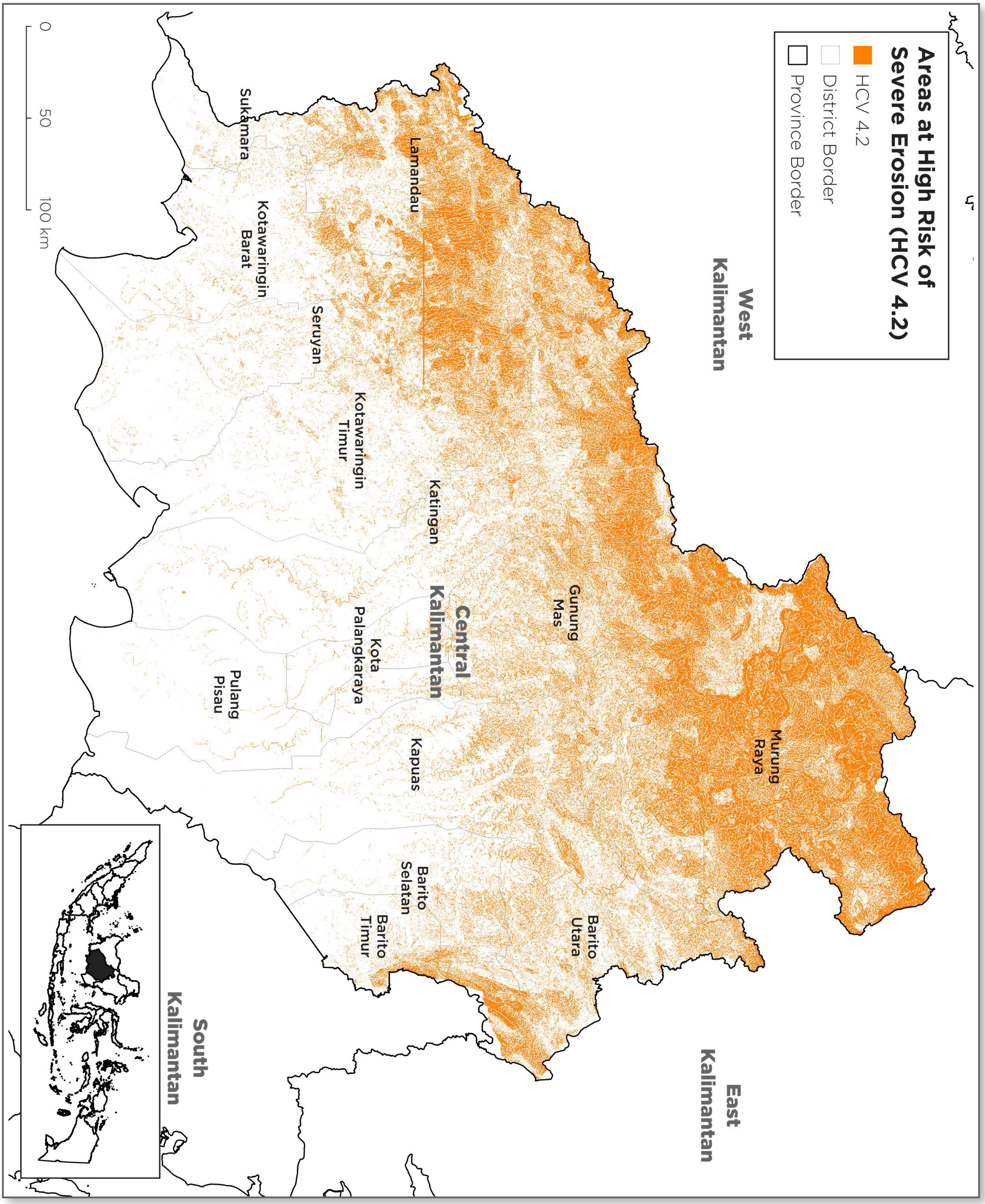
HCV 4.2 - AREAS IMPORTANT FOR THE PREVENTION OF EROSION AND SEDIMENTATION

HCV 4.2 draws attention to areas that present a high risk for severe erosion and sedimentation. HCV 4.2 covers nearly 4.5 million ha in Central Kalimantan, reflecting the steep slopes and shallow soils widespread throughout much of the province (Figure III-10). Highest risk areas are concentrated in the north, but also extend southward along dissected terraces separating the major north, south running rivers that drain the interior of the province.

HCV 4.2 mapping illustrates that much of Central Kalimantan Province must be managed carefully to prevent erosion and excessive sedimentation of rivers and waterways. In area terms, high erosion risk areas are most extensive in Murung Raya, Katingan, and Gunung Mas Districts, but also cover large areas of Barito Utara, Kapuas, Kotawaringin Timur, Lamandu and Seruyan.

DISTRICT	HCV 4.2
BARITO SELATAN	120,051
BARITO TIMUR	54,171
BARITO UTARA	383,607
GUNUNG MAS	**464,454**
KAPUAS	338,113
KATINGAN	**453,596**
KOTAWARINGIN BARAT	168,302
KOTAWARINGIN TIMUR	344,845
LAMANDAU	352,051
MURUNG RAYA	**1,324,521**
PALANGKA RAYA	17,954
PULANG PISAU	33,436
SERUYAN	376,284
SUKAMARA	57,101
TOTAL	***4,488,486***

Figure III-10. HCV 4.2 Areas Important for the Prevention of Erosion and Sedimentation of Rivers.



HCV 4.2 covers nearly 4.5 million ha in Central Kalimantan, reflecting the steep slopes and shallow soils that are widespread in much of the province, especially in the north.

3.2.1 GEOGRAPHICAL DISTRIBUTION OF ALL HCV AREAS ACROSS DISTRICTS OF CENTRAL KALIMANTAN

All HCV areas identified and mapped in the study should receive special consideration for management attention as part of future provincial or district level development planning review and/or Strategic Environmental Assessment activities. Yet, it can be useful to ask if some districts emerge as a higher priority than others based on the number and cumulative extent of HCVs present in them compared to other districts.

Using a simple metric of cumulative rank across the five HCVs studied (where ranks 1,2,3 indicate larger areas), the districts of Katingan, Murung Raya, Gunung Mas, Kapuas, and Seruyan emerge as notably important compared to other districts (Table III-7).

Murung Raya supports by far the largest area of cumulative HCV, at nearly 2.1 million ha; Katingan ranks in the top three in HCV extent for all five HCVs. In contrast, the districts of Palangka Raya, Barito Timur, and Sukamara score lower. For Palangka Raya this partly reflects its smaller size; for Barito Timur and Sukamara, it reflects high levels of past deforestation having left smaller areas of remaining forest. The relationship between total HCV area, remaining forest and past deforestation is depicted in Figure III-11.

Taken as a group, these top five ranking districts together comprise 56-75% of the area of each HCV type delineated in the study and 62% of total HCV areas overall. This suggests that incorporating protection of HCV areas into sustainable development planning in these districts could provide a solid foundation for balancing environmental and development goals for the province as a whole.

Figure III-11. Total HCV area, forest cover and historic loss by district

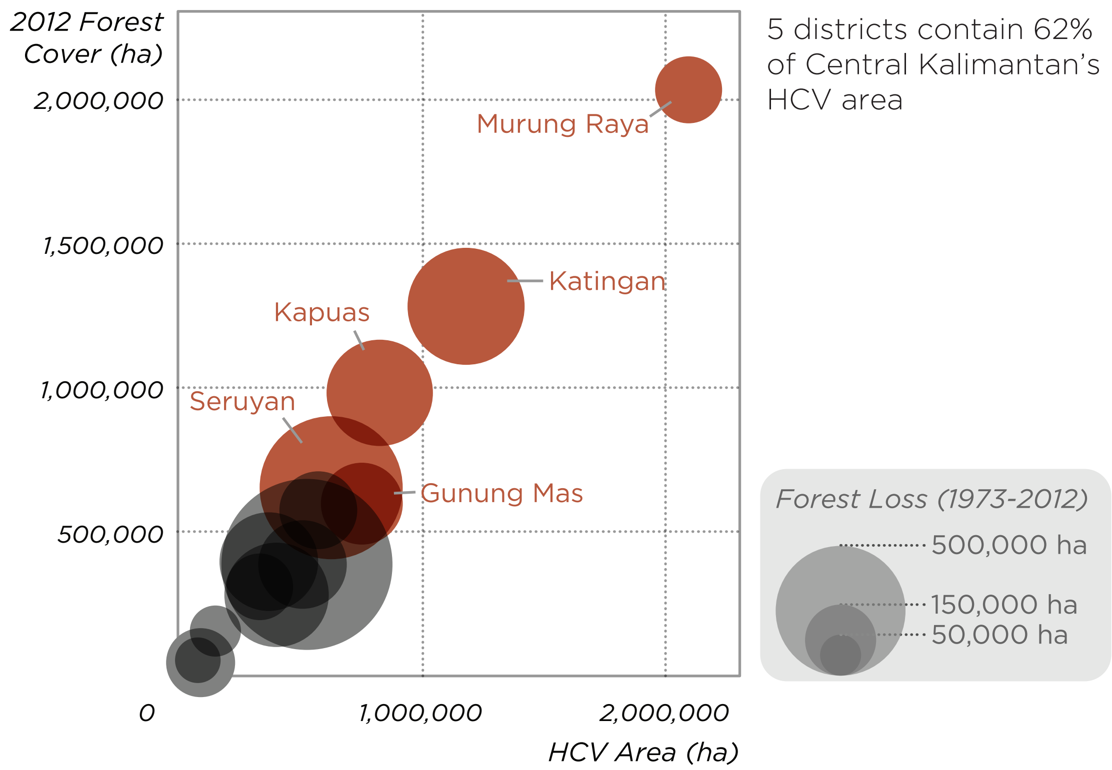


Table III-7. Extent of HCV Types in each District Ranked in Descending Order and Cumulative Ranking for all HCVs Captured

DISTRICT	HCV 1.1 HECTARES	HCV 1.1 RANK	HCV 2.1 HECTARES	HCV 2.1 RANK	HCV 2.2 HECTARES	HCV 2.2 RANK	HCV 3 HECTARES	HCV 3 RANK	HCV 4.2 HECTARES	HCV 4.2 RANK	COMBINED HCV AREAS HECTARES	COMBINED HCV AREAS RANK	HCV RANK SCORE
BARITO SELATAN	180,798	6	73071	11	161666	10	118992	7	120051	10	333985	11	55
BARITO TIMUR	0	14		13	27182	13	24639	13	54171	12	80260	14	79
BARITO UTARA	43056	11	118132	8	186771	7	147474	6	383607	4	573590	6	42
GUNUNG MAS	88279	8	231501	4	339977	4	200339	3	464454	2	751805	4	25
KAPUAS	420890	4	118422	7	453829	3	245251	2	338113	8	825032	3	27
KATINGAN	466157	3	557929	2	539426	2	254762	1	453596	3	1178581	2	13
KOTAWARINGIN BARAT	287857	5	20720	12	181576	8	156245	5	168302	9	402617	9	48
KOTAWARINGIN TIMUR	17431	13	107659	9	177396	9	69874	11	344845	7	526981	7	56
LAMANDAU	51991	10	127369	6	224035	6	81540	10	352051	6	508958	8	46
MURUNG RAYA	687980	1	1328843	1	1709053	1	98589	9	1324521	1	2089655	1	14
PALANGKA RAYA	69028	9	104284	10	107714	12	15276	14	17954	14	152163	12	71
PULANG PISAU	467870	2	236705	3	132647	11	107605	8	33436	13	370861	10	47
SERUYAN	177481	7	180557	5	286043	5	174347	4	376284	5	626246	5	31
SUKAMARA	31229	12		13	24811	14	31831	12	57101	11	91694	13	75
TOTAL	3132121		3,132,121		4,552,126		1,726,764		4,488,486		9,405,716		

Top 3 ranking districts for each HCV are highlighted in grey; Top 5 overall HCV Rank Score are highlighted in black.

Section 4: Threats to High Conservation Values

In Section 3, we identify and map HCV types across Central Kalimantan. This first step in the HCV approach to balancing development and conservation objectives must be followed by the development of management and monitoring plans to maintain or enhance the HCV areas identified. Developing management plans, however, requires first understanding the major threats to these HCV areas and the options for addressing them. In this section, we highlight threats to HCV areas as a basis for future multi-stakeholder efforts to consider management options in more detail.

Threats to HCV areas originate from a variety of sources, including planned or unplanned factors, with direct or indirect impacts. The identification of an activity that poses a threat does not necessarily mean the activity must be stopped, but rather that its potential impacts must be fully considered, and if allowed to proceed then adequate safeguards must be in place during planning and implementation of these activities to mitigate unacceptable levels of impact on HCV areas. We focus on the main and most urgent risks to HCV areas and show how they could be managed through strategic interventions to reduce or eliminate impact.

Identification and measurement of direct risks to HCV areas first involved mapping the location of potential threats that are present today or could emerge in the future. The sources of past and ongoing threats can be identified based on available geospatial and non-spatial information (e.g. spatial plans, licensing, forest loss and fires), and future threats can be assessed using trajectory analysis of e.g. recent rates of deforestation or fire, assisted by outside consultations.

Here, we describe categories of risk based on: (i) a qualitative assessment of the impact of different risks posed by key actors, and (ii) a quantitative assessment of different development activities and their overlap with HCV areas. The main risk factors assessed are summarized in Table IV-1 (adapted from HCV Network Indonesia, 2013).

The identified risks are also classified based on levels of risk to determine the relative priority for intervention. Levels of risk can be classified into four main groups,[10] which are:

1. **Trend** - the projected temporal pattern of intensity or size of areas affected
2. **Impact** – estimated magnitude of direct or indirect impacts on overall HCV types in a particular area
3. **Proportion** - the share of an HCV area affected by a specified risk factor
4. **Recovery time** - length of time for recovery of the affected area post-impact

For the purposes of this study, we examine the first three categories of risk levels: trend, impact, and proportion.

10 Multi Criteria Evaluation (MCE)

Table IV-1. Risk Types Identified through Spatial Analysis

POTENTIAL RISK	DESCRIPTION OF RISK TRENDS
Encroachment	Forest degraded or lost due to human activity is likely to occur in the same location and is generally associated with accessibility of the HCV area.
Settlements	The location of settlements within or with easy access to forest areas is a potential risk to HCV areas. This risk diminishes as the distance of settlement from the HCV area increases.
Road network	Road networks are a major source of access to forest areas. This risk diminishes as the distance of the road network to the HCV area increases.
Fires	Fires have an impact on land cover. This risk diminishes when fire levels are low and the incidence of fires is declining.
Mines	Open pit mining activities significantly alter land cover. This risk diminishes when the mining area is located outside or further away from the HCV area.
Forest concessions (HPH) and Industrial fiber plantation (HTI)	Logging activities in a forest concession alter the vegetation structure of the forest. This risk diminishes as the distance of HPH/HTI from the HCV area increases.
Status of forest area	Forest area that has been specified as Production Forest for Conversion (HPK) and other land use (APL) may be used for production purposes (including conversion) that would impact ecosystem values and associated HCVs.

Source: Above descriptions adapted from HCV Network Indonesia (2013). Management Guidelines and Monitoring of High Conservation Value. IFACS-USAID.

4.1 Potential Risks from Different Actors

Different actors govern or carry out various land use activities that pose risks to HCV areas. In Table IV-2 we provide an overview of the main actors and related activities with a qualitative assessment of the potential for these activities to threaten HCV areas. The table is intended to help inform future multi-stakeholder discussions for mainstreaming HCV management through development planning and policy reform (by indicating which actors and institutions are priorities for participation) and possibly direct engagement with priority actors affecting HCVs in target locations.

4.2 Potential Risks from Key Development Activities

The team generated quantitative data on risks to HCV areas from planned or existing development activities through spatial analysis. For the purposes of this analysis, the team takes a precautionary approach and the risk assessment assumes that any development intervention may have an impact on ecosystems identified as HCV areas. Using this approach, planned development activities were found within all identified HCV areas. Table IV-3 provides an overview of these risks in relation to each of the HCV categories.

All HCV types are potentially affected by one or more threats. Viewing all HCV areas as a group, 62% of identified areas are at risk of impact from one or more factor. This varies widely by HCV, with HCV 3 and HCV 4.2 most severely affected, and HCV 1.1 least so. Planned forest conversion due to spatial planning potentially affects nearly 20% of identified areas, logging nearly 35% and fiber and other plantations affecting 17%.

Overall, logging poses the most widespread threat to HCV areas identified in the study. With the exception of HCV 1.1 all other HCVs in the study had between one-third to nearly one half of each HCV area potentially affected by logging permits, with HCV 4.2 most severely affected. The direct impact of logging on HCVs is considered medium (Table IV-2) but in reality can vary widely depending on implementation practices.

Pending forest utilization licenses, including both logging and plantation forestry, are also extensive, potentially affecting more than 2 million ha of HCV areas in the aggregate, especially HCV 2.2, 3 and 4.2. That such licenses are still pending and could present opportunities for proactive engagement in select areas to mitigate the risk of these impacts, but a more scaleable approach would be through programmatic, policy-oriented engagement at provincial or district levels.

Spatial planning also poses a serious risk of forest conversion for all HCVs, especially for HCV 2.2, 3 and 4.2. Overall, 18% of mapped HCV areas are currently zoned for conversion, with more than 25% of HCV3 areas potentially affected. The impact level of this threat is high, and must be addressed as part of future development planning reviews at provincial or district levels. Spatial planning impacts are therefore a priority for future multi-stakeholder engagement around development policy and government planning to strengthen HCV management.

Table IV-2. The Threats to HCV Areas in Central Kalimantan. The table indicates key actors, policies, programs influencing each risk type, and qualitative level of impact risk posed by each risk.

ACTOR	RISKS: RELATED POLICIES/ INITIATIVES	RISKS: RELATED ACTIVITIES	IMPACT OF RISKS: 1.1	2.1	2.2	3	4.2
CENTRAL GOVERNMENT							
Ministry of Environment and Forestry	Utilization of forest areas	Forest conversion	High	High	High	High	High
	Permits	Forest plantation permits	High	High	High	High	High
		Logging permits	High	Medium	Medium	Medium	Medium
Ministry of Agriculture	Permits	Expansion of agricultural land	High	High	High	High	High
Ministry of Energy and Mineral Resources	Permits	Mining licenses	High	High	High	High	High
SUB-NATIONAL GOVERNMENT							
Provincial and District/ City Governments	RTRWP/K	Zoning of permissible land uses	High	High	High	High	High
	Infrastructure	Road	Medium	Medium	Medium	Medium	Medium
		Irrigation	Low	Low	Low	Low	Low
		Transmigration	High	High	High	High	High
		Expansion of rice field	High	High	High	High	High
		Railroads	High	High	High	High	High
		Settlements	High	High	High	High	High
	Permits	Land clearing	High	High	High	High	High
PRIVATE SECTOR							
Companies and individuals	Permits	Land clearing	High	High	High	High	High
		Illegal logging	High	High	High	High	High
		Palm oil plantations	High	High	High	High	High
		Industrial Plantation Forest (HTI)	High	High	High	High	High
		Mining exploitation	High	High	High	High	High
		Illegal mining	High	High	High	High	High
OTHER							
Community	Local initiative	Forest encroachment	High	High	High	High	High
	Land clearing	Slash and burn	Medium	Medium	Medium	Medium	Medium
	Basic needs	Forest encroachment	Low	Low	Low	Low	Low
	Canal	Land clearing	Medium	Medium	Medium	Medium	Medium
	Habitation	Land clearing	High	High	High	High	High
	Certificate of customary land	Farm, forestry, hunting	Low	Low	Low	Low	Low
	Private land	Illegal mining	High	High	High	High	High
		Illegal logging	High	High	High	High	High
		Dayak Misik1	Medium	Medium	Medium	Medium	Medium
Natural factors	Natural events	Landslide	Low	Low	Low	Low	Low
		Flood	Low	Low	Low	Low	Low
		Drought	Low	Low	Low	Low	Low
		Fire	Medium	Medium	Medium	Medium	Medium

Table IV-3. Summary Area of Each HCV Potentially at Risk from Spatial Planning and Land Use Licensing in Central Kalimantan

FORMS OF THREATS	AREA OF HCVA (HA) THREATENED					TOTAL AREA THREATENED (HA, EXCL. OVERLAP)
	HCV 1.1	HCV 2.1	HCV 2.2	HCV 3	HCV 4.2	
SPATIAL PLANNING						
Conversion Forest Area SK 529 (HPK)	0	65,896	306,692	282,322	442,752	1,093,804
Non Forest Area SK 529 (APL)	0	5155	108027	160955	467518	640,319
Combined area	0	71051	414719	443277	910270	1,734,123
LAND USE LICENSING						
Forest Plantation (e.g. rubber)	139,294	87,786	302,560	343,104	598,028	1,310,892
IUPHHK-HT (fiber forestry)	367	6,039	60,480	120,019	195,041	314,405
IUPHHK-HA (logging)	68,998	1,064,023	1,852,656	523,519	2,036,784	3,319,434
Pending Production Forest Utilization permit	9,279	137,942	353,062	351,614	446,745	2,020,220
Permit To Borrow and Utilize Forest (mining exploration or exploitation)	37	2,559	11,391	5,344	17,574	38,046
PLANNED INFRASTRUCTURE DEVELOPMENT						
Transmigration	0	-	1,802	1,791	12,116	14,500
TOTAL HCV AREA						
Total Area	2,990,049	3,205,190	4,552,124	1,726,764	4,488,485	9,405,716
Area threatened by one or more factor	212,207	1,232,060	2,426,351	1,189,928	3,139,343	5,790,466
% of HCV Area threatened	7.1	38.4	53.3	68.9	70	61.6

List of acronyms:

- HPK: Hutan Produksi yang dapat dikonversi/Convertible Production Forest
- APL: *Area Penggunaan Lain*/Non – forestry Utilization Area
- IUPHHK – HT: *Ijin Usaha Pemanfaatan Hasil Hutan Kayu pada Hutan Tanaman*/Forest Timber Product Exploitation Permit for Plantation Forest
- IUPHHK – HA: *Ijin Usaha Pemanfaatan Hasil Hutan Kayu pada Hutan Alam*/Forest Timber Product Exploitation Permit for Natural Forest

Section 5: Developing HCV management strategies

As discussed, identification of an area as supporting one or more HCV types does not automatically prohibit development or mandate strict conservation. Rather, the HCV approach offers a framework for balancing environmental, social and economic values by identifying areas of exceptional importance within the landscape, and requiring an evaluation of how planned developments will impact their long term maintenance. The HCV mapping and threat assessments presented here can be used by policy-makers, as well as NGOs, business and community institutions, to inform development policies, plans, procedures and licensing requirements to optimize land allocation, management and monitoring of natural capital across the province.

Section 5 describes how HCV management options could be pursued at different scales, including the macro or jurisdictional-scale, the meso or sub-jurisdictional/landscape-scale, or the micro or site-level scale. A suggested decision tree framework for developing a landscape-scale management plan for HCV areas is presented, followed by a discussion of possible options for integrating management of HCV areas into Indonesia's legal and regulatory frameworks.

5.1 Decision Making for HCV Management

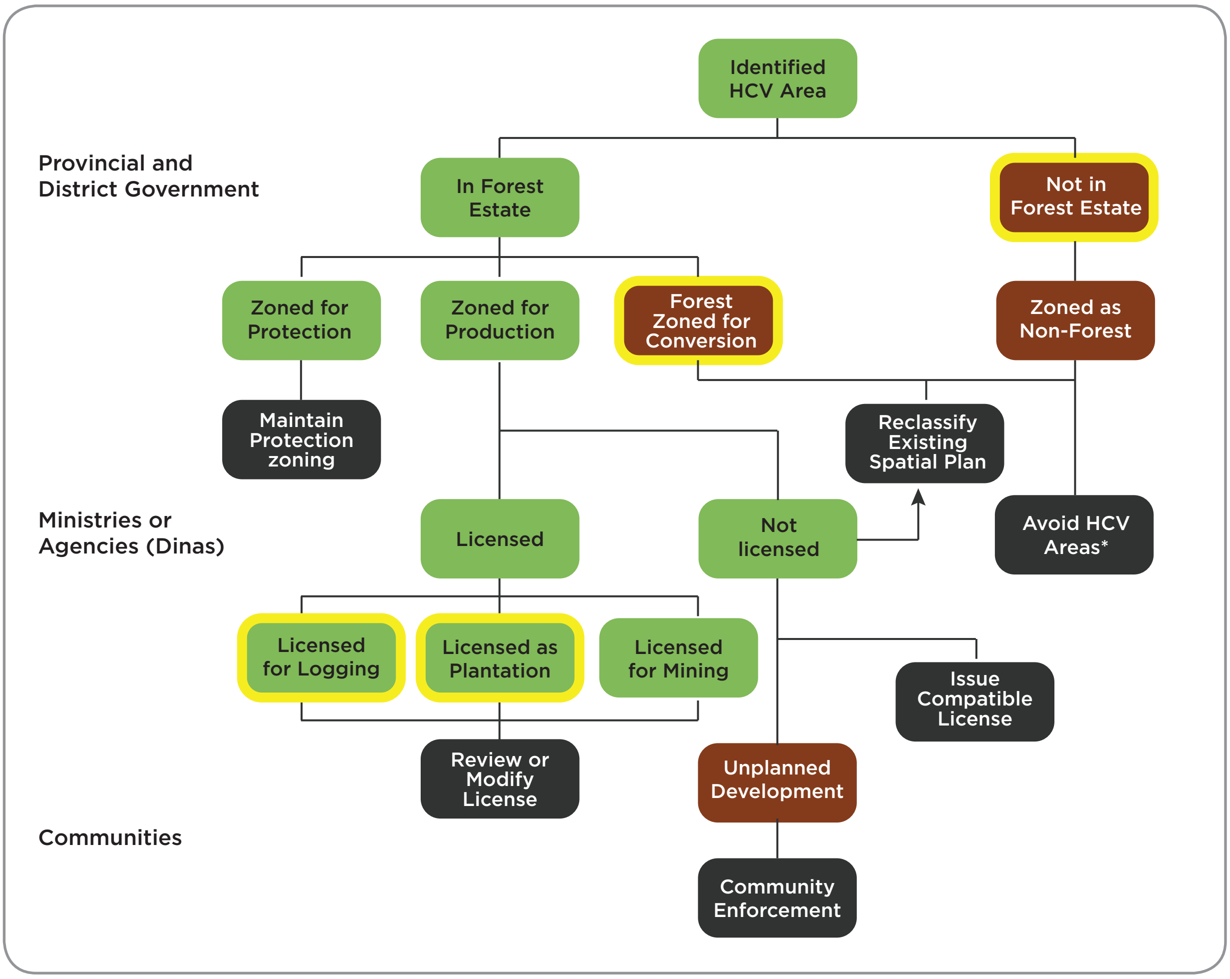
Ultimately, decision making for HCV management at the landscape scale will require a meaningful exchange of views on values and priorities, to work toward a process for credible decision making about how to balance development and conservation priorities. There is considerable experience in the private sector, NGOs and communities in the issues involved in balancing such trade-offs at a site-level, e.g. for a specific logging concession or palm oil plantation. However, there is much less experience to date in the development of landscape- or jurisdiction-wide HCV management planning. Below, we offer one of many possible frameworks for guiding decision making and directing discussion among stakeholders about what management options should be considered for a given HCV area facing a given type of threat.

The framework is presented in two parts, first a branching flow chart to understand how HCV areas are threatened by different factors (Figure V-1), and second, a box diagram illustrating management objectives and actions related to HCV areas based on the type of potential threat (Figure V-2).

In the branching flow chart (Figure V-1), boxes in black indicate decision points, with those in green showing land uses potentially compatible with maintaining HCV areas and those in brown likely incompatible. Boxes with broad yellow outlines are of special concern in Central Kalimantan given the size of HCV areas affected by that threat (e.g. 35% of HCV areas are threatened by logging, 18% are threatened by conversion under spatial plans, and 17% are threatened by plantation licenses).

In the box diagram (Figure V-2), management options and, in some cases, suggested actions related to HCV areas are presented by threat type (the dark gray boxes). Overall, HCV 3 Areas (red band, rare and endangered ecosystems) are of particular concern and are least likely to be compatible with other uses. For some HCV 2.1 areas this will also be true. These management actions are not presented as prescriptions, but rather as suggested options to stimulate discussion and debate among interested parties, ideally as part of a landscape conservation planning process at the district or provincial scales.

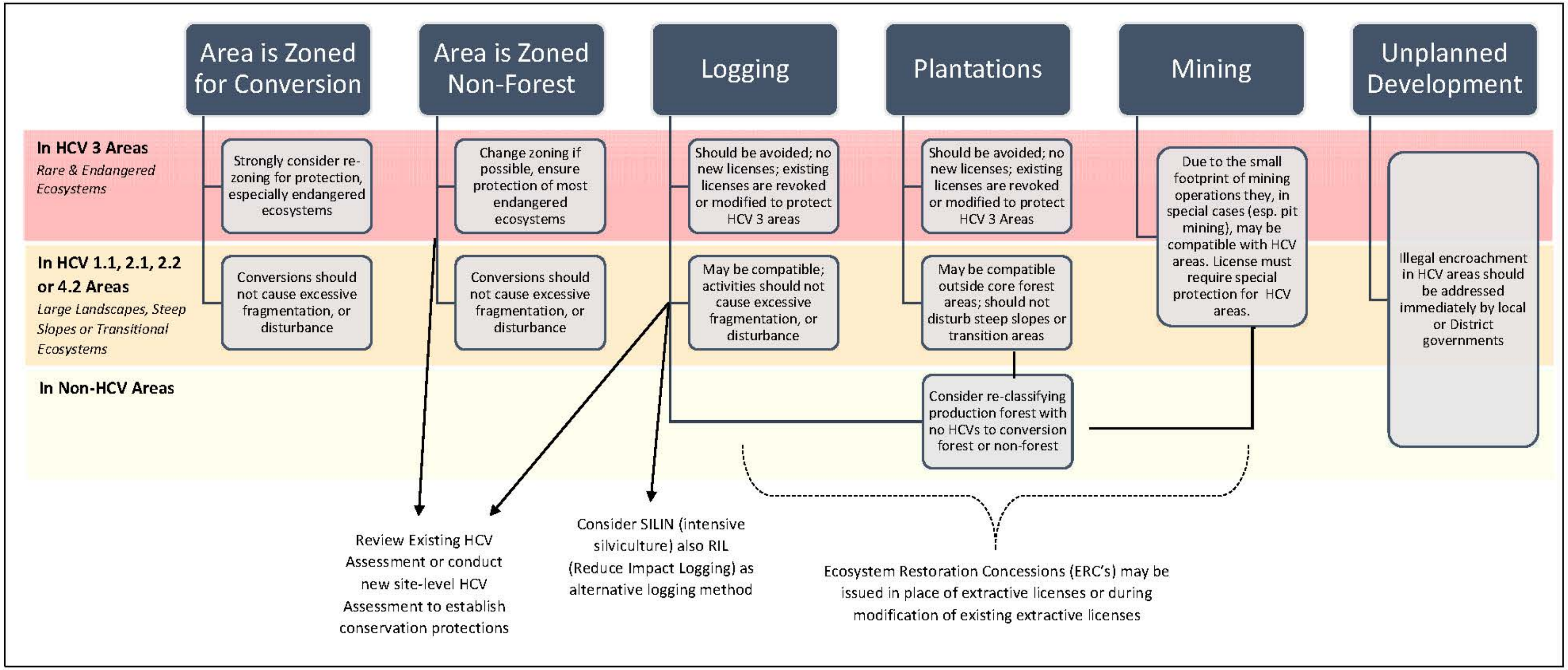
Figure V-1. Management options for protecting HCV areas, and main decision makers involved at different points of the decision tree.



Boxes in black indicate decision points; those in green are potentially compatible with maintaining HCVs and brown are likely incompatible; those with broad yellow outlines are of particular concern in terms of overall impact to HCV areas in Central Kalimantan (35% of HCV areas are threatened by logging, 18% are threatened by forest conversion under current spatial plans, and 17% are threatened by plantation licenses).

*HCV 3 areas should be avoided in all cases; activities should not result in excessive fragmentation, especially in areas that support biodiversity, or within core forest areas (HCV 2.1). Disturbance of steep erosive slopes (HCV 4.2) and transitional ecosystem boundaries should be avoided. Activities of special concern are transmigration, settlement expansion, roads, fires and land clearing of any kind. Decisions about HCV avoidance may be made at district, ministerial or community levels.

Figure V-2. Management objectives and actions related to HCV areas by type of potential threat.



Types of potential threat are indicated in each of the dark gray boxes. Under each potential threat type are management options and, in some cases, suggested actions related to HCV Areas. HCV 3 areas (red band, rare and endangered ecosystems) are of particular concern and are least likely to be compatible with other uses.

5.2 Mainstreaming the HCV Identification Result into Policy

To some extent, Indonesian laws already incorporate core HCV principles. Table V-1 highlights six examples of how different aspects of HCV principles feature in Indonesian laws or regulations. While the values embedded in the HCV approach are not new to Indonesia, the approach outlined in this report to identification and management of HCV areas is new to government policy, with a few exceptions at sub-national levels.[11]

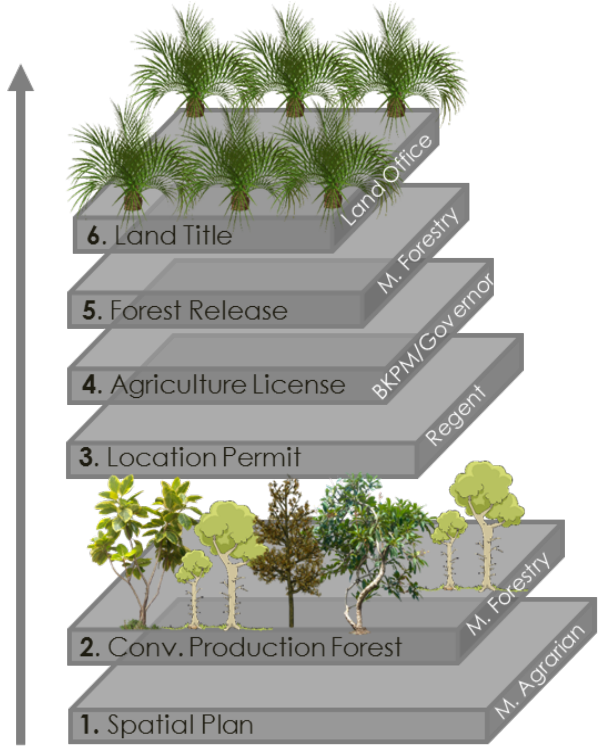
Within the Government of Indonesia's existing policy frameworks, HCV identification and management is still a voluntary activity. However, there are options to ensure that these voluntary activities can feed into and strengthen mandatory processes.

In the agricultural sector, there are six major bureaucratic steps (each under the jurisdiction of a different institution) to undertake in order to first designate an area as a production forest and then convert it into a plantation (Figure V-3).

HCV area identification results could potentially be inserted into each of these steps and considered as part of the approval process. However, the earlier the intervention in this six step process, the better the potential for protecting HCV areas. Therefore, our study recommends that, first and foremost, HCV mapping should be taken into account during the spatial planning process, especially for protection of large, landscape-scale HCV types such as HCV 2.1. It would be of great additional value, however, if HCV types were considered at step 3 (licensing decisions) or at a micro-level at step 5 for site-level protections.

Ultimately, policy strengthening efforts are needed to help decision makers utilize HCV guidelines in order for HCV identification and management to become a practical public policy with a wider base of legitimacy. The following sections describe some of the options for mainstreaming HCV principles and processes into policy.

Figure V-3. There are six major bureaucratic steps to designate an area as production forest and then convert it into a plantation



11 See Central Kalimantan Governor Regulation No. 41 of 2014 on HCVA Plantation Management in Central Kalimantan; and Minister of Agrarian Affairs Circular Letter No. 10 of 2015 on High Conservation Value.

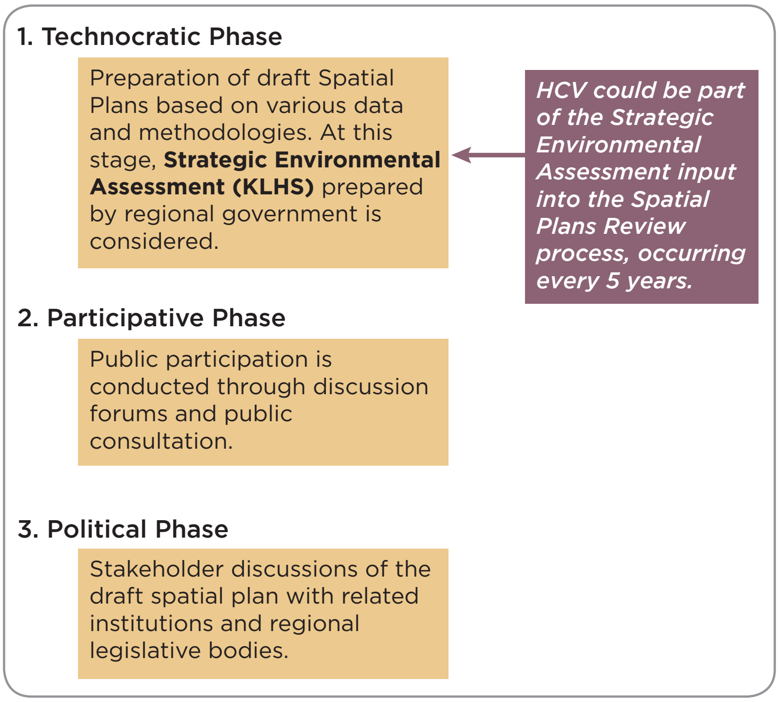
Table V-1. Six examples of HCV principles in Indonesian laws or regulations.

HCV VALUES	SIMILAR INDONESIAN LAWS/REGULATION
1. Biodiversity is present in significant concentrations	*Law No. 5 of 1990 on the Conservation of Biological Natural Resources and its Ecosystem*: **Mandates the designation of certain ecosystem areas as protected areas with special management procedures and limitations for sustainable use.**
2. Ecosystems contain naturally occurring species	*Government Regulation No. 68 of 1998 on Natural Protection Areas and Natural Conservation Areas*: **Mandates the protection and management of natural reserve areas that have naturally occurring flora, fauna, and ecosystems.**
3. Endangered ecosystems are present	*Law No. 5 of 1990 on the Conservation of Biological Natural Resources and its Ecosystem*: **Sets a specific category for endangered flora or fauna, and imposes penalties for the capture, harm, or trade of endangered species.**
4. Ecosystem services are provided by the site	*Law No. 41 of 1999 on Forestry*: **Mandates the need for a license and its limitations to utilize ecosystem services in a production forest or protected forest.**
5. Livelihoods and communities' basic necessities are dependent on the site	*Article 67 of Law No. 41 of1999 on Forestry*: **Protects indigenous community rights to maintain livelihood from forest utilization.**
6. Cultural identity or historical/ religious significance in the area is critical to the community	*Law No. 11 of2010 on Cultural Heritage*: **Mandates the protection, development, and utilization of cultural heritage (meaning objects or lifestyles older than 50 years or has a historical/ scientific/ religious/ cultural significance to the state's identity) on land and water.**

5.2.1 INTEGRATING HCV IDENTIFICATION AND MANAGEMENT INTO MANDATORY SPATIAL PLANNING LAWS

Both spatial planning activities and HCV identification activities can be considered landscape planning, and as such have potential synergies as presented in Figure V-4.

Figure V-5. The three stages of preparing a spatial plan.



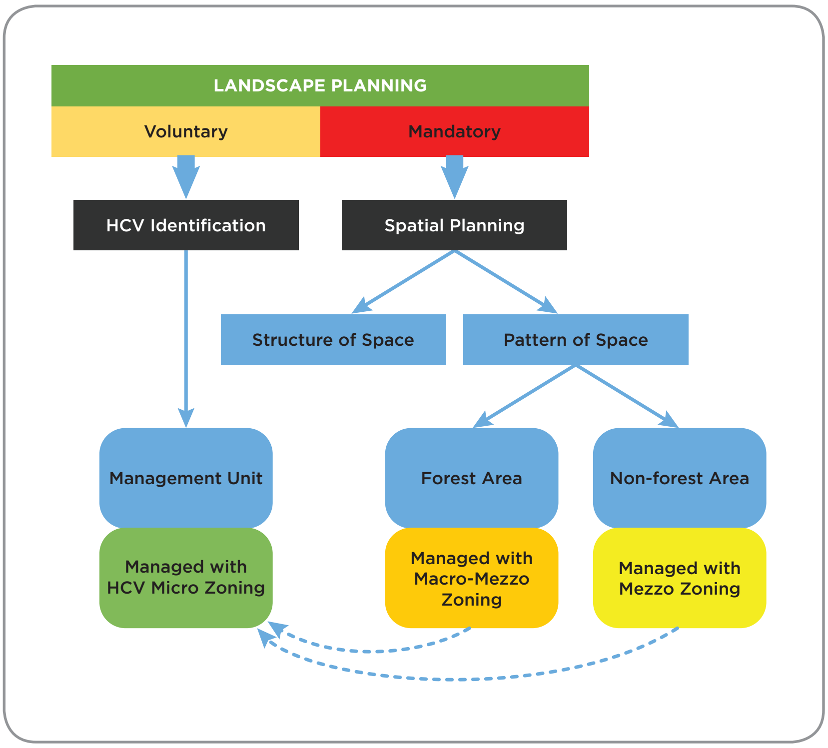
Based on the Figure V-4, the key entry point that is potentially relevant to all stages of allocation for HCV and other areas is the spatial planning process. Law No. 26 of 2007 on Spatial Planning is the basis for nationwide spatial plans for land, sea, air, and underground space in Indonesia. Forestry Plans (such as the National Forestry Plan, Provincial Forestry Plan, District Forest Plan, and Forest Management Units) must follow and consider existing spatial plans. Since the HCV identification and management approach is designed to be used for various areas of development beyond just forestry, the Spatial Planning Law is particularly relevant as it covers all areas whether relating to structure (e.g. infrastructures in place to support human socio-economic activities) or pattern (distribution of uses within an area, whether for conservation or development).

Spatial planning is done at three hierarchal levels: the National Spatial Plan (which includes island spatial plans) (Rencana Tata Ruang Wilayah Nasional – "RTRWN"), the Provincial Spatial Plan (Rencana Tata Ruang Wilayah Nasional – "RTRWP"), and the Regency/City Spatial Plan (Rencana Tata Ruang Wilayah Kabupaten/Kota – "RTRWK"). The preparation of a spatial plan covers a multitude of government departments and stakeholders, spanning three stages shown in Figure V-5.

Law No. 32 of 2009 on the Environment allows regional governments to draw up a Strategic Environmental Assessment that feeds into their development plans, as well as the spatial planning processes. Since it allows for the use of various data and methodologies, the Strategic Environmental Assessment provides a good entry point for consideration of an HCV assessment.

Spatial plans, once enacted, can be revisited for a proposed amendment every five years. This Spatial Plan amendment process provides a strategic path to insert HCV approaches in its entirety, thus making sure that conservation values are reflected in spatial plans.

Figure V-4. Mandatory and Voluntary Landscape Planning



5.2.2 RECLASSIFYING EXISTING SPATIAL PLANS OR MODIFYING LICENSING DEVELOPMENTS

Existing spatial planning maps could be revised to allow for HCV maintenance by reclassifying some areas currently zoned for Other Land Uses (APL) or Convertible Production Forest (APL/HPK) to Limited or Permanent Production Forests, or Protection Forests (HP/HPT/HL). Such a reclassification would reduce the risks of conversion, but not prevent it entirely since Permanent or Limited Production Forest can still be utilized for industrial forest plantation purposes. There may be a need for stronger protections in place to avoid Industrial Forest (HTI) development in the HCV area, especially for HCV 2.1 (Large Landscapes) and HCV 3 (Endangered Ecosystems).

Alternatively, where spatial planning changes are not possible, adjustments to development requirements for logging, forestry plantations or oil palm could be an alternative, e.g. following this guideline for managing HCV 3 (Table V-2, drawn from Wells et al. 2010).

5.2.3 INTEGRATING HCV INTO BUSINESS LICENSE PROCESSES FOR SITE-LEVEL MANAGEMENT

There have been legislative attempts to insert HCV assessments as a requirement prior to issuance of a business license, namely in the location permit (Izin Lokasi), plantation license (Izin Usaha Perkebunan – "IUP"), or cultivation permit (Hak Guna Usaha – "HGU") procedures (see inset). Under such legislation, HCV areas that are identified within palm oil plantations (i.e. site-level) areas would be managed by, monitored, and become the overall responsibility of the plantation company.

Even though this study focuses on a province-wide approach to HCV management, it does not seek to replace existing site-level management policies. It envisages that province-wide HCV assessments can provide a baseline for all HCV assessors and improve the quality of HCV identification results at the site-level and enhance planning activities and HCV monitoring for the region in which the site is located.

Figure V-6. There have been legislative attempts to insert HCV assessments at these stages of licensing.

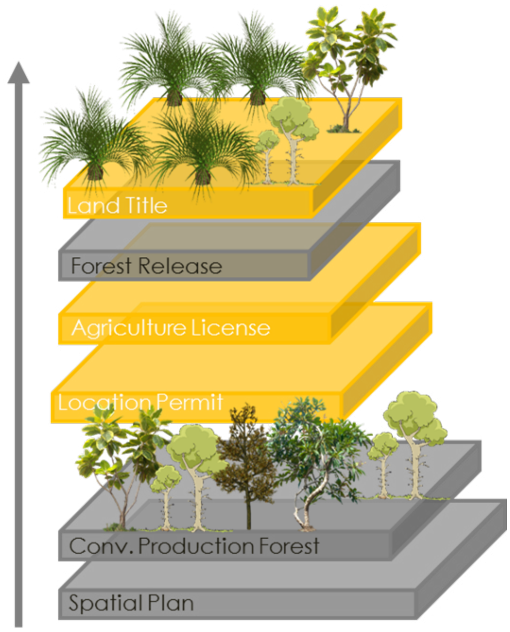


Table V-2. Suggested Options for Setting Management Priorities for HCV 3

CURRENT THREAT LEVEL FOR HCV 3	PROJECTED THREAT LEVEL FOR HCV 3		
	CATEGORY 1 LOSSES <75%	CATEGORY 2 LOSSES 75-90%	CATEGORY 3 LOSSES >90%
Losses <50%	-	1	1
Losses 50-75%	1	2	3
Losses 75-90%	N/A	2	3
Losses >90%	N/A	N/A	3

Category 1 Some losses are acceptable but only if some gains can be achieved for the same HCV 3 area. Gains could include improvement of proactive protection, conservation of the ecosystem achieved elsewhere, or a requirement in the spatial plan that at least 25% of the HCV area to be maintained in its natural state (e.g. it falls in protected areas or cannot be converted).

Category 2 No further losses are acceptable, except if it can be proven both that without management intervention all of the HCV area will be lost because of planned or unplanned conversion, and that the proposed operation will guarantee that the total loss will not be above the maximum total that has been agreed upon by all related parties (and in no condition will be over 90% of historical extent).

Category 3 No further losses are acceptable, the immediate need is to change the spatial planning, implement a conservation strategy to maintain all the remaining patches of HCV area, and expand their current size through rehabilitation if necessary.

While this proposed legislation is encouraging and demonstrating real efforts to strengthen HCV implementation, they are currently conflicting with other higher-level national laws, as described below.

5.2.4 ENABLING HCV MANAGEMENT AS A SITE-LEVEL, VOLUNTARY ACTIVITY FOR PRIVATE COMPANIES

In Indonesia, the HCV approach to land use allocation initially came to the forefront of discussions by Roundtable on Sustainable Palm Oil (RSPO) advocates and Indonesian members of RSPO who were required to identify and manage HCV forest. In 2003, a first attempt was made to create a toolkit to apply the HCV concept to the Indonesian context with the publication of "The Identification, Management, and Monitoring of High Conservation Value Forest: A Toolkit for Forest Managers and Other Stakeholders". It was subsequently revised in 2008 to accommodate different sectors apart from forestry and involve a wider range of stakeholders (Consortium to Revise the HCV Toolkit for Indonesia).

At this stage, HCV was envisaged as voluntary, with no aspiration to become mandatory under Indonesian law. Over time, some legislative attempts have been made to provide HCV initiatives some legal basis for implementation. Normally, corporate initiatives do not meet government resistance, however, in this case, resistance came in the form of the new Plantations Law issued in late 2014.

The Plantations Law states that under the Cultivation License (HGU) land left uncultivated for three years would be considered "abandoned land", which means the company could lose their license over that undeveloped land. Companies that identified HCV areas within their concessions and managed them by means of conservation faced the risk of having their plots declared abandoned and then expropriated by the state. Effectively this meant the HCV Toolkit for Indonesia could only be used by companies to identify HCV areas but not to conserve them (management options that still allows for cultivation would be possible).

Legal amendments are thus required to protect the full right of companies to voluntarily manage HCV areas within their own concessions. This might be achieved by, among others, amending the Agriculture Law, or allowing local government to designate undeveloped land as protected conservation areas.

5.2.5 ESTABLISHING THE HCV MANAGEMENT PLANS THROUGH MULTI-STAKEHOLDER CONSULTATION

Stakeholders have diverse interests in the management of identified HCV areas. Support from all stakeholders is needed to establish a platform for HCV area management that is recognized by key parties and has strong legitimacy from a legal standpoint. Transparency and participatory planning, as well as accountability, are important requirements.

HCV identification results could be integrated into policy at two levels of the public policy making process:

1. Conceptual level. Increase awareness of the supportive political institutions on the value of HCV approach so that they understand and realize the importance of ecosystem sustainability to maintain livelihoods and strengthen underlying fundamentals for long-term economic growth.
2. Operational level. This includes building a political case that can appeal to policy makers and politicians on the benefits of identifying and managing HCV areas and the importance of creating public policies to maintain them.

The entire policy-making process related to HCV area identification and management can be expected to run more smoothly and enjoy long-term sustainability if the process is conducted through collaborative management and consensus-building, especially taking into account the pluralism present in multi-stakeholder processes like HCV. Gray (1989) in Suporahardjo (2005) explained that building collaborative partnerships requires an agreement from stakeholders on key foundational issues, which includes:

3. Defining the shared problem, a commitment to be in partnership, to identify stakeholders, to clarify the legitimacy of stakeholders, to recognize the characteristics of meeting the implementers (convener), to identify resources;
4. Setting the direction of collaboration by establishing the rules for collaboration, setting the agenda, organizing sub-groups to work on particular issues, conducting joint research projects, exploring solutions, achieving agreement and closing the transaction; and
5. Implementation, including getting support from affected communities, building external support, structuring, monitoring agreements, and handling complaints.

These considerations will need to be kept in mind for the planning and implementation of multi-stakeholder efforts to mainstream HCV management considerations.

Section 6: Conclusion and Recommendations

The Governments of Indonesia and Central Kalimantan have ambitious targets to both grow the economy through expansion in the agricultural sector, primarily oil palm, while simultaneously improving environmental quality by reducing deforestation. These targets have national and global significance. Central Kalimantan has 1.2 million hectares of planted palm oil. It is the second largest crude palm oil (CPO) producing region in Indonesia, which is the largest CPO producer in the world.

The study highlights that just under 4 million ha of land was converted from forest to other uses over the 40-year period from 1973 to 2012, an average 100,000 ha per annum. Palm oil, the largest land-based economic activity in the province, was a contributing driver of forest loss but covers only 1.2 million ha or 30% of the converted land. This suggests that considerable deforested land could be available for future plantation growth without additional forest loss.

The study also shows that there remains potential for significant additional forest loss in the future. Spatial plans have designated around 1.1 million ha of forested lands for planned deforestation.

These findings highlight that Central Kalimantan Province has major opportunities to better manage its land resources to meet its development goals while further protecting valuable biodiversity and important environmental services that regulate and protect the region's natural resources and ensure the long-term sustainability of its growth. They highlight a clear need to review spatial planning in support of provincial objectives for economic growth and improved environmental governance and that they can be reconciled by reallocating land through more careful consideration of the role of high value ecosystems in supporting economic growth.

To help achieve this, the study advocates using a High Conservation Value (HCV) approach as a tool for policy makers to understand where high value ecosystems are located and to facilitate the development of appropriate management strategies, development planning processes, and regulatory systems to protect them. It also seeks to identify areas of high convervation value across the province using different datasets and on-the-ground verification. Our study is the first step in a multi-stage, multi-stakeholder process to achieve that.

Key findings

- **HCV areas mapped in this study are widespread in Central Kalimantan, covering over half the entire province.** It is expected that if all areas meeting the criteria of HCV categories, were identified then the total size of HCV areas would be much larger. This identification could be achieved through cascading meso-scale to micro-scale ground survey and participative land use mapping. This does not mean that most of Central Kalimantan province should not be developed, rather that large-scale planning and management is required to balance development with the maintenance of key environmental services.
- **Incorporating HCV identification and management into sustainable development planning in certain key districts would lay a solid foundation for achieving environmental and development goals for the province as a whole.** HCV areas mapped in this study are more extensive in some districts than others. For the five HCV types identified, the districts of Katingan, Murung Raya, Gunung Mas, Kapuas and Seruyan together comprise 56-75% of province-wide HCV areas for each HCV type and 62% of HCV areas overall.
- **Nearly 62% of identified HCV areas (5.8 million ha) are under threat by one or more factor.** Development activities such as logging, plantations, mining, and transmigration are taking place in HCV areas identified. Logging poses the most widespread threat to HCV areas identified in the study affecting nearly 35% of them. Planned forest conversion under current spatial plans potentially affects nearly 18% of identified HCV areas, and fiber and other plantations more than 17%. 3.6 million ha is considered at low risk of impact.
- Mitigating these risks will require immediate engagement with policy makers, development planners and private sector **actors** to align development planning, policy making, and regulatory procedures around the goal of minimizing impacts on HCV areas through a nested, cascading approach of landscape-based planning to site-level management.

6.1 Recommendations

We offer the following recommendations for consideration as part of future public-private, multi-stakeholder efforts to strengthen and advance Central Kalimantan's sustainable development agenda:

1. **Develop a comprehensive provincial landscape management strategy to better enable the region to meet its agricultural production and environmental protection goals in parallel.** Initially, we recommend to consistently incorporating HCV area identification and management recommendations into Central Kalimantan's spatial planning and development program planning process through the Strategic Environmental Assessment (Kajian Lingkungan Hidup Strategis or KLHS) to be conducted in mid 2016. This approach can be strengthened by including HCV area assessments and management actions in other relevant national and regional policies, as well as the 5-yearly regional development plans produced at the provincial and district level (RPJMP and RPMK).
2. **Review ongoing or planned development activities that overlap with areas identified as containing HCVs.** This could form part of (a) future government license review programs, or (b) development of management plans for licensed activities, including modifying activities where necessary and appropriate, and putting in place a monitoring framework to manage the risks of negative environmental impacts.
3. **Include HCV area considerations in development or implementation of Central Kalimantan's spatial plan to help ensure that HCV areas are managed or conserved, as appropriate.** This can be done by reclassifying several forest areas from non-forest areas (APL) or convertible production forests (HPK) into limited production forest (HP), permanent production forest (HPT), or protection forest (HL), which all provide greater scope for sustainable forest management or conservation.
4. **Augment this initial province-wide, landscape-scale analysis with further analysis to identify HCV categories that are outside the scope of this study.** This includes analysis at the meso-scale, including smaller-scale landscapes such as those contained within large forest management units (KPH), as well as analysis at the micro-level, for example, using the smallest ecosystem units or a site-specific, project based assessment. The analysis presented here could also be improved both in terms of accuracy and level of detail for the identified HCV areas by improving availability of and periodically updating spatial data sets.

Next steps

This study will be used as a basis for the the REDD+ Production– Protection Working Group to produce recommendations and a policy paper that will be submitted to the provincial government to help support policy making and implementation.

PILAR Center of Excellence at the University of Palangka Raya and CPI will supplement its findings by jointly developing a further study on Natural Capital Assessment (NCA) to provide analysis on the economic value of HCV areas. Combined with the study, Central Kalimantan's Oil Palm Value Chain: Opportunities for Productivity, Profitability and Sustainability Gains, this NCA study will provide Central Kalimantan with the information to make policy and investment decisions better suited to sustainable development.

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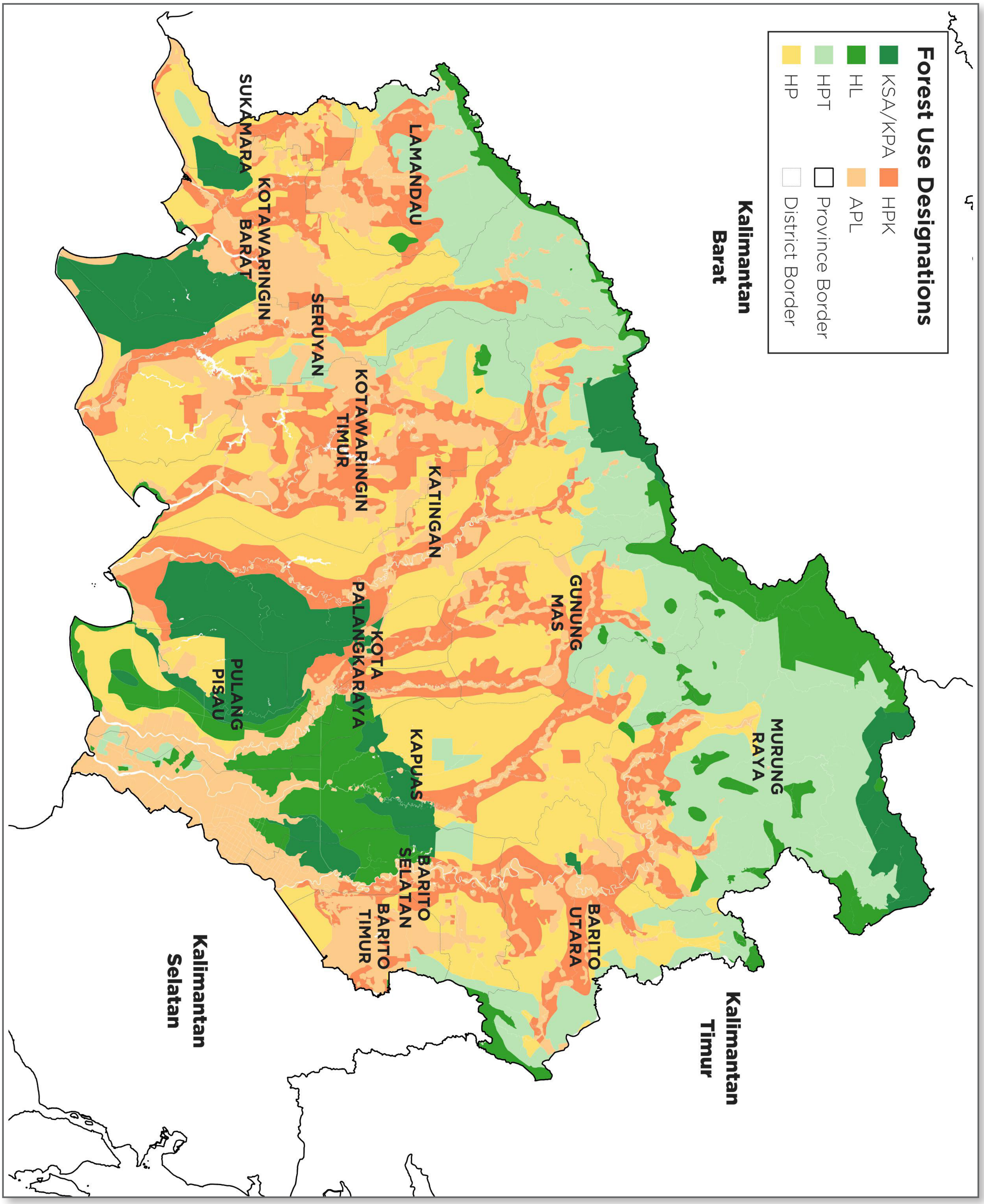
Annexes

Annex 1. Indicative Map of Forest Use Designation, Decree of Ministry of Forestry No. 529 year 2012



Annex 2. Narrative description of major ecosystem types present in Central Kalimantan and the RePPProT proxies used for their indicative mapping.

Drawn from Wells et. al. (2010) Landscape HCV Mapping in East Kalimantan, Indonesia.

Background

An extremely rich diversity of vegetation types is present across Central Kalimantan, with spatial patterning that reflects influences of soils, drainage, geology, and elevation. These vegetation types differ in terms of species composition and relative abundances; ecosystem properties; value as habitat for rare, threatened or endemic species; and importance for local livelihoods of rural communities.

Throughout the report, we map ecosystem types and associated high conservation values (HCVs) using ecosystem proxies derived from a modified land systems dataset based on RePPProT (1990), following the protocol defined in the revised HCV Toolkit for Indonesia. These land system classes (ecosystem proxies) are distinguished based on differences in geology, soils, drainage, slope, rain fall, dominant vegetation types and geographic position, factors widely known to determine ecosystem distributions in nature. Use of the modified land systems as ecosystem proxies is, therefore, reasonable, but is to be regarded at this stage as a working hypothesis. The ecosystems referred to by different RePPProT based ecosystem proxies is not evident to those unfamiliar with the nomenclature of Indonesian land systems, so in this section, we describe the broad vegetation types represented by these land systems in the study area using more familiar vegetation terminology and classes.

MANGROVE FOREST

Mangrove is the collective term used in reference to tree vegetation that colonizes sheltered muddy shores within the tidal zone. Mangrove swamps are commonly found along ocean facing coastal strips, estuarine river deltas, inland brackish water rivers and on islands. Whilst mangrove plant species are specially adapted to survive saline conditions, they may occur as far as 50 km inland along the major rivers of Borneo. In addition to adaptations for extreme saline conditions, unusual features of the root systems of mangrove plants, including aerial roots and pneumatophores, also enable gas exchange above the waterlogged, oxygen poor soils. These root structures, in turn, capture sediments brought down by rivers, leading to land formation and the seaward advance of the coastline. Mangroves also often grow often in association with nipa palms (Nypa frutescens) that occasionally form extensive mono-specific stands, often along banks of brackish water rivers or on inland backwater swamps of the mangrove.

Mangrove ecosystems are among the world's most productive ecosystems, rich in both marine and terrestrial fauna. The marine fauna includes a variety of large crustaceans and mollusks, and is an important spawning ground and nursery for prawns and many pelagic fish of economic importance to offshore fisheries. The terrestrial fauna includes the Proboscis monkey (Nasalis lavartus), Silvered langur (Trachypithecus cristatus), monitor lizards (Varanus spp.), crocodiles, and more than 20 species of birds that are endemic to mangroves or highly dependent upon them.

Mangroves are a mainstay of local livelihoods for coastal communities, providing coastal protection, and sources of timber, edible mollusks and crustacea, and of course fish. However, over-harvesting of mangroves for charcoal production and conversion of to fish or shrimp ponds are a serious threat. In East Kalimantan, conversion of mangroves to fish ponds has been a major driver of mangrove loss and is the primary explanation for the mangrove dominated KJP land system in the Northern Lowland region (see Section 6 below) being considered endangered under HCV 3.

In HCV terms, the density and diversity of HCV 1 species (Threatened, Protected or Endemic Species) in mangrove forest are very low for plants and low to intermediate for animals.

In this report, mangrove forest is represented by the KJP ecosystem proxy.

PEAT SWAMP FOREST

Peat swamp forest is a widespread terrestrial ecosystem throughout the lowlands of south, west and northern Borneo (Whitmore 1984; Wikramanayake et al. 2002), with a variety of distinct forms depending on peat depth, patterns of drainage and disturbance history. It is most well developed in coastal areas, but in Kalimantan also occurs inland in association with major rivers, such as the Kapuas and Barito, and seasonal wetlands such as the Sentarum and Mahakam lake systems. Though present in the mapping area, peat swamp is not a dominant feature of the Berau landscape, and the once extensive peat swamp areas in East Kutai were destroyed by El Nino related fires in 1982/83.

Peat swamp forest (PSF) structure and floristic composition vary markedly with peat depth and drainage patterns. This variation includes, on the one hand, carbon-dense, relatively diverse tall forests of 40-50 m canopy on shallow peat associated with rivers, and on the other hand stunted, floristically impoverished shrub vegetation types (<5 m tall) or even grasslands on deep peat typical of dome structures (Anderson 1983). Overall biodiversity is lower in PSF than other lowland forest types (Mirmanto et al. 1999; Wikramanayake et al. 2002; Ashton 2009), but unique biodiversity attributes are found here that merit conservation. These include a variety of aquatic vertebrates and invertebrates, some considered near habitat specialists (Ng et al. 1994; Page et al. 1997), as well as a number of globally threatened birds and large mammals, most notably the Proboscis monkey Nasalis lavartus, especially in areas where PSF is adjacent with lowland mineral areas or freshwater swamps. Densities of most vertebrates are lower in PSF, however, than mineral soil areas (Gaither 1994; Whitten et al. 2000; Quinten et al. 2010), reflecting the nutrient-poor status and lower productivity of this ecosystem (Mirmanto & Polosokon 1999; Nishimua et al. 2006; Janzen 1974). Woody plant species richness in PSF is on average less than half that of lowland forest on mineral soils (Paoli et al. in prep), and Critically Endangered (CR) members of the flora are especially under-represented, with only eight of Indonesia's 140 CR plants present in PSF (three as strict specialists), compared to 104 in mineral forest areas (84 as strict specialists; Paoli et al. in prep). Nevertheless, plant species of concern are present in PSF, including the globally threatened dipterocarps Shorea teysmanniana, S. uliginosa and S. platycarpa; the near threatened Ramin tree of commerce Gonystylus bancanus (CITES Appendix II); and the widespread Jelutung tree Dyera costulata (protected by Indonesian law but severely over-harvested throughout its range, especially in peat).

PSF has declined markedly in extent throughout Borneo in the last three decades, due to conversion to agriculture and fires (Holmes 2002). In Indonesia, only a limited area of intact PSF areas has full, formal protection status. A Presidential Decree issued in 1990 declared all peat lands >3 m deep as Protected Areas unsuitable for development, a fact often seen as a form of de facto protection, but the Ministries of Agriculture and Forestry issue licenses for oil palm and logging, respectively, on such lands.

In HCV terms, the density and diversity of HCV 1 species (Threatened, Protected or Endemic Species) in peat swamp is low to intermediate for plants, but intermediate to high for animals, depending on the predominance of different peat swamp sub-types.

In this report, peat swamp forest is represented by the GBT and MDW ecosystem proxy.

RIPARIAN FOREST AND FRESHWATER SWAMPS

Freshwater swamp, and associated riparian vegetation types are an important and productive terrestrial ecosystem, with numerous structural and compositional forms whose occurrence varies with local terrain features, proximity to river, frequency and duration of flooding and soil type. It is locally common in lowland Borneo, with extensive areas historically in central southern Borneo. Riparian and freshwater swamp forest are present in the mapping area, but with relatively limited distribution, concentrated in coastal areas and inland flood plains along major rivers, such as the Kelai and Segah.

Freshwater swamp is thought to have been the natural vegetation cover of approximately 7% of Kalimantan (MacKinnon & Artha, cited in MacKinnon et al. 1996), but most of this has been cleared for conversion to wetland rice cultivation. It is therefore considered an extremely endangered ecosystem (Wikramanayake et al. 2002). Freshwater swamps develop on waterlogged soils, where periodic flooding causes freshwater inundation and water logging of soils. Soils are much less acidic than peat swamps, and among the most nutrient rich topical soils due to frequent deposition of silt and associated organic matter. Forests tend to be very productive in terms of tree growth, litter fall and leaf and fruit production, with high natural rates of disturbance and canopy turn over due to frequent tree falls and gap formation. Where inundation is frequent but temporary, freshwater swamps can have tall stature (up to 35 m) and standing biomass; where inundation is frequent and prolonged, forests can be stunted and dominated by only a few tree species. Compositionally, freshwater swamps share many species in common with lowland forest on mineral soils, but in general, are less rich in species. The most abundant tree species in this vegetation type are members of the genera Alstonia, Campnosperma, Dyera, Koompassia, Litsea, Neesia, Saraca and Syzygium.

Further inland and upstream from areas prone to frequent flooding, freshwater swamp gives way to riparian forest along slopes of gradually ascending stream channels or steep-sided ravines (both forms shown above). Riparian forest variations include small to medium stature forest along narrow, fast flowing streams, often with rapids and exposed riverbed boulders and highly specialized floristic associates, as well as tall stature forest along slowing moving meandering streams, reminiscent of lowland forest on alluvium. Riparian vegetation, and especially gulley forest, is often protected from strong wind and micro-climatic fluctuations by local physiographic features, such as sharp ridges and steep slopes, promoting the formation of moist local environments. Soil moisture in riparian forest is high due to down slope movement of water from surrounding slopes and ridges and localized occasional flooding, which can lead to the formation of raised local alluvial terraces.

Some epiphytic and herbaceous plants are strict specialists in this habitat (i.e., they are absent from upper slope, ridge and plateau environments), and some trees also show increased abundance near rivers. Such trees include Dracontomelon dao, Pometia pinnata, Hopea coriacea, Hopea sangal, Dipterocarpus oblongifolius (pictured above) Vatica venulosa ssp. venulosa and the tengkawang or illipe nut species Shorea macrophylla and Shorea palembanica.

Remnant riparian and gulley forests are extremely important for biodiversity conservation and management of environmental services, especially in landscapes undergoing fragmentation. These habitats are important not only for conservation of specialized plant species that depend on relatively moist/humid conditions, but also to maintain key habitats required by animals for feeding and breeding, as well as connectivity among forest blocks.

In HCV terms, the density and diversity of HCV 1 species (Threatened, Protected or Endemic Species) in freshwater swamp and associated riparian forests is intermediate to high, second only to lowland forest on mineral soils.

In this report, riparian and fresh water swamp are represented by the BKN, BLI, KHY, KLR, PMG, SBG, and TNJ ecosystem proxies.

LOWLAND FOREST ON WELL-DRAINED SOILS

Lowland forest on well-drained mineral soils is the most species rich and tallest stature ecosystem on Borneo. It is the most extensive natural ecosystem type in the mapping area. Most lowland forests on mineral soils in the mapping areas have been logged; unlogged areas are concentrated in hilly terrain and/or interior regions.

Canopy heights of these lowland forests range from 35-50 m, with emergent trees reaching >60 m in height or more, and aboveground biomass values range from ca. 300-600 Mg per ha, on average 60% higher than that of the Amazon (Paoli et al. 2008; Slik et al. 2010). The floristic composition of lowland forest on mineral soils differs markedly from all forms of swamp forest described above, but on average shares more in common with freshwater swamp than with peat swamp forms. Lowland forests on mineral soils are dominated numerically and in terms of biomass by canopy trees in the species-rich family Dipterocarpaceae, hence the widely used phrase name Lowland Dipterocarp Forest in reference to this forest type. Most forest botanists further distinguish two further sub-types of dipterocarp forest based on elevation, the so-called mixed dipterocarp forest (MDF) below 300-500 m and hill dipterocarp forest (HDF) above this elevation and up to the point of transition into sub-montane forest. Floristic differences between MDF and HDF are marked, especially among dipterocarps, but because the elevation cut-off between MDF and HDF is approximate and extremely variable on different mountains, here we do not separate or attempt to map these two sub-types. Rather we distinguish a larger number of lowland sub-types based on ecosystem proxies defined by soils, geology, landform and drainage, factors known to determine lowland forest sub-types of Borneo (Potts et al. 2002; Paoli et al. 2006; Slik et al. 2009).

Historically, deforestation rates in Indonesia have been much higher in forest on mineral soils than peat, but large areas of logged and/or burned lowland forest remain, with high value for biodiversity (Meijaard et al. 2006; Berry et al. 2008, 2010). This is especially true given that bio-geographically distinct sub-types of lowland forest on mineral soils are under-represented in Indonesia's existing protected area network (MacKinnon 1997), and many of which are under threat (Curran et al. 2004; Gaveau et al. 2009).

The density and diversity of HCV 1 plant and animal species (Threatened, Protected or Endemic) in lowland forest on mineral soils are higher than any other ecosystem type.

In this report, lowland forest on well drained soils is represented by the BTA, KPR, LHI, LWW, MPT, TWB, and TWH ecosystem proxies.

KERANGAS

Kerangas (or heath) forest is a distinctive forest ecosystem present throughout Borneo and well represented in the mapping area. Historically, kerangas covered several million ha across Kalimantan but began declining in extent in the 1970s, due widespread informal logging, conversion for agriculture and wildfires. Today, kerangas is considered an endangered ecosystem in Kalimantan.

Kerangas forest develops on bleached white or brown sand soils derived from the in-situ decomposition of coarse-textured sedimentary rock or raised inland beach deposits of Pleistocene coastline. Kerangas ranges markedly in stature in response to soil conditions, ranging from tall stature forms up to 35 m in canopy height where drainage is unimpeded, to short, stunted vegetation forms with a partially open canopy of 10 m or less. The most well developed kerangas forms grow on either water-logged sandy soils with impeded drainage or drought-prone sandy soils on ridges and plateaus. A thick root mat (up to 20 cm) and abundant, consolidated, undecomposed surface litter (humus) are typical of the forest floor in kerangas. On occasion, peat-like accumulations in the upper soil horizon may occur where drainage is poor due to localized concavities in underlying impervious rock or a cemented hard pan of clay transported downward in the soil horizon (spodic layer). Such kerangas on wet, shallow peat (typically <2 m) is often referred to as kerapah or kerapot by local communities and shows strong floristic similarities with peat swamp forest. As with rivers draining peat swamp, rivers draining kerangas forest (especially kerapah) are red or black in color, due to high concentrations of soluble tannins and other organic acids.

Despite marked structural and to a lesser degree floristic variation among kerangas forms, the following characteristics in combination can be diagnostic of most forms: (i) continuous and even canopy of long narrow tree crowns; (ii) near absence of giant emergent trees >100 cm diameter; (iii) medium to high densities of shrubs, treelets and small diameter climbing and twining plants in the understory, especially rotan (Calamus spp.) and pandans (Pandanus spp.); (iv) high density and ground coverage of understory mosses and bryophytes, as well as pitcher plants in the genus Nepenthes; (v) a distinctive form aerial termite nests; (vi) a high diversity of orchids, in a variety of growth forms but especially epiphytes; and (vii) presence of indicator species in combination such as Hopeakerangasensis, Gymnostoma nobilis, Shorea coriacea, S. retusa, S. sagittata and (in West and northern Central Kalimantan) S. peltata.

Kerangas supports lower plant and animal diversity than lowland forests on well-drained soils but harbors a large number of endemic (or near endemic) plants (Ashton 2010), especially understory and epiphytic woody or herbaceous species. Common woody plants of kerangas include Vaccinium lauriflorum, Rhodomyrtus tomentosus, Tristianopsis whiteana, Gymnostoma nobile, Shorea retusa, Hopea kerangasensis, Hopea dryobalanoides, Swintoniaglauca, Combretocarpus rotundatus, Cratoxylum glaucum and a rich assemblage of species in the genus Syzygium. Many plant species have specialized adaptations to the low nutrient conditions typical of kerangas, including the epiphytic myrmecophytes (ant plants) Myrmecodia and Hydnophytum, and the carnivorous pitcher plants (Nepenthes), sundews (Drosera) and bladderworts (Utricularia); and understory and epiphytic orchids including the protected black orchid (Coelogyne pandurata). In comparison to other forest types on Borneo, kerangas forests contain a relatively high density of plants of Austraulasian origin, including the families Myrtaceae and Casuarinaceae, and gymnosperms of the southern hemisphere, including Agathis, Podocarpus, and Dacrydium.

In HCV terms, the density and diversity of HCV 1 species (Threatened, Protected or Endemic Species) in kerangas is low to intermediate overall, but most of the HCV 1 species present are near endemics. In this report, Kerangas Forest is represented by the BRH,BRW, MTL, PKU, PST, and TDR ecosystem proxies.

KARST FOREST

The Mangkalihat Peninsula has the most extensive area of forest on limestone on the island of Borneo. In this report, we use a narrower interpretation of forest on limestone that includes only 'tower' and 'cockpit' types. That is, steep sided highly weathered formations (tower) and conical or hemispherical limestone hills with more gentle slopes (cockpit). These limestone types are approximated by the OKI and GBJ land systems, respectively, which we term Karst forest.

The karst forest areas thus defined typically have shallow soils or bare rock surfaces on steeper slopes and cliffs that support small trees and shrubs. On the gentler lowland slopes, the forest is higher and mainly dominated by dipterocarp trees in the canopy, often with high stocking density of commercial timber. The summits of limestone hills may be covered in a deep mat of peat-like humus and supports a low stature forest, sharing some species more typical of heath forest than lowland mineral forest areas, most notably with few dipterocarps.

On montane limestone areas, no dipterocarps are present, and small trees are interspersed with shrubs and an abundance of bryophytes. On the deep humus layers, calcifuges are found that include shrub rhododendrons and conifers. Although few detailed systematic studies have been made in Kalimantan's limestone areas, studies performed to date suggest they support a rich flora with many limestone endemics, though relatively poor in tree species overall. In 2006, The Nature Conservancy conducted a major biodiversity expedition in the Mangkalihat Peninsula and confirmed the rich biodiversity potential of the area (Salas 2005).

Karst areas are an extremely important habitat for certain fauna, especially bats, crustacea, mollusks, and insects associated with the often extensive network of cave systems present. Though primates, including the orangutan (Pongo pygmaeus), may also be present in karst areas, they generally occur at lower densities than other ecosystems (Husson et al. 2009; Marshall et al. 2007). A number of pant species are also endemic to, or markedly more abundant in, karst areas, including herbaceous species such as members of Begoniaceae, as well as shrubs in the Ericaeacae. Many plant species in these limestone areas are also draught tolerant. During droughts, karst forests are locally susceptible to fire.

In this report, karst forest areas are represented by the GBJ and OKI ecosystem proxies.

SUB-MONTANE FOREST

Unlike the peat, kerangas and karst ecosystems described above, whose distribution is driven by substrate, elevation causes important changes in vegetation structure and composition across Borneo. Such changes are best exemplified in Borneo on Mount Kinabalu, which shows distinct zonation of vegetation types with elevation, spanning lowland forest, sub-montane forest, montane forest, cloud forest, high elevation shrub lands, grass land, and bryophyte dominated crevice communities lining bare rock. At over 4100 m a.s.l., Mount Kinabalu is exceptional on Borneo, with the majority of mountain peaks on the island <2000 m. As a result, most Bornean mountains show vegetation changes with elevation that extend from lowland rain forest at low elevations to Sub-montane, montane and possibly cloud forest near summits and along ridges and exposed plateaus; true montane grasslands and heathlands are uncommon.

The proximal causes of tropical vegetation change with elevation are complex and have a long history of scientific inquiry and debate. Underlying this complexity is a phenomenon referred to as the Massenerhebung effect, wherein vegetation zones are compressed on coastal mountains compared to larger, more inland ones, a result of transitions from one vegetation type to another occurring at lower elevations on smaller mountains. Such patterning with elevation appears to reflect the joint influences of climate, especially temperature, which decreases more slowly with elevation on larger mountains (lower 'temperature lapse rates'), as well as soil drainage and water holding capacity. This means that mountains of the same size but different geographic locations, underlying geologies, and local climate or wind patterns can have very different zones of transition from lowland to sub-montane to montane forest, making vegetation zonation mapping across large mountainous areas very difficult without field work or high resolution aerial photography.

For practical purposes, however, it is necessary to define transition boundaries for elevation zones, and the revised HCV Toolkit recommends an upper limit of 500 m a.s.l. for true lowland forest on most mountains, beyond which the forest is better described as sub-montane. In turn, the Toolkit recommends that sub-montane forest extends up to an approximate elevation of 1000 m a.s.l., beyond which forest on most mountains is better described as montane. We have followed these recommendations throughout this report.

Generally speaking, the transition from lowland to sub-montane forest is more gradual, subtle and cumulative than transitions from lower montane to montane, and requires systematic floristic sampling to define. The transition has practical conservation importance, however, because shifts in dominant lowland to sub-montane flora has an impact on habitat quality, with lower fruit productivity and consequently frugivore densities in sub-montane and especially montane forest compared to the lowlands (e.g. Marshall 2009; summaries in Whitmore 1984). Higher elevation forests still have a role to play as potential 'keystone habitats', however, providing food during periods of low fruit availability in the lowlands (Cannon et al. 2007a,b), and in the future may function increasingly as refuge habitat for lowland species in response to changing climate (e.g., Illan et al. 2010).

The main structural and floristic differences between lowland and sub-montane vegetation include the following. Tree densities are higher in sub-montane, but maximum tree size and canopy height are lower, reflecting a marked decline in abundance and maximum size of canopy and emergent trees in the Dipterocarpaceae. The canopy of sub-montane forest shows more uniform texture and crown diameter than lowland forest, but not the highly uniform canopy texture diagnostic of montane forest in aerial images. Floristically the dominant plant families of sub-montane forest show affinities with those of temperate climates, especially members of the Fagaceae (Castonopsis, Lithocarpus, and Quercus), Ericaceae, Myrtaceae (Leptospermum) and cone-bearing tropical gymnosperms, including Dacrydium, Gymnostoma, Podocarpus, Phyllocladus and the large emergent tree Agathis borneensis (see right). Figs and fruit bearing lianas are less abundant than in the lowlands, but tree ferns and understory palms increase in density through sub-montane and especially in montane forest.

In HCV terms, the density and diversity of HCV 1 species (Threatened, Protected or Endemic Species) in sub-montane vegetation is low to intermediate compared to lowland habitats, but as noted above likely provides important habitat support functions during periods of low fruit availability in the lowlands. In this report, sub-montane forest areas are represented by the Sub ecosystem proxy.

MONTANE FOREST

On mountains of sufficient height and suitable climatic and soil, sub-montane vegetation is replaced by structurally and floristically distinct montane forest. In contrast to the gradual nature of the transition from lowland to sub-montane forest, that of sub-montane to montane forest is usually abrupt and marked by the onset of persistent cloud formation and presence of superficial peat. The elevation at which montane vegetation occurs varies markedly across Borneo, from 650 m on the island of Pulau Karimata to 1200 m on Bukit Baka in central Borneo, to 2200 m on Mount Kinabalu in Sabah. As noted, this reflects differences in temperature lapse rates and soils on mountains of different maximum height and proximity to the coast – an example of the so-called Massenerhebung effect (Whitmore 1984).

Ecological dynamics of montane forest are much slower than at lower elevations, reflecting cooler temperatures, lower solar insulation and nutrient limitations of growth, especially nitrogen, resulting from temperature and moisture limitations on decomposition. Well-developed montane forest shares much in common with heath forest (kerangas) in terms of structure (stem diameter, tree height and canopy texture), physiognomy (stem shape, leaf size, and leaf thickness) and floristics (especially abundance of understory and epiphytic orchids and Nepenthes pitcher plants). This had lead some to suggest that ecological factors causing the replacement of sub-montane vegetation by montane forest may be similar to those causing the formation of kerangas, including tolerance to nutrient scarcity and wide fluctuations in water availability (both water logging and periodic drought). Detailed studies to differentiate between the relative importance of these factors have not been performed (but see Pendry & Proctor 1996 for review).

Floristically, montane forests are relatively species poor compared to lowland and sub-montane forest but support a number of habitat endemic plants, especially ferns (including tree ferns), palms, orchids, carnivorous plants, and myrmecophytic epiphytes.

Under conditions of wet, near constant cloud cover, a sub-type of montane vegetation referred to as cloud forest or moss forest develops and is characterized by a dense, even canopy of small diameter trees with twisted and moss covered stems. Here, species in the Myrtaceae, Clusiaceae, Theaceae, Fagaceae and various gymnosperm families are especially common.

The occurrence of HCV 1 species (Threatened, Protected or Endemic Species) in montane forest is low. In this report, montane forest is represented by the Mon ecosystem proxy.

DISTURBED VEGETATION TYPES

The mapping area has experienced a variety of disturbance histories, including low to high intensity commercial logging, small-scale swidden agricultural, wild fires and forest conversion to fiber or oil palm plantations. This has produced large areas of disturbed primary (i.e. logged or damaged by wild fires but never cleared) and secondary forest types (sensu Corlett 1995) of varying structure, floristic composition and value as habitat for native flora and fauna. In the landscape HCV study reported here, a forest/non-forest maps was produced, but no attempt was made to distinguish disturbed primary vegetation types (so-called degradation classes) or the fine scale mosaic of secondary vegetation types.

Appendix L-1. Rare and Endangered Ecosystems in the "Central Kalimantan Lowlands"

SYMBOL LAND SYSTEMS	MAXIMAL EXTENT OF ECOSYSTEM (HA)	NATURAL EXTENT OF ECOSYSTEM (HA)	PAST ECOSYSTEM (HA)	HISTORY LOST (PERCENT)	>50% HAS LOST	PERCENT TO PHYSIOGRAFI	<1% TO PHYSIOGRAFI	FUTURE EXPECTED (HA)	PERCENT FUTURE LOST	> 75% FUTURE LOST	HCV3	STATUS
BKN	47.012	29	445	93,5	Y	0 ,0	Y	18	96,1	Y	HCV 3	REC
BLI	14.233	2.908	2.708	(7,4)	N	1,8	N	387	85,7	Y	HCV 3	E
BPD	7.305	593	5.166	88,5	Y	0,4	Y	593	88,5	Y	HCV 3	RE
BWN	125.409	34.815	42.701	18,5	N	22,0	N	14.421	66,2	N	N/A	N/A
GBT	283				N	-	Y			N	HCV 3	R
HJA	15.718	7.646	12.712	39,9	N	4,8	N	7.646	39,9	N	N/A	N/A
KLR	5.793	21	1.834	98,8	Y	0,0	Y		100,0	Y	HCV 3	REC
KPR	1.492	27	974	97,2	Y	0,0	Y	25	97,4	Y	HCV 3	R EC
Lake	5.530	4	46								N/A	N/A
LHI	6.672				N	-	Y			N	HCV 3	R
LNG	2.122	164	458	64,2	Y	0,1	Y	164	64,2	N	HCV 3	RE
LWW	229.239	386	1.801	78,6	Y	0,2	Y	256	85,8	Y	HCV 3	RE
MPT	162.441	12.787	47.377	73,0	Y	8,1	N	11.920	74,8	N	HCV 3	E
MTL	22.546	25	417	93,9	Y	0,0	Y	9	97,9	Y	HCV 3	REC
OKI	6.888	615	1.173	47,6	N	0,4	Y	574	51,0	N	HCV 3	R
PDH	30.652	3.547	8.011	55,7	Y	2,2	N	3.208	60,0	N	HCV 3	E
PKU	5.273	61			N	0,0	Y			N	HCV 3	R
PLN	29.694	14.063	17.375	19,1	N	8,9	N	14.063	19,1	Y	N/A	N/A
RGK	2.607	327	918	64,4	Y	0,2	Y	327	64,4	N	HCV 3	RE
TNJ	202.565	320	1.637	80,5	Y	0,2	Y		100,0	Y	HCV 3	REC
TWB	9.663	126			N	0,1	Y	94		N	HCV 3	R
TWH	215.372	1.966	12.224	83,9	Y	1,2	N	1.212	90,1	Y	HCV 3	EC
Grand Total	1.148.508	80.429	157.977					54.917				

Appendix L-2. Rare and Endangered Ecosystems in the "Interior Hill and Plains"

SYMBOL LAND SYSTEMS	MAXIMAL EXTENT OF ECOSYSTEM (HA)	NATURAL EXTENT OF ECOSYSTEM (HA)	PAST ECOSYSTEM (HA)	HISTORY LOST (PERCENT)	>50% HAS LOST	PERCENT TO PHYSIOGRAFI	<1% TO PHYSIOGRAFI	FUTURE EXPECTED (HA)	PERCENT FUTURE LOST	> 75% FUTURE LOST	HCV3	STATUS
BKN	40.471	3.631	4.256	15	N	0	Y	250	94	Y	HCV 3	REC
BLI	1.989	134	403	67	Y	0	Y		100	Y	HCV 3	REC
BPD	11.341	4.759	10.791	56	Y	0	Y	3.312	69	N	HCV 3	RE
BRW	577	577	577	0	N	0	Y	577	0	N	HCV 3	R
BWN	5.050	1.852	3.102	40	N	0	Y	14	100	Y	HCV 3	REC
GBT	4.601	3.376	3.679	8	N	0	Y	923	75	N	HCV 3	R
HJA	735.727	156.602	545.860	71	Y	7	N	108.709	80	Y	HCV 3	E
JLH	51.082	12.111	46.592	74	Y	1	Y	10.004	79	Y	HCV 3	RE
KLR	236	14	87	84	Y	0	Y		100	Y	HCV 3	REC
KPR	35.869	22.723	34.875	35	N	1	Y	21.524	38	N	HCV 3	R
Lake	71	7									N/A	N/A
LHI	63.367	41.529	52.379	21	N	2	N	36.144	31	N	N/A	N/A
LWW	345.081	115.416	246.327	53	Y	5	N	95.515	61	N	HCV 3	E
MGH	45.392	15.526	25.051	38	N	1	Y	12.729	49	N	HCV 3	R
MPT	203.286	156.803	185.774	16	N	7	N	131.610	29	N	N/A	N/A
MTL	109.338	79.495	102.730	23	N	3	N	60.236	41	N	N/A	N/A
OKI	3.334	2.229	3.010	26	N	0	Y	2.126	29	N	HCV 3	R
PDH	12.865	12.348	12.644	2	N	1	Y	12.348	2	N	HCV 3	R
PKU	0	0	0	0	N	0	Y	0	0	N	HCV 3	R
PLN	209.271	52.802	186.223	72	Y	2	N	37.256	80	Y	HCV 3	E
RGK	475.299	113.852	324.242	65	Y	5	N	91.295	72	N	HCV 3	E
River	9.781	40	1.065	96							N/A	N/A
SMD	300	192	300	36	N	0	Y	192	36	N	HCV 3	R
SPG	12.765	6.794	11.724	42	N	0	Y	5.008	57	N	HCV 3	R
TBA	2.819	1.312	2.154	39	N	0	Y	1.108	49	N	HCV 3	R
TDR	8.824	5.627	7.870	28	N	0	Y	4.569	42	N	HCV 3	R
TWB	90.124	52.079	77.960	33	N	2	N	38.984	50	N	N/A	N/A
TWH	663.269	302.880	444.871	32	N	13	N	259.088	42	N	N/A	N/A
TWI	3.311	911	2.199	59	Y	0	Y	137	94	Y	HCV 3	REC
Grand Total	3.145.436	1.165.621	2.336.745					933.657				

Appendix L-3. Rare and Endangered Ecosystems in the "Interior Terraces"

SYMBOL LAND SYSTEMS	MAXIMAL EXTENT OF ECOSYSTEM (HA)	NATURAL EXTENT OF ECOSYSTEM (HA)	PAST ECOSYSTEM (HA)	HISTORY LOST (PERCENT)	>50% HAS LOST	PERCENT TO PHYSIOGRAFI	<1% TO PHYSIOGRAFI	FUTURE EXPECTED (HA)	PERCENT FUTURE LOST	> 75% FUTURE LOST	HCV3	STATUS
BKN	33473,39	5149,602	4744,543	(8,5)	N	0,3	Y		100,0	Y	HCV 3	REC
BLI	61165,83	24039,78	36640,72	34,4	N	1,2	N	7066,735	80,7	Y	HCV 3	E
BRH	41224,97	6969,961	40356,09	82,7	Y	0,4	Y	4377,624	89,2	Y	HCV 3	RE
BWN	1395122	317495	1019215	68,8	Y	16,0	N	237281,6	76,7	Y	HCV 3	E
GBT	14758,62	4032,709	13764,32	70,7	Y	0,2	Y		100,0	Y	HCV 3	REC
HJA	5644,666	410,8749	2937,344	86,0	Y	0,0	Y	66,36139	97,7	Y	HCV 3	REC
JLH	1493,603	64,08444	627,5697	89,8	Y	0,0	Y	33,55346	94,7	Y	HCV 3	REC
KHY	511,2838	37,53316	272,8358	86,2	Y	0,0	Y		100,0	Y	HCV 3	REC
KLR	792,4695		196,7166	100,0	Y	-	Y		100,0	Y	HCV 3	REC
Lake	673,0403	18,83937	344,4173					3,78625			N/A	N/A
MDW	30508,44	6787,948	27525,25	75,3	Y	0,3	Y	3482,028	87,3	Y	HCV 3	RE
PKU	891241,6	518065,5	801960,8	35,4	N	26,1	N	422354,9	47,3	N	N/A	N/A
PLN	2000,793	78,41842	1516,975	94,8	Y	0,0	Y		100,0	Y	HCV 3	REC
RGK	36704,62	2733,263	9096,518	70,0	Y	0,1	Y	1154,733	87,3	Y	HCV 3	RE
River	7523,492	19,4239	335,0145								N/A	N/A
SBG	54649,17	11609,42	10379,83	(11,8)	N	0,6	Y		100,0	Y	HCV 3	REC
SGT	6073,648	676,7345	3246,917	79,2	Y	0,0	Y	386,6156	88,1	Y	HCV 3	RE
SRM	165,0184	9,396737	26,55477	64,6	Y	0,0	Y		100,0	Y	HCV 3	REC
TWB	7596,066	1381,618	7407,277	81,3	Y	0,1	Y	918,1896	87,6	Y	HCV 3	RE
TWH	6979,659	548,9122	5091,046	89,2	Y	0,0	Y	140,9969	97,2	Y	HCV 3	REC
Grand total	2598303	900129,1	1985685					677267,1				

Appendix L-4. Rare and Endangered Ecosystems in the "Mahakam Lowlands"

SYMBOL LAND SYSTEMS	MAXIMAL EXTENT OF ECOSYSTEM (HA)	NATURAL EXTENT OF ECOSYSTEM (HA)	PAST ECOSYSTEM (HA)	HISTORY LOST (PERCENT)	>50% HAS LOST	PERCENT TO PHYSIOGRAFI	<1% TO PHYSIOGRAFI	FUTURE EXPECTED (HA)	PERCENT FUTURE LOST	> 75% FUTURE LOST	HCV3	STATUS
BKN	40.257,6	2.396,3	18.781,2	87,2	Y	0,1	Y	1.535,9	91,8	Y	HCV 3	REC
BLI	26221,20649	262,3563974	10220,27912	97,4	Y	0,0	Y	62,10605478	99,4	Y	HCV 3	REC
BRH	21794,43598		9340,566826	100,0	Y	-	Y		100,0	Y	HCV 3	REC
BRW	8710,568793	6467,919129	6957,433227	7,0	N	0,2	Y	4930,976552	29,1	N	HCV 3	R
BTA	15155,07182	3293,249338	5151,336501	36,1	N	0,1	Y	2748,658863	46,6	N	HCV 3	R
BTK	91417,20946	16825,52684	29429,38502	42,8	N	0,4	Y	10145,17459	65,5	N	HCV 3	R
GBJ	900,4266561	107,7381726	900,4266561	88,0	Y	0,0	Y	4,2875043	99,5	Y	HCV 3	REC
GBT	323629,6032	23130,94477	312680,3396	92,6	Y	0,6	Y	7150,091299	97,7	Y	HCV 3	REC
HJA	3183,282836	655,8384655	2821,544675	76,8	Y	0,0	Y	655,8384655	76,8	Y	HCV 3	RE
KHY	77215,69854	990,8255484	31016,57071	96,8	Y	0,0	Y		100,0	Y	HCV 3	REC
KJP	156407,2336	37248,28672	120009,0596	69,0	Y	0,9	Y	26121,69394	78,2	Y	HCV 3	RE
KLR	111018,7956	3535,641845	81061,05106	95,6	Y	0,1	Y	1176,590572	98,5	Y	N/A	REC
KPR	7510,448646	67,22089281	6434,851772	99,0	Y	0,0	Y	62,7010451	99,0	Y	HCV 3	REC
Lake	43476,56904	11,0752436	4669,759035					3,870561071			N/A	N/A
LHI	68965,9992	14656,90444	58429,46581	74,9	Y	0,4	Y	13337,26545	77,2	Y	HCV 3	RE
LWW	892909,0452	89229,66802	693634,783	87,1	Y	2,2	N	58347,11505	91,6	Y	HCV 3	EC
MDW	73948,05697	3499,693891	57663,72774	93,9	Y	0,1	Y		100,0	Y	HCV 3	REC
MGH	3810,509782		316,5262506	100,0	Y	-	Y		100,0	Y	HCV 3	REC
MPT	675870,3563	215529,2069	605552,6505	64,4	Y	5,2	N	187830,7717	69,0	N	HCV 3	E
MTL	103713,9665	18262,93535	81329,11314	77,5	Y	0,4	Y	14794,01098	81,8	Y	HCV 3	RE
OKI	3227,929881	1400,669772	2397,495884	41,6	N	0,0	Y	1400,669772	41,6	N	HCV 3	R
PDH	71042,66867	17369,71153	70484,0552	75,4	Y	0,4	Y	17197,96959	75,6	Y	HCV 3	RE
PKU	118618,2752	31,6583281	89168,90406	100,0	Y	0,0	Y	16,05444713	100,0	Y	HCV 3	REC
PLN	2970,609042	780,7619374	2622,819977	70,2	Y	0,0	Y	780,7619374	70,2	N	HCV 3	RE
PMG	1783,399029	1615,048706	1724,415444	6,3	N	0,0	Y	1615,048706	6,3	N	HCV 3	R
PTG	4614,325839	183,3289674	2079,307469	91,2	Y	0,0	Y	176,3888739	91,5	Y	HCV 3	REC
River	24336,23681	66,68188405	1666,756248	96,0				14,05176936			N/A	N/A
SBG	98989,69284	7614,951789	45452,72182	83,2	Y	0,2	Y	1576,488102	96,5	Y	HCV 3	REC

SYMBOL LAND SYSTEMS	MAXIMAL EXTENT OF ECOSYSTEM (HA)	NATURAL EXTENT OF ECOSYSTEM (HA)	PAST ECOSYSTEM (HA)	HISTORY LOST (PERCENT)	>50% HAS LOST	PERCENT TO PHYSIOGRAFI	<1% TO PHYSIOGRAFI	FUTURE EXPECTED (HA)	PERCENT FUTURE LOST	> 75% FUTURE LOST	HCV3	STATUS
SMD	40241,1306	18488,74763	26802,34201	31,0	N	0,4	Y	14199,2498	47,0	N	HCV 3	R
STB	10159,81833	5974,469171	7981,241215	25,1	N	0,1	Y	4301,342383	46,1	N	HCV 3	R
TDR	9003,999889	5898,256374	7986,997364	26,2	N	0,1	Y	3698,573728	53,7	N	HCV 3	R
TNJ	86931,33031	420,4954805	31221,62526	98,7	Y	0,0	Y	191,5667145	99,4	Y	HCV 3	REC
TWB	162775,6865	1337,017484	135255,499	99,0	Y	0,0	Y	838,3182139	99,4	Y	HCV 3	REC
TWH	1827181,909	373698,8058	1586781,412	76,4	Y	9,0	N	276336,0423	82,6	Y	HCV 3	E
TWI	951,5593604	1,433828913	816,6080002	99,8	Y	0,0	Y	1,433828913	99,8	Y	HCV 3	REC
Grand Total	5208944,62	871053,3211	4148842,261					651250,9995				

Appendix L-5. Rare and Endangered Ecosystems in the "Meratus Mountains"

SYMBOL LAND SYSTEMS	MAXIMAL EXTENT OF ECOSYSTEM (HA)	NATURAL EXTENT OF ECOSYSTEM (HA)	PAST ECOSYSTEM (HA)	HISTORY LOST (PERCENT)	>50% HAS LOST	PERCENT TO PHYSIOGRAFI	<1% TO PHYSIOGRAFI	FUTURE EXPECTED (HA)	PERCENT FUTURE LOST	> 75% FUTURE LOST	HCV3	STATUS
BKN	9.244,1	1.417,4	4.662,4	69,6	Y	0,1	Y	598,3	87,2	Y	HCV 3	RE
BPD	356671,1285	297989,9	346037	13,9	N	17,5	N	296166,0897	14,4	N	N/A	N/A
BRW	32666,61653	24207,24	32666,62	25,9	N	1,4	N	24207,23632	25,9	N	N/A	N/A
GDG	1023,60517	710,1862	1023,605	30,6	N	0,0	Y	403,1028974	60,6	N	HCV 3	R
HJA	1448,598965	1431,886	1448,599	1,2	N	0,1	Y	1431,885639	1,2	N	HCV 3	R
KPR	3823,610712	750,7496	2526,31	70,3	Y	0,0	Y	750,4883347	70,3	N	HCV 3	RE
LHI	10111,93669	6778,624	9697,271	30,1	N	0,4	Y	6730,841228	30,6	N	HCV 3	R
LNG	201303,4074	175203,9	200000,9	12,4	N	10,3	N	160970,1848	19,5	N	N/A	N/A
LWW	8086,095028	2231,504	5358,419	58,4	Y	0,1	Y	1930,617363	64,0	N	HCV 3	RE
MPT	344792,7205	246984,9	332531,2	25,7	N	14,5	N	231028,1646	30,5	N	N/A	N/A
MTL	139978,3671	48487,86	137888,7	64,8	Y	2,9	N	46288,27498	66,4	N	HCV 3	E
OKI	52775,05608	41677,48	49655,44	16,1	N	2,5	N	40616,31647	18,2	N	N/A	N/A
PDH	386128,1883	275969,6	339167,8	18,6	N	16,2	N	266745,6211	21,4	N	N/A	N/A
PLN	34109,17929	24443,43	34109,18	28,3	N	1,4	N	24441,47663	28,3	N	N/A	N/A
SST	7023,255423	4139,697	7023,255	41,1	N	0,2	Y	2165,098019	69,2	N	HCV 3	R
TDR	1812,38003	1360,368	1563,946	13,0	N	0,1	Y	1307,222439	16,4	N	HCV 3	R
TWB	10571,24108	4399,663	9208,946	52,2	Y	0,3	Y	3687,641901	60,0	N	HCV 3	RE
TWH	186203,8819	106303,3	178123,1	40,3	N	6,3	N	86989,22089	51,2	N	N/A	N/A
TWI	7518,627165	5291,568	6275,558	15,7	N	0,3	Y	5291,567804	15,7	N	HCV 3	R
Grand Total	1795291,962	1269779	1698968					1201749,393				

Appendix L-6. Rare and Endangered Ecosystems in the “Muller Mountains”

SYMBOL LAND SYSTEMS	MAXIMAL EXTENT OF ECOSYSTEM (HA)	NATURAL EXTENT OF ECOSYSTEM (HA)	PAST ECOSYSTEM (HA)	HISTORY LOST (PERCENT)	>50% HAS LOST	PERCENT TO PHYSIOGRAFI	<1% TO PHYSIOGRAFI	FUTURE EXPECTED (HA)	PERCENT FUTURE LOST	> 75% FUTURE LOST	HCV3	STATUS
BPD	303069	283976,6	290862,8	2,4	N	6,7	N	280526,0687	3,6	N	N/A	N/A
BRW	925921,9	908291,8	922655,3	1,6	N	21,4	N	883595,1341	4,2	N	N/A	N/A
BTA	28739,59	28667,95	28739,59	0,2	N	0,7	Y	28667,95027	0,2	N	HCV 3	R
HJA	158630,3	123722,8	142066,7	12,9	N	2,9	N	121390,0102	14,6	N	N/A	N/A
JLH	33714,2	29788,1	32763,44	9,1	N	0,7	Y	26550,76164	19,0	N	HCV 3	R
KPR	562,8934	562,1094	562,8934	0,1	N	0,0	Y	562,1093654	0,1	N	HCV 3	R
KRU	7014,016	7011,055	7014,016	0,0	N	0,2	Y	7011,054717	0,0	N	HCV 3	R
LHI	36201,85	28518,14	30610,49	6,8	N	0,7	Y	27147,12298	11,3	N	HCV 3	R
LNG	38277,66	35167,89	35946,31	2,2	N	0,8	Y	33451,65847	6,9	N	HCV 3	R
LWW	8452,36	5471,06	5691,798	3,9	N	0,1	Y	5319,207588	6,5	N	HCV 3	R
MPT	590070,7	457839,4	489434,1	6,5	N	10,8	N	453137,3891	7,4	N	N/A	N/A
MTL	107089,6	96071,47	102651,3	6,4	N	2,3	N	90698,28061	11,6	N	N/A	N/A
OKI	36,7304	36,7304	36,7304	-	N	0,0	Y	36,73040195	-	N	HCV 3	R
PDH	1269366	1195947	1214187	1,5	N	28,2	N	1190987,837	1,9	N	N/A	N/A
PLN	278807,4	179056,1	227620,8	21,3	N	4,2	N	165404,7775	27,3	N	N/A	N/A
RGK	22566,27	8611,864	15582,8	44,7	N	0,2	Y	7541,860173	51,6	N	HCV 3	R
River	3698,459	72,49793	546,5618					37,27286831			N/A	N/A
SHD	1845,825	75,32598	147,2872	48,9	N	0,0	Y	75,32597874	48,9	N	HCV 3	R
STB	7726,387	7686,153	7726,387	0,5	N	0,2	Y	7686,152589	0,5	N	HCV 3	R
TBA	26094,54	12938,13	13506,2	4,2	N	0,3	Y	12872,9839	4,7	N	HCV 3	R
TDR	227307,2	219528	226700,2	3,2	N	5,2	N	214256,622	5,5	N	N/A	N/A
TWB	100687,7	83953,42	91163,48	7,9	N	2,0	N	82583,24176	9,4	N	N/A	N/A
TWH	500977	319018,1	357542,7	10,8	N	7,5	N	304814,5	14,7	N	N/A	N/A
Grand Total	4676858	4032011	4243759					3944354,052				

Appendix L-7. Rare and Endangered Ecosystems in the "Northern Mountain Ranges"

SYMBOL LAND SYSTEMS	MAXIMAL EXTENT OF ECOSYSTEM (HA)	NATURAL EXTENT OF ECOSYSTEM (HA)	PAST ECOSYSTEM (HA)	HISTORY LOST (PERCENT)	>50% HAS LOST	PERCENT TO PHYSIOGRAFI	<1% TO PHYSIOGRAFI	FUTURE EXPECTED (HA)	PERCENT FUTURE LOST	> 75% FUTURE LOST	HCV3	STATUS
BKN	9048,187537	7044,114531	8452,938	16,7	N	0,1	Y	4711,435	44,3	N	HCV 3	R
BPD	1592942,424	1567947,782	1588760	1,3	N	21,6	N	1509452	5,0	N	N/A	N/A
BRW	133834,4568	129364,975	133323,4	3,0	N	1,8	N	125978,2	5,5	N	N/A	N/A
BTA	112911,924	112174,7397	112792,9	0,5	N	1,5	N	96127,92	14,8	N	N/A	N/A
BTK	184005,6324	173648,2565	166078,1	(4,6)	N	2,4	N	143191,2	13,8	N	N/A	N/A
HJA	90686,55686	77641,93022	85714,15	9,4	N	1,1	N	57559,68	32,8	N	N/A	N/A
LHI	31096,39981	30854,32781	31096,4	0,8	N	0,4	Y	25426,05	18,2	N	HCV 3	R
LNG	1838,292722	1834,887105	1838,293	0,2	N	0,0	Y	1834,887	0,2	N	HCV 3	R
LPN	659581,9791	654147,4844	657250,8	0,5	N	9,0	N	643788,2	2,0	N	N/A	N/A
LWW	4466,797885	1262,929948	4079,491	69,0	Y	0,0	Y	967,2072	76,3	Y	HCV 3	RE
MPT	267651,4932	253411,4657	263762,3	3,9	N	3,5	N	225268,9	14,6	N	N/A	N/A
MTL	68401,43757	67655,66653	67631,2	(0,0)	N	0,9	Y	66892,33	1,1	N	HCV 3	R
OKI	9233,408188	9093,108985	9233,408	1,5	N	0,1	Y	9047,64	2,0	N	HCV 3	R
PDH	3496376,504	3365084,344	3485008	3,4	N	46,3	N	3286976	5,7	N	N/A	N/A
PLN	387560,2443	368720,6612	376743	2,1	N	5,1	N	314436,6	16,5	N	N/A	N/A
PMG	15455,68671	15434,37977	15455,69	0,1	N	0,2	Y	12313,6	20,3	N	HCV 3	R
RGK	7351,782113	6250,923308	5889,932	(6,1)	N	0,1	Y	3906,72	33,7	N	HCV 3	R
River	3347,678179	245,5932035	2804,738					88,01384			N/A	N/A
SMD	38465,50866	37420,34454	37285,43	(0,4)	N	0,5	Y	36721,14	1,5	N	HCV 3	R
STB	107572,0242	100771,7803	95842,25	(5,1)	N	1,4	N	87518,89	8,7	N	N/A	N/A
TBA	1360,064904	1314,886721	1360,065	3,3	N	0,0	Y	1016,831	25,2	N	HCV 3	R
TDR	632,097532	627,3629662	632,0975	0,7	N	0,0	Y	614,3314	2,8	N	HCV 3	R
TWB	37902,1427	37422,53166	37593,6	0,5	N	0,5	Y	30035,17	20,1	N	HCV 3	R
TWH	77475,06305	67695,263	75925,07	10,8	N	0,9	Y	60033,32	20,9	N	HCV 3	R
TWI	534,7291179	534,2826229	532,4335	(0,3)	N	0,0	Y	534,2826	(0,3)	N	HCV 3	R
Grand Total	7339732,515	7087604,022	7265086					6744441				

Appendix L-8. Rare and Endangered Ecosystems in the "Schwaner Mountains"

SYMBOL LAND SYSTEMS	MAXIMAL EXTENT OF ECOSYSTEM (HA)	NATURAL EXTENT OF ECOSYSTEM (HA)	PAST ECOSYSTEM (HA)	HISTORY LOST (PERCENT)	>50% HAS LOST	PERCENT TO PHYSIOGRAFI	<1% TO PHYSIOGRAFI	FUTURE EXPECTED (HA)	PERCENT FUTURE LOST	> 75% FUTURE LOST	HCV3	STATUS
BPD	1006394	903835	954908,1	5,3	N	31,8	N	867296,9	9,2	N	N/A	N/A
HJA	512113,6	253412,2	333808	24,1	N	8,9	N	217775,4	34,8	N	N/A	N/A
JLH	151843,1	122944,4	140379,7	12,4	N	4,3	N	112202,9	20,1	N	N/A	N/A
KPR	254,5632	252,1247	254,5632	1,0	N	0,0	Y	252,1247	1,0	N	HCV 3	R
MPT	161169,8	41070,52	51368,44	20,0	N	1,4	N	37103,51	27,8	N	N/A	N/A
MTL	3732,577	34,4423	177,557	80,6	Y	0,0	Y	19,01908	89,3	Y	HCV 3	RE
PDH	56123,01	36768,24	42852,57	14,2	N	1,3	N	35742,4	16,6	N	N/A	N/A
PLN	968542,1	726029,9	864823,5	16,0	N	25,6	N	669219,1	22,6	N	N/A	N/A
RGK	98694,36	61005,52	78431,16	22,2	N	2,1	N	57000	27,3	N	N/A	N/A
River	549,2296	11,71998	436,0554					1,341468			N/A	N/A
TBA	5194,824	2841,885	3126,188	9,1	N	0,1	Y	2599,358	16,9	N	HCV 3	R
TDR	4240,809	3531,455	4240,809	16,7	N	0,1	Y	3531,455	16,7	N	HCV 3	R
TWH	108947,3	25919,46	40615,11	36,2	N	0,9	Y	24773,41	39,0	N	HCV 3	R
TWI	356259,3	296058,1	326103,7	9,2	N	10,4	N	287148,2	11,9	N	N/A	N/A
Grand Total	3434058	2473715	2841525					2314665				

Appendix L-9. Rare and Endangered Ecosystems in the "Southern Coastal Lowlands"

SYMBOL LAND SYSTEMS	MAXIMAL EXTENT OF ECOSYSTEM (HA)	NATURAL EXTENT OF ECOSYSTEM (HA)	PAST ECOSYSTEM (HA)	HISTORY LOST (PERCENT)	>50% HAS LOST	PERCENT TO PHYSIOGRAFI	<1% TO PHYSIOGRAFI	FUTURE EXPECTED (HA)	PERCENT FUTURE LOST	> 75% FUTURE LOST	HCV3	STATUS
BKN	6577,593978	1989,279	2394,847575	16,9	N	0,1	Y	3,623009668	99,8	Y	HCV 3	REC
BLI	40131,22592	9548,155	23200,69236	58,8	Y	0,3	Y	2599,315175	88,8	Y	HCV 3	RE
BRH	854913,7471	609505,7	819653,1345	25,6	N	16,7	N	520846,9856	36,5	N	N/A	N/A
BWN	11488,57573	871,2938	5368,669476	83,8	Y	0,0	Y	486,9052103	90,9	Y	HCV 3	REC
GBT	1392877,54	741935,4	1298302,694	42,9	N	20,3	N	650546,9344	49,9	N	N/A	N/A
HJA	18010,79289	1960,802	4757,231343	58,8	Y	0,1	Y	1433,857734	69,9	N	HCV 3	RE
JLH	319,0009142	120,3539	319,0009142	62,3	Y	0,0	Y	120,3538887	62,3	N	HCV 3	RE
KHY	1217892,931	102599,2	246270,7752	58,3	Y	2,8	N	47846,08462	80,6	Y	HCV 3	E
KJP	94176,93907	39710,05	38397,48492	(3,4)	N	1,1	N	19005,42651	50,5	N	N/A	N/A
KLR	185198,9571	32135,86	49552,96651	35,1	N	0,9	Y	24921,25963	49,7	N	HCV 3	R
Lake	26971,14153	492,0988	4783,548565					271,8355928			N/A	N/A
LWW	1052,316194	228,8981	420,2866032	45,5	N	0,0	Y	48,656433	88,4	Y	HCV 3	RE
MDW	873849,6748	239359	594927,2165	59,8	Y	6,6	N	157528,2408	73,5	N	HCV 3	E
MPT	155,784749				N	-	Y			N	HCV 3	R
PKU	39244,10287	9071,357	16919,67226	46,4	N	0,2	Y	1862,75318	89,0	Y	HCV 3	RE
PLN	2814,312863	1073,78	1707,197102	37,1	N	0,0	Y	952,4844937	44,2	N	HCV 3	R
PMG	30210,04275	17104,25	16582,43731	(3,1)	N	0,5	Y	10760,06081	35,1	N	HCV 3	R
PTG	95833,33393	15468,79	12657,34525	(22,2)	N	0,4	Y	10891,81782	13,9	N	HCV 3	R
RGK	3776,954588	1190,202	1190,201978	-	N	0,0	Y		100,0	Y	HCV 3	REC
River	81359,53001	734,4115	9230,205483					88,12685816			N/A	N/A
SBG	196647,0998	86026,2	90756,36628	5,2	N	2,4	N	18073,54717	80,1	Y	HCV 3	E
SGT	570931,3915	123338,6	281902,8938	56,2	Y	3,4	N	115972,7185	58,9	N	HCV 3	E
SRM	187254,5371	42304,19	133048,9865	68,2	Y	1,2	N	36913,07091	72,3	N	HCV 3	E
TNJ	20860,17208	0,719025	23,39447736	96,9	Y	0,0	Y		100,0	Y	HCV 3	REC
TWH	996,0877922	6,543442	54,61083343	88,0	Y	0,0	Y		100,0	Y	HCV 3	REC
Grand total	5953543,786	2076775	3652421,859					1621174,058				

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