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Design for a District Level Natural Capital Assessment in Central Kalimantan

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October 2016

A CPI Working Paper

Descriptors

Sector	Land valuation , land use and spatial regulations, environmental and resource economics, ecosystem services valuation
Region	Central Kalimantan, Indonesia
Keywords	Natural capital accounting, spatial planning, land use management
Related CPI Reports	Central Kalimantan High Conservation Value Provincial Assessment_
	Using Data Tools to Optimize Indonesia's Land Resources: An Overview of Natural Capital Assessment (April 2013)
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Climate Policy Initiative (CPI) works to improve the most important energy and land use policies around the world, with a particular focus on finance, through in-depth analysis on what works and what does not. 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 Palangkaraya Institute for Land-use and Agricultural Research at the University of Palangkaraya in Kalimantan. CPI is supported by a grant from the Norwegian Agency for Development Cooperation for the Central Kalimantan Production and Protection initiative.

Supported by

Palangkaraya Institute for Land and Agricultural Research (PILAR) is a research foundation that supports local experts, researchers, and students at the University of Palangkaraya 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.

Acknowledgements

The authors are grateful for the review and contributions from team members at CPI, namely Jane Wilkinson, Suzanty Sitorus, Tiza Mafira and Arta Bramansa Ottay. The authors would also like to thank Ari Murdimanto for providing GIS assistance for the report.

The authors have benefited from meetings with the Ministry of Finance, Government of Indonesia, State Asset Management Department, the World Bank WAVES partnership, and the field research team based in PILAR: Dr. Ir. R.M. Sukarna, M.Si., Agung Wibowo, S.Hut., M.Si., Ph.D. and Santosa Yulianto, S.Hut., M.Sc. from Department of Forestry, University of Palangka Raya in Central Kalimantan. This work has also benefited from on-going research work in the land use workstream on High Conservation Value Mapping led by Ir. Bismart Ferry, M.Si., as a part of the Central Kalimantan Production-Protection Program (2013-2015). Funded by the Norwegian Development Agency (NORAD).

Contents

1. Executive Summary

Indonesia's land provides significant benefits to the economy, businesses, and communities. Some of these benefits, such as agricultural and mining production, are reflected in land values. Other benefits, however, are not included in the cost or valuation of land despite their importance. These benefits include water provisioning services, carbon stock, and wildlife habitats, to name a few. This gap means that when communities, the government, or businesses make decisions about how to allocate or use land, they have access to only part of the picture.

This challenge is exemplified in the Central Kalimantan province, which is the third largest province in Indonesia and home to approximately 10% of Indonesia's forests as well as a network of rivers flowing into the Java Sea and the Schwaner mountains, which host biodiverse flora and fauna supported by a rich indigenous Dayak culture. Growing pressure to increase oil palm output has led to deforestation, which threatens the valuable land services available to communities (Busch et al. 2015). This occurs despite the large amount of alternative land available for oil palm expansion in the region, for example through conversion of an estimated 3.3 million hectares of suitable degraded lands (Gingold et al 2012).

There is a win-win solution for Central Kalimantan and for Indonesia that promotes both economic growth and natural resource protection, which is to optimize land use through policy that is based on natural capital valuation. Natural capital valuation, or natural capital assessment, is a toolset used in major economies around the world that maps the value of various land uses on actual pieces of land, drawing upon a range of social, environmental, and economic indicators.

However, current land valuations in Indonesia do not comprehensively reflect the true value of land and natural resources. Existing assessments underestimate the value of land and ecosystem services and do not take all variables and land uses into account due to the difficulty in accessing consistent data, especially spatial data.

For example, studies that assess a business as usual projected scenario show variations to the value of natural capital into the future. These valuations range from a loss of USD 72 per Ha per year through deforestation, to a gain of USD 91 per Ha per year through sale of timber and other forest and agriculture services. Similarly, in assessing a green growth scenario, they show benefits of valuations that span a wide range of USD 17 to USD 816 Per Ha per year. While most studies cover variables of carbon provisioning services and timber and non-forest timber products, variables like hydropower and other water provisioning services are mostly excluded due to data or methodological limitations, with no link with high conservation values or translated policy impact on the ground (Berghöfer et al 2016).

Further, even when land valuations do exist, policy making in the land use sector that applies these results has been severely limited. Currently, land use licenses for forestry are not issued on the basis of the guidelines of economic valuation of forest ecosystems regulated by the Ministry of Environment and Forestry. Indonesia's Ministry of Finance and Ministry of Environment and Forestry have conflicting and inconsistent regulations and guidelines to value land with varying levels of comprehensiveness, especially on inclusion of ecosystem and carbon provisioning services. It is unclear which of the various regulations takes precedence, and how license issuance links with the spatial planning process and contribute to policy in practice.

This working paper, produced by Climate Policy Initiative with the technical support of Palangkaraya Institute for Land Use and Agricultural Research (PILAR) and University of Palangkaraya (UPR), lays the foundation for district level natural capital assessment by reviewing existing mapping and regulations, and describing the design of such a study.

- This is the first time that a comprehensive, need-based valuation has been designed based on high conservation value mapping and a regulatory review of guidelines for valuation, land use, and spatial planning. The assessment, when completed, will assign the true value of land throughout a district, laying the ground for further district assessments, and forming the foundation for management strategies that reflect the opportunities for production and protection for Central Kalimantan's natural resources. **We find opportunities for district level natural capital assessment across a number of key districts, including Seruyan, Katingan, Gunung Mas, and Murung Raya, however, we recommend a pilot in Kotawaringin Timur.** While more than half of the land area of Central Kalimantan would benefit from an improved land management approach,

Kotawaringin Timur provides the greatest opportunity because it shows promise for both low emissions palm oil cultivation and productivity gains, as well as protection of high conservation value areas.

- Kotawaringin Timur contains the highest amount of high conservation value area —27,502 hectare— amongst all districts under plantation status, i.e. areas that presently have licensed palm oil cultivations. However, presently, the district contains only 2.89% of Central Kalimantan's high conservation value area under protected status as national reserve and protected forests, the lowest compared to all districts.
- Historically, Kotawaringin Timur has among the most severe levels of deforestation across districts based on forest cover analysis from 1973-2012.
- Kotawaringin Timur also has the highest installed capacity and concentration of palm oil mills (27 in total with 1,585 ton Fresh Fruit Bunches/hour installed capacity) and palm kernel mills (4 in total with 39.5 ton kernel/hour capacity).

Almost 48,839 hectares of high conservation value areas identified in Kotawaringin Timur are at risk of oil palm expansion, which are under convertible-production forest status, allowing amongst other uses, issuing of licenses for oil palm cultivation. These areas would be important, especially in terms of valuing land in scenarios of forest versus cultivated oil palm. There are significant opportunities that lie within the district for low emission expansion of palm oil cultivation over an estimated 365,407 hectare, and for protection of 48,839 hectare of critical high conservation value area for 'land management' corridors.

We have developed a new approach for a natural capital assessment that would harmonize the guidelines and regulations around land valuation across government agencies and contexts, and link these with spatial planning and policymaking processes. A combination of geographic information systems (GIS), inventories, participatory approaches, and expert opinions are the most efficient and reliable approach based on integrating economic valuation methods for forest ecosystems described in Ministry of Environment and Forestry Regulation No. 15/2012 and the Ministry of Finance Regulation No. 98/PMK.06/2010 on the assessment of natural resource assets owned by the state. This approach will be recommended for future natural capital assessment within district level in Central Kalimantan.

2. Introduction

Indonesia is home to more than 10% of the world's tropical forests, which cover more than half of the country and provide valuable ecosystem services, for example, carbon provisioning services, water supply and provisioning services, flood and erosion prevention services, and nature recreation services, for both local and global communities. However, these forests are increasingly threatened by deforestation from agricultural expansion (particularly oil palm), forest and peat fires, and illegal logging. Growth in oil palm plantations alone threatens to deforest roughly 5%[1] of Indonesia's land area (Carlson et al 2013). The rapid expansion of agricultural production onto new land, including peatlands, also threatens the local economy, the welfare of indigenous communities, and the habitats of endangered species. It increases greenhouse gas (GHG) emissions, and often fuels land conflicts with local communities.

Central Kalimantan, which is the third largest province by area and home to approximately 10% of Indonesia's forests and 10% of Indonesia's oil palm plantations, demonstrates these land use pressures. The agricultural sector contributes around 28% to Central Kalimantan's gross domestic product (GDP), of which oil palm alone contributed 14% in 2013 (BPS, 2014), underpinning its importance to the regional and national economy. Pressure to expand production is high – by 2020, the provincial government aims to add 3.5 million hectares of new oil palm plantations to meet the Government of Indonesia's national goal of achieving 40 million tonnes of Crude Palm Oil (CPO) production.

Meanwhile, Indonesia's government has set targets of reducing emissions by 29% and up to 41% with international support by 2030, based on a 2010 projected business-as-usual scenario making up for 2.881 $GtCO_2e$ by 2030 (INDC, 2015). Based on an average of the past ten years, 60% of Indonesia's GHG emissions derive from land use and land use change, and emissions from land use, land use change, and forestry are expected to make up one-third of the government's reduction targets to vary between roughly 600 and 900 $mtCO_2e$/year from 2020 to 2030 (Climate Action Tracker, 2016).

While there appears to be a tension between the government's economic and environmental goals, in fact the Indonesian government has an opportunity to achieve economic growth and emissions reductions simultaneously: First, by ensuring that land is allocated and used on the basis of pre-determined valuations of natural capital, along with mechanisms that reward productivity gains on suitable lands; and second, by promoting the protection of high conservation value lands and the ecosystem services they provide to support human welfare, directly or indirectly.

However, the realization of these opportunities are challenged by the undervaluation of ecosystem services. Ecosystem services are not fully captured in commercial markets or adequately quantified in terms comparable with economic services and manufactured capital (Costanza et al., 1997), especially since commercial markets fail to capture the social and environmental value of these services (Carassco et al., 2014). In addition, when they do exist, current natural capital assessments suffer from systematically undervaluing land, due to lack of consistent data and methodology challenges, and in practice, there are very few examples of where decision makers have integrated the results of natural capital assessments into land planning processes (Laurans et al., 2013) due to poor links with policy making process and existing regulations on spatial planning. Thus, results which lack credibility, legitimacy and relevance have rarely been applied in practice towards informing development and environmental policies (Berghöfer,et al 2016).

To address the challenge of undervaluation of ecosystem services and the clear need for policymaking process and decisions that are based on sound natural capital valuation, Climate Policy Initiative (CPI) has partnered with the Palangkaraya Institute for Land Use and Agricultural Research (PILAR) and University of Palangkaraya (UPR) to examine the current landscape of natural capital assessments, and develop a more comprehensive and needs based design for natural capital assessments, in particular, proposing a pilot at the district level. This work is part of the PALM initiative – Production and Protection approach for Land Management.

The purpose of a natural capital assessment is to propose economic estimates of the value of various land uses on actual pieces of land in a business-as-usual scenario. The values draw upon a range of social, environmental and economic indicators, and in particular, the design of this assessment is based, for the first time, on Central Kalimantan's spatial plan (RTRWP, 2015) and the newly available high conservation value mapping, "Central Kalimantan High

1 Conversion of more than 9 Million Ha of existing palm oil permits in Kalimantan by 2020 would emit more than 4.4-.5. Gt CO2

Conservation Value Provincial Assessment" (PILAR, 2016) that identifies biological, ecological, social and cultural values with important ecosystems covering 60% of the Central Kalimantan's land area.

The ultimate goal of natural capital assessment is to inform the design of mechanisms, which could incentivize management strategies towards protection and incentivizing economic productivity gains using fiscal instruments or payment for performance schemes. It does this by providing distinct land use recommendations for a defined land area, for example suited for development, not suited for development, based on weighing multiple possible uses and benefits. A natural capital assessment also includes estimating the amount of support required to protect areas or the revenue generated from ecosystem services, and determining green GDP generated, improvements to wealth accounting, and the design of appropriate land use management strategies for critically endangered ecosystems. It also helps estimate the potential value added for businesses that adopt strategies to support sustainable, high productivity production of low-emission palm oil with integrated supply chains. Further, a natural capital assessment also supports provincial and district governments, businesses, and local communities in conducting environmental impact assessments and improving land use planning, management and licensing. This working paper is organized as follows:

- **Chapter 3** analyses the current landscape of natural capital assessments in Indonesia and their different estimated values of land, in order to highlight why current assessments systematically undervalue land.
- **Chapter 4** considers, for the first time, Indonesia's existing regulatory systems for land evaluation and accounting and their inclusion in the process of spatial planning. It evaluates two regulations that guide the valuation of land as input to policy makers for planning and for state asset accounting.
- **Chapter 5** assesses whether a district-level or provincial-level assessment is a better choice for a pilot, finding that the district-level compares favorably across a number of criteria
- **Chapter 6** identifies key districts, which provide significant opportunities for piloting our natural capital assessment in order to support the Production and Protection Approach to Landscape Management (PALM).
- **Chapter 7** proposes our design for a natural capital assessment tailored for the districts of Central Kalimantan, and addresses the methodological and data challenges that undermine the quality of current assessments in Indonesia.

3. Indonesia's natural capital assessment landscape shows that land is grossly undervalued

Current land valuations do not take all variables and land uses into account due to the difficulty in accessing consistent data, especially spatial data.

This paper builds on our previous work, 'Using Data Tools to Optimize Indonesia's Land Resources: An Overview of Natural Capital Assessment,' which describes the process of attributing (identifying and weighing) monetary values to a wide scope of land uses including benefits from goods and services such as carbon provisioning and ecosystem services that the land resource accrues. There are different approaches to incorporating land values into the real economy of goods and services. These approaches often differ according to the needs of the implementers who use the results to create incentives to influence optimal land use. Examples include natural ecosystem assessment, ecosystem assessment, natural capital analysis, systematic conservation planning, suitability mapping, and strategic environmental assessment (Benami and Wilkinson, 2013).

In Indonesia, literature and current studies conducted to value land and natural capital have resulted in a range of different values. However, as shown in **Figure 1** and **Table 1**, none of these studies have taken all variables and land uses into account due to the difficulty in accessing consistent data, especially spatial data. There are sets of studies that consider ecosystem service valuations, others that focus on general socio-cultural values of land, and others that only focus on the two scenarios of cultivation versus conservation.

Figure 1 summarizes the geographic diversity and variations in coverage of land use values assessed across Indonesia. Recent studies have covered a breadth of land uses in valuation owing to advancement in methods of valuation, and have streamlined focus of field study to the village level. Assessments have moved towards scenario based accounting of business as usual trajectories and green growth trajectories versus monetizing singular variables. However, they still lack comprehensiveness and have no link with official government assessments. **Table 1** further details the various existing natural capital assessments, showing different estimated values of per hectare per year yielded through existing studies on the value of land and natural capital in Indonesia.

Despite the compendium of disaggregated land values and varied values for the same services across different studies, there is growing recognition that natural capital assessments need to be carried out as a general land accounting exercise and include other land uses and possibilities such as alternative energy and water provision services. While mapping these variables comprehensively presents some challenges, individual studies by companies conducting market research and by researchers from local universities could offer important information to inform a more comprehensive approach.

While earlier valuations looked at approaches comparing conservation versus deforestation scenarios, more recent valuations take a broader approach with comparison of a 'greener' scenario with a business-as-usual (BAU) scenario. The shift of this perspective reflects the concept of production and protection, which does not see environmental costs at odds with development but rather values 'greener growth' scenarios that meet both environmental and green growth development goals.

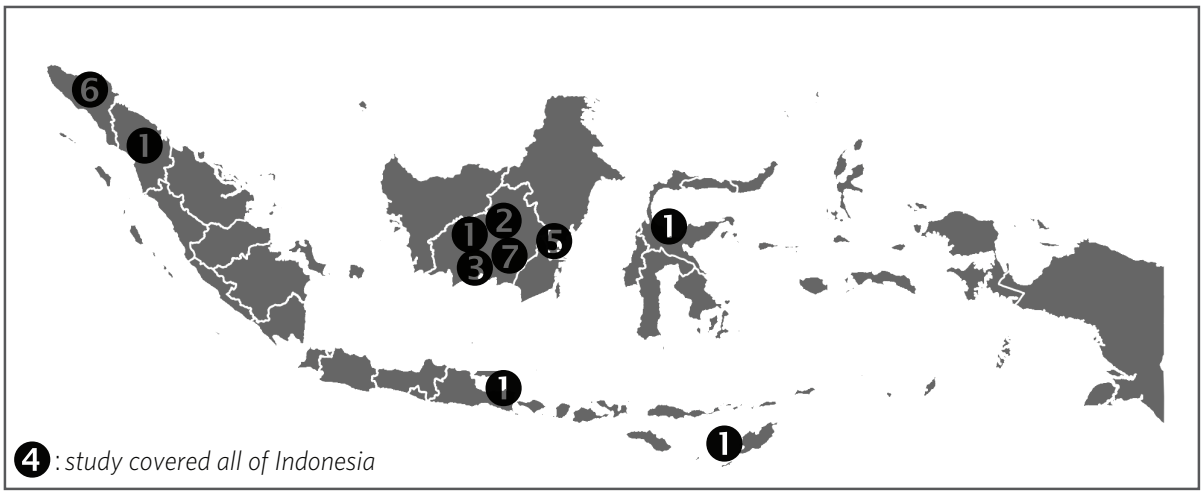
Other approaches to natural capital valuation compare improved agricultural practices, plantation expansions, increases in land productivity and avoided deforestation to a BAU scenario. One example is the United Nations Development Programme (UNDP) Low Emission Capacity Building (LECB) report on green growth, which estimates income accruing to ecosystems, cash and non-cash, based on where the villages are located: forest, riparian lands, rural mixed with rattan, rural mixed with coal, and others as per 119 villages in 6 districts sampled in Central Kalimantan.

Austin et al. (2015) uses an econometric approach to assess the economic tradeoffs for expanding oil palm cultivation. They estimate potential palm oil revenue if the forest is cleared for palm oil production in a specific site, a cost curve, and the associated map of avoided CO_2 emissions. This is not an ecosystem

Figure 1 Indonesian landscape of land valuation and natural capital assessments

	❶	❷	❸	❹	❺	❻	❼
Source:	UNORCID (2015)	GGGI (2015)	Hein and Sumarga (2014)	USAID (1998)	Kusuma (2005)	Van Beukering et al. (2003)	Ministry of Finance, Indonesia (2011)
Ecosystem Services							
Water provisioning services*	☑	☐	☑	☑	☑	☑	☑
Biodiversity and Conservation	☐	☑	☑	☑	☑	☑	☑
Forest Products	☑	☑	☑	☐	☑	☑	☐
Tourism	☐	☐	☑	☐	☑	☑	☑
Carbon Storage and Sequestration	☑	☑	☑	☑	☑	☑	☐
Land Uses							
Agriculture	☐	☑	☑	☐	☑	☑	☐
Fisheries	☐	☑	☐	☐	☐	☑	☐
Estimated Value ($/ha/yr)	BAU: **$52** GG: **$681**	BAU: **$40** GG: **$817**	BAU: -**$72** GG: **$42**	**$106**	**$6,025**	BAU: **$91** GG: **$128**	***not disclosed***

Study locations:



❹ : *study covered all of Indonesia*

Table 1: Summary of current studies conducted to value land and natural capital in Indonesia

NAME OF STUDY	AREA STUDIED	ESTIMATED VALUES PER HECTARE PER YEAR	LAND USES COVERED
Van Beukering et al. (2003): Economic valuation of the Leuser national park on Sumatra, Indonesia	Leuser National Park on Sumatra, Indonesia Approx. 25,000 km^2 of tropical forest	• Conservation: $128 • Deforestation for land use: $91	Water supply, fisheries, flood prevention, agriculture, hydropower, tourism, biodiversity, carbon sequestration, timber and non-timber forest products and fire prevention
Global Green Growth Institute (GGGI, 2015): Ecosystem restoration: green growth opportunities in the Katingan peatlands.	203,570 hectare of peatland forest area under PT RMU as the holder of ecosystem restoration license (across 60 years) in Katingan and Kotawaringin Timur districts of Central Kalimantan	• BAU cultivation scenario: $485m with $39.7 per hectare per year. • Green growth scenario: $9.974 bn with $816.59 per hectare per year	Socio-cultural value of the standing forest to local community's fuel wood, agricultural use, fisheries, and local and global biodiversity value, sustainable timber revenues and GHG emission benefits.
Ministry of Finance, Indonesia (2011): Sebangau National Park evaluation	5,300 km^2 (peat swamp forest), between the Katingan and Kahayan rivers	Results not disclosed to the public	Tourism, flora and fauna, hydrology services.
USAID (1998): Natural Resources Management (NRM)	Indonesia	Ecosystem Service Values • Soil and water conservation: $37.97 • Carbon uptake: $5 • Flood protection: $48.64 • Water transport: $5.30 Biodiversity: $9.45	Soil and water conservation and provisioning services, carbon provisioning services, biodiversity
(Kusuma, 2005): Economic Valuation of Natural Resource Management: A Case Study of The Benuaq Dayak Tribe In Kalimantan, Indonesia	Three villages of the Benuaq Dayak tribe in West Kutai District, East Kalimantan Province	Benuaq Dayak of $6,025.88 per hectare per year was calculated by summing the direct use value ($0.028 per hectare per year), indirect use value ($3,156 per hectare per year), and non-use value ($2,870 per hectare per year).	Timber and non-timber products, including foods and health products. Flood prevention, carbon sequestration, etc. Conservation value, future value for forests, biodiversity values, forest value options based on timber concession or agricultural plantation value.
Sumarga and Hein (2014): Mapping ecosystem services for land use planning, the case of Central Kalimantan and Hein and Sumarga (2016): Benefits and costs of oil palm expansion in Central Kalimantan, Indonesia, under different policy scenarios	97% of Central Kalimantan which is state owned land, i.e. 14,895,708 ha	2025 Scenario simulations: • BAU: Loss of $72.1/hectare/year • With moratorium scenario and current policies towards benefit sharing, and conservation program: $17 /hectare/ Year • Sustainable Production Scenario with benefit sharing, improvement in conservation and community development program: $42.24 / hectare/year. (includes peatland, mineral soil development and forestry)	Rattan, timber, oil palm, paddy rice, carbon sequestration (provisioning services) and wildlife habitat, nature recreation and flood prevention (cover as a risk variable).
UNORCID (2015) Forest ecosystem valuation study: Indonesia. United Nations Office for REDD Coordination in Indonesia	Five key provinces: Central Sulawesi, Nusa Tenggara Timur, Jambi, East Java, Central Kalimantan	The added gains of green growth scenario over BAU from 2015-2030 • Soil erosion prevention range: $2 (BAU)- 81 million per year. • Carbon sequestration: $17-97 million per year • Carbon storage: $1.2- 19 billion per year • Water augmentation: $435 million to $2.4 billion per year	Timber and non-timber forest products, soil erosion prevention, carbon sequestration and storage, and water augmentation

BAU: business-as-usual

approach; however, it is a fresh way to use econometric approaches to land use modelling.

Another recent study by Law et al. (2015) assesses spatial interaction and quantified and mapped ecosystem service values, and evaluates the potential provision of ecosystem services under future land-use scenarios for the Ex-Mega Rice Project (EMRP) peatland in Central Kalimantan, focusing on the ecosystem services of regulation (carbon stocks and the potential for emissions reduction), provisioning (timber, crops from smallholder agriculture, palm oil), and supporting (biodiversity) services.

While these existing studies are valuable, it is clear that a more comprehensive assessment of the aspects and services of ecosystems and uses of land is needed. One way to ensure comprehensiveness is by regulating standard methodology procedures for natural capital valuation so as to enable effective implementation and uptake towards evidence based policy making and spatial planning. Current guidelines and regulations are discussed in the following section.

Box 1: Official Forest Classifications

Considering the wide range of benefits from forests, there are several main types of utilization, collection and other permits that can be issued as a concession right over production forests and/or protected forests. Forests can be classified by status, function, and type, each of which branches out into sub-classifications.

- **By status.** Sub-classifications are: State Forests (Hutan Negara): a forest located on land that is not subject to a land title; Rights Forests (Hutan Hak): a forest located on land that is subject to land title, such as right of ownership (Hak Milik), right to build (HGB), and right to utilize (Hak Pakai), and right to cultivate (HGU), and; Indigenous Forest (Hutan Adat): a state forest located on land governed by the laws of indigenous communities.[a]
- **By Function.** Conservation Forests (*Hutan Konservasi*): a forest area where the primary function is to serve as a plant and animal conservation of its ecosystem, and consists of Nature Reserves and National Parks (*Kawasan Hutan Suaka Alam*), Conservation Forest areas (Kawasan Hutan Pelestarian Alam), and Hunting Parks (*Hutan Taman Buru*); Protected Forests (*Hutan Lindung*): a forest area where the primary function is to protect life-supporting systems, including the management of the water system, erosion and flood protection, and maintaining land fertility; Production Forests (*Hutan Produksi*): a forest area where the primary function is to produce forest products. There are three kinds of production forests: Permanent production forest (*Hutan Produksi Tetap or HT*), Limited production forest (*Hutan Produksi Terbatas or HPT*) and Conversion production forest (*Hutan Produksi Konversi or HPK*).
- **By Type.** Natural Forest (*Hutan Alam*) and Man-made Forest (*Hutan Tanaman*) which further consists of: Industrial Forests (*Hutan Tanaman Industri or HTI*): a forest area that has been planted on to supply raw materials for timber industrial purposes; Community Forests (*Hutan Tanaman Rakyat or HTR*): a forest area that has been planted on to preserve forestry resources; and Rehabilitation Forests (*Hutan Tanaman Hasil Rehabilitasi or HTHR*): a forest area planted on under a rehabilitation program to recover and improve life-supporting ecosystems.

a Constitutional Court Decision No. 35 of 2012 granted Indigenous Forests a distinct category leading to more autonomy by indigenous communities over their forests. Previously under Law No. 41/1999 on Forestry, Indigenous Forests were a part of State Forests and therefore subject to state designation.

4. Regulatory guidelines for land use in Indonesia can be harmonized to enable valuation driven spatial planning reform

This chapter looks at Indonesia's current guidelines, methodologies, and regulations that govern how land is valued and allocated. In order to optimize land use allocation, the Indonesian government could harmonize these regulations and embed them in the spatial planning process, particularly where resources or associated services do not have an explicit market price, e.g. standing forests, clean water, etc. Further, harmonizing these regulations would provide a basis to refer to the value of natural assets in legal proceedings, like determining environmental liability in civil cases[2] and assisting land reform for land which has an unassigned use or title.

4.1 The need to harmonize land valuations and the spatial planning process

The determination of legal title and allocation of land use by the government is not based on any land valuation, especially that of natural capital, and hence does not reflect the true or potential value of optimum use of the land.

In Indonesia, the State has the authority to arrange and allocate land and to determine legal relations between land (right) holders. The State runs differentiated, parallel tracks of spatial planning processes based on land use classifications which are not driven on the basis of land valuation. These inconsistencies are compounded at the local level.

First, spatial planning for forest land use and for non-forest land use are disconnected. While Law No. 26 of 2007 on Spatial Planning forms the basis for nationwide spatial plans for land, sea, air, and underground, covering non-forest land use[3], forest land use is regulated under Law No. 41 of 1999 on Forestry, as amended by Law No. 19 of 2004 ("Forestry Law"). Hence, land use allocations are made by the government and reflected in regional spatial planning maps. This implies that land allocated under forest use and non-forest use are evaluated with separate lenses on inconsistent timelines, making it challenging for non-forest land to be allocated as forests and forest land to be freed for non-forestry purposes.

Second, there is a lack of valuation-driven determination for both forest and non-forest lands. Valuation does not form the basis for altering the designation and function of forest areas (**Box 1**), as reflected in Government Regulation No. 104 of 2015[4]. Even though the preparation of spatial plans includes a technocratic phase based on various data, budget, and methodologies, it's unclear how the spatial planning process evaluates land use, especially for forests, and how it embeds the forest licensing process in implementation.

These challenging inconsistencies are compounded at the local level. In Central Kalimantan, regional government regulations for spatial planning mandate that at least 30% of the total space of an area where a river passes through must be forested areas.[5] However, this allocation does not include a formal process to reflect the values of land in the spatial planning law (15/PRT/M/2009)[6]. Hence, the map created on the basis of this law and the licenses of land which are granted by local land agencies before the map, risk being inconsistent and unreflective of the true value of land.

2 A recent example is a 2014 ruling against PT Kallista Alam for illegally burning peatland forest in Aceh Province, which held the company financially responsible for damaged ecosystems.

3 Article 15, Law 26/2007

4 Government Regulation No. 104 of 2015 on the Procedures for Altering the Designation and Function of Forest Areas.

5 Article 17 (5) Law 26/2007

6 Ministerial level regulation: Peraturan Menteri Pekerjaan Umum Nomor: 15/PRT/M/2009 tentang Pedoman Penyusunan Rencana Tata Ruang Wilayah Propinsi (Regulation of the Minister of Public Works No. 15 / PRT / M / 2009 on Guidelines for Preparation of Spatial Plan Province)

4.2 The need to harmonize land valuations and forest licensing procedures

The issuance of licenses for land use for forestry is not done on the basis of the guidelines of economic valuation of forest ecosystems regulated by the Ministry of Forestry, now the Ministry of Environment and Forestry.

The process of issuing general forest utilization licenses does not involve land valuation or accounting. Relevant directorate generals of the Ministry of Forestry (now the Ministry of Environment and Forestry[7]) must confirm the requested area's function, permitted uses, and where it is located in terms of the forest zone and land allotments, its land cover, and forest zone borders, in a map which is subjected to technical evaluation before submitting to the Minister. Further, if the Minister approves of the report, a Minister's letter is then issued instructing the applicant to conduct an environmental impact analysis. After the required environmental impact assessment (AMDAL/ UKL/ UPL) has been approved, the Minister instructs the Directorate General of Forest Plantology to issue a Working Area Map to be handed over to the Directorate General of Forest Development.[8]

Indonesian ministries have different guidelines for conducting land valuations with varied levels of emphasis and comprehensiveness. While the WAVES partnership[9] and One Map[10] are making progress in streamlining a statistical database (especially for land use and spatial data), Indonesian government agencies need to better coordinate on environmental valuation efforts to inform planning and sustainable development (Phelps et al 2014). One recommendation is to have the environmental impact analysis (AMDAL) and technical valuation for issuing forest utilization licenses follow the guidelines for the valuation of forest ecosystems (details below).

4.3 Opportunities to harmonize existing guidelines and regulations for land valuations

Two regulations govern the valuation of natural capital and land accounting. **Tables 2a and 2b** sets out their terms of coverage, methodology, process and value added to the policy process.

The Ministry of Environment and Forestry Regulation No 15/2012 for valuation of forests covers forest ecosystem services and their values more extensively, including extractive, non-extractive, environmental impacts, biodiversity services and social and cultural values. It also provides a detailed framework for use, type, approach and appropriate method with hypothetical examples for each value. This framework recognizes that different values can have different methodologies. However, there is no clarity on who should use these guidelines, in which context, and how these might support improvements to policy and spatial planning. It is unknown whether these guidelines have been used in any valuations in practice.

The Ministry of Finance Regulation No. 98/ PMK.06/2010 focuses on providing commercial valuations, upon request. Government departments in charge of oil/gas and mining or forestry, and any entity with a clear purpose and a license/concession over an area, may request a valuation of associated state assets including oil, gas, geothermal, mineral, coal and forest. The State Asset Management Directorate under the Ministry of Finance plans to strengthen the guidelines related to forestry and marine and water resources.[11]

7 The Ministry of Forestry and Ministry of Environment were merged into the Ministry of Environment and Forestry in 2015.

8 Ministry of Forestry Regulation No. 50 of 2010 jo. No. 26 of 2012 on Guidelines for Granting and Extending a Work Area for IUPHHK HA, RE and HTI in A Production Forest.

9 Wealth Accounting and the Valuation of Ecosystem Services (WAVES) is a World Bank-led global partnership that aims to promote sustainable development by ensuring that natural resources are mainstreamed in development planning and national economic accounts. From 2013, WAVES is being implemented by the World Bank under the framework of the Green Development Support Program. Currently, they have identified the natural capital and ecosystem accounts linked to priorities of the Government of Indonesia and outlined a plan for the next four years.

10 The One Map initiative, stipulated in Law No. 4/2011 on geospatial information works towards bringing together land use, land tenure and other spatial data into a singular incorporate database for Indonesia.

11 Regulations of the Directorate General: Guidelines for Assessment of Production Forest Resource (No. 7 / KN / 2012), Guidelines for Assessment SDA Forest Protection and Conservation (No. 7 / KN / 2014) and the Technical Bulletin Forest Inventory Benefits of Natural Resources (2015), Guidelines for Assessment Captured Fisheries (2016), Guidelines for Assessment of Small Islands and coastal areas (2017), Groundwater Assessment Guidelines (No. 11 / KN / 2012), Guidelines for Assessment of Surface Water Resource (2018).

While forest valuations should include assessment of data related to quality and quantity of flora and fauna, it is unclear if these specific variables are recognized as state assets and whether their cost or income accrued from them guide the valuation. In any case, Ministry of Finance Regulation No. 98/PMK.06/2010 does not consider capitalizing forest flora and fauna for areas beyond non-forest purposes. If environmental goods, services and values are not recognized as state assets, damage assessments may not be able to formally account for them as state losses. Links with spatial planning are poor since the regulation indicates that the spatial plan itself needs to exist before the valuation. Overall, this regulation does not mandate a comprehensive assessment of non-market values which are essential to drive forest protection.

The Ministry of Finance and Ministry of Environment and Forestry have conflicting and inconsistent regulations and guidelines to value land. It is unclear which regulation takes precedence and how they link with the spatial planning process and contribute to policy in practice.

In practice, this regulation would lead to a natural gas plant being set up on land allocated by the government as use for non-forest purposes, even if the conservation value of forest and ecosystems is higher than the commercial value of natural gas. For example, a commissioned valuation of Taman National Sebangau covers eco-tourism, flora and fauna and hydrology as variables considered for the valuation, but only covers the area designated as a national park. The results of this valuation are not captured as state assets in any wealth accounting framework or within fiscal policy frameworks despite being shared with relevant entities, within the Ministry of Finance and other representatives involved in the process.

Optimal land use productivity is impeded by the fact that land valuation is based on the land title of the area and not on land use. Spatial planning policies and regulations would benefit from valuation-driven, evidence-based policymaking.

Opportunities exist to protect critical forest resources and increase productivity by optimizing the allocation of land use via a more comprehensive land valuation. A land management approach guided by the true value of land and not the land title would reflect where and how much land is needed to sustain livelihoods from ecosystem services to keep forests standing and to maximize gains from productive land. This approach can be achieved by harmonizing the guidelines and regulations around land valuation across government agencies and contexts, and linking these with spatial planning and policymaking processes in order to enable effective implementation.

Table 2a: Regulations governing natural capital and land accounting in Indonesia

CRITERIA	MINISTRY OF ENVIRONMENT AND FORESTRY REGULATION NO. 15/2012 ON ECONOMIC VALUATION GUIDELINES FOR FOREST ECOSYSTEMS
What is being evaluated?	Forest ecosystems
Who evaluates? Who is involved in the process?	Development planners/policy makers
How does it affect policies? How is it used? What is the purpose?	It does not provide official linkages to policy, but is meant to provide general guidance to policymakers in planning forest development/ utilization based on an economic approach. In particular, economic valuation of forest ecosystems are expected to: (1) identify the critical value, the benefits and problems that arise on forest ecosystems for sustainable utilization of the resource, (2) guide the direction of policy and accountability sustainable use forest ecosystems, (3) develop indicators of sustainable use of forest ecosystems, (4) improve the standard for measuring sustainable use forest ecosystems. In essence decisions about forest ecosystems should pay attention to trade-offs of the impact on the natural resources and how to minimize the impact that follows.
Methodology	Direct market approach: Through a productivity approach – {(1) changes in productivity, 2) replacement cost, and 3) cost of prevention.}, human capital or approach of the value of the lost (foregone earnings), and the opportunity cost approach of using resources. Non-market approaches: The method of hedonic value (hedonic pricing), the method of estimation from travel costs, the method of estimation from willingness to pay or willingness to receive compensation (contingent valuation), and the method of transfer benefits.
Coverage	Forest ecosystems: (1) determination of the area / region and local figures to identify the functions and benefits of forest ecosystems, (2) identification of problems, types, classification, and distribution in forest ecosystems
How are forests evaluated?	(1) Total economic value. Extractive: wood, timber, firewood, charcoals, fruits, skin of wood, herbal, tree saps, insects, wildlife, micro-organisms, honey, agricultural and horticultural commodities, hydrology and others. Non-extractive: recreational, education and research value. (2) Total cost of damage. Environmental impacts: ecosystem services (avoiding erosion, flood prevention, producing oxygen (oxygen price in hospitals), carbon sequestration, water protection, food and nutritional value of forest products. Biodiversity services: genetic value (willingness to pay biodiversity), transit home migratory species, protected/endangered species. Social and cultural values: religious activity, traditional values/ ancient, scenic value (all willingness to pay).
How is data collected? What are the stages of analysis?	Depends on the approach and methodology undertaken but general steps involve: 1) setting up of data and information on the quantity of natural resources, 2) conducting a simple survey to help get the necessary information about the quantity and price of natural resources not yet available, and 3) multiplying the quantity of natural resources with its market price.

Table 2b: Regulations governing natural capital and land accounting in Indonesia

CRITERIA	MINISTRY OF FINANCE REGULATION NO. 98 / PMK.06 / 2010 ON THE ASSESSMENT OF ASSETS OWNED BY THE STATE IN THE FORM OF NATURAL RESOURCES
What is being evaluated?	State-owned natural resources, which for the purpose of the assessment includes all oil, gas, geothermal, minerals, coal and forest resources.
Who evaluates? Who is involved in the process?	Based on request of government entities or other interested parties with a legal right over the area, a "Directorate General Valuation Team" formed by Ministry of Finance DG of State Assets. The Team may also commission external experts at the discretion of assessment team.
How does it affect policies? How is it used? What is the purpose?	Although a clear purpose must be stated when making the request for a valuation, it is unclear how it impacts policies if at all. For oil, gas, geothermal, coal, and mineral resources, the state and other interested parties would be able to assess the value of natural resource utilization/extraction projects beforehand to estimate its potential contractual value. For forests, economic value can also be assessed presumably to gauge its potential use, but the regulation establishes no formal links to forest planning processes.
Methodology	(1) Market: comparing the value of sales or offers similar or replacement object types and relevant market data, (2) Cost: considers the costs incurred to acquire new objects minus the depreciation and, deterioration of the evaluated object, (3) Income: estimating the revenues potentially produced by the evaluated object taking into account the capitalization and discount rate and net present value), and/or (4) other approaches.
Coverage	State owned natural resources: (1) assessment of oil, gas, geothermal energy, minerals, and coal and forests to determine arms-length value of utilization, exploitation, and/or estimates of potential fair value, or with regard to forests only, (2) estimated economic value of forests.
How are forests evaluated?	The valuation process consists of: 1. Identifying/defining the request 2. Determining the purpose of the valuation 3. Initial data collection 4. Field survey 5. Data analysis 6. Determining the valuation approach/method 7. Value determination 8. Valuation reporting It is worth noting that if the Valuation Team is unable to conduct a field survey for whatever reason, the valuation is discontinued.
How is data collected? What are the stages of analysis?	Much of the data is sourced from legal documentation such as licenses, i.e. for forests it would require a utilization/collection license, except for forests without a utilization status or that have not been claimed for management by a third party. Other documents include the spatial plan, map of the area, price descriptions, and information on value of transaction/offer, and activity plans. In the analysis stage, several factors are taken into consideration, i.e. location, area designation, licenses, legal documents, forest coverage, type of forest, price of forest products, existing flora and fauna, and quality and quantity of flora and fauna.

5. A district-level assessment provides the right opportunity to pilot a natural capital assessment

Compared with a provincial-level assessment, a district-level assessment provides a higher level of detail, helps in targeting variables as per localized conservation values with clear land use classifications, and is tailored towards the needs of the program.

A needs-based natural capital assessment is most suitable at the district level. First and foremost, this enables the assessment to effectively serve as a supporting tool to pilot a Production and Protection approach to agriculture and land management, which will be implemented on a district level. Secondly, district level analysis is more comprehensive, with a richer level of spatial data available to focus at per km^2 than a provincial-level analysis that allows for more tailored research on specific ecosystem and demographic characteristics. Finally, a smaller land area requires less time, fewer resources, and can be completed at a lower cost. Details of the comparison between provincial and district level analysis are presented in **Table 5**.

Table 5: Advantages and disadvantages of a natural capital assessment at the provincial and district levels.

	PROVINCIAL LEVEL	DISTRICT LEVEL
Information level	Lower level of detail, compatible with the level of detail for the high conservation value (HCV) analysis.	Higher level of detail, targeted variables and clear land use classifications, however the HCV analysis will not be equally detailed.
Data availability	Less detailed but more available at the aggregated level.	More available at the aggregated level. Details can be sought out with detailed surveys such as IKONOS and LANDSAT 8.
Required time	Since the area to be assessed is larger and there is lower data availability, it will take a longer amount of time.	Focusing on one or two districts will reduce the required time, especially with regards to collecting detailed LANDSAT and spatial data samples per km^2
Resources needed	Required human resources consist of GIS (geographic information system) experts and economists who specialize in resource economics and valuation. Resources would be required for data collection, surveying and field trips as well.	The required resources are similar to the provincial level, however, since the land area is smaller, the number of resources needed is lower.
Budget allocation	Time allocation and number of resources result in a high usage of resources and budget.	Potential for cost effective resource and budget efficiency.

6. There are opportunities across a number of key districts, including Seruyan, Katingan, Gunung Mas, and Murung Raya, and Kotawaringin Timur

More than half of the land area of Central Kalimantan would benefit from an improved land management approach, and we find particular opportunities for district level natural capital assessment across a number of key districts, including Seruyan, Katingan, Gunung Mas, and Murung Raya, and Kotawaringin Timur. We recommend a pilot in Kotawaringin Timur owing to promising opportunities for low-emissions oil palm in this district.

The Central Kalimantan government is planning to triple plantation area to reach above 3.5 Million hectares by 2020 in order to meet Indonesian Government targets to increase CPO production to 40 million tonnes by 2020. The increased pressure on land continues to threaten the tropical forests located in Central Kalimantan, which account for 10% of Indonesia's native forests. Land use classifications that reflect the true value of land would enable incentives towards optimal land use. Lack of coherent regulatory guidelines and incomprehensive studies on natural capital give us an incomplete picture on what land is truly worth in Central Kalimantan. Hence, there is a need for valuation driven policy and spatial planning reform to address growing pressure on land to support deforestation free palm oil supply chains through incentives for optimal land use.

This section examines the districts of Central Kalimantan which could provide significant opportunities for applying the Production and Protection Landscape Management (PALM) approach, and defines the areas fit for an in-depth natural capital assessment. These areas are characterized by the misalignment between their allocated land use classifications versus their bio-physical characteristics under high conservation value mapping.

The goal of the Central Kalimantan Production and Protection Landscape Management (PALM) approach is to incentivize low-emission palm oil by establishing a public-private partnership at a district level. Hence, this exercise was conducted to identify district-level field research areas for natural capital assessment pilots. In line with the Production and Protection approach, we've identified areas where the current allocation of land use includes palm oil cultivation on high conservation value areas, and significant opportunities for production gains in production forest areas which are underutilized. These identified areas are most suitable for applying the PALM approach of land management to protect ecosystems with high conservation values and maximize the productivity of sustainable oil palm. This further forms the basis of the attributes of land which will be monetized for the natural capital assessment, but also supports tailored land management strategies for misaligned areas.

In order to find opportunities to align the natural capital value with the assigned value of land, CPI transposed the high conservation value (HCV) maps with the spatial map of Central Kalimantan Province (RTRWP-Rencana Tata Ruang Wilayah Provinsi) to identify where and the volume by which characteristics did **not** reflect allocated land use classifications.

Each high conservation value[12] has a corresponding land management strategy which allows for research to focus on variables to be valued which match land attributes. These land attributes form the basis of choice of ecosystem services and variety of benefits that the field research should focus on to monetize and assess as natural capital.

12 The High Conservation Value Mapping provides a framework to help identify biological, ecological, social and cultural values considered exceptionally important, and to develop management plans to maintain these values or enhance them where appropriate. The methods used in identifying HCV areas are based on and adapted from a similar analysis in East Kalimantan completed in 2010 (see Wells, Paoli and Suryadi, 2010). PILAR (2016) report outlines the results of the first attempt at mapping selected biological and ecological HCVs at a province-wide, landscape scale for Central Kalimantan

There is a need to design strategies for natural capital assessments on the basis of high conservation value mapping. Misalignment between allocated land use and high conservation value mapping provides opportunities to manage biodiverse and critically endangered areas as well as maximize productivity for sustainable low-emission oil palm.

For example, as seen in **Table 3,** HCV 4.2 shows areas which are at high risk of erosion and sedimentation. Identified misaligned land areas under 4.2 with the spatial plan under the chosen district would have field research which includes the variable flood prevention, water supply and provisioning services as one of the key environmental ecosystem services under study.

This makes the study comprehensive but also highly relevant and aligned with conservation value maps. This exercise not only focuses the research design, identifies the district, and forms the basis of the attributes of land which will be monetized for the natural capital assessment, but also supports tailored land management strategies for misaligned areas.

6.1 The need for the PALM land management approach: scale and volume

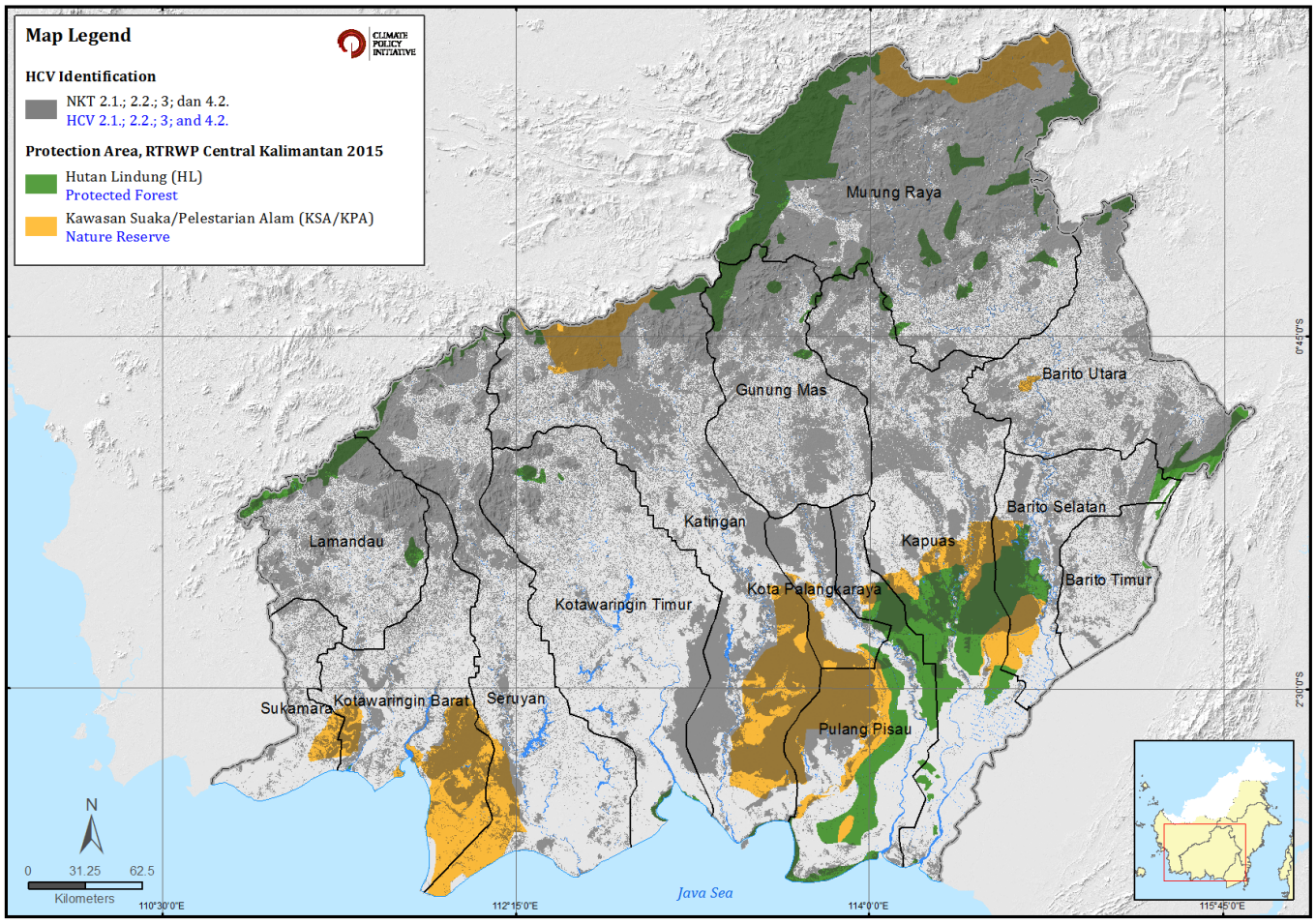
The provincial spatial plan (RTRWP, 2015) allocates 19.19% of Central Kalimantan's land as protected forests and nature reserve. The **Map 1** below indicates that 82.61% of Central Kalimantan's area has been identified under high conservation value (2.1, 2.2, 3 and 4.2). Once transposed, our analysis finds 58.12% of Central Kalimantan's area can benefit from an improved land management approach. In particular, 10.85% of Central Kalimantan would benefit from a land management strategy targeted towards forest conservation, 19.27% from managing landscapes of contiguous ecosystems, 9.06% from managing rare or endangered ecosystems, and 18.94% from management to prevent harmful erosion and sedimentation.

Table 3: Proposed approach towards optimized land use management strategies

HIGH CONSERVATION VALUE	DETAILS OF HIGH CONSERVATION VALUE MAPS CONSIDERED AND TARGETED MANAGEMENT STRATEGIES	LAND ATTRIBUTES AND RESPECTIVE VARIABLES FOCUS FOR NATURAL CAPITAL ASSESSMENT AT DISTRICT LEVEL
2.1	Large natural landscapes with capacity to maintain natural ecological processes and dynamics Management to guarantee that the core area and associated buffer zone are maintained as forest or other natural vegetation.	Provisioning services: forest, carbon sequestration, timber and non-timber produce
2.2	Areas that contain two or more contiguous ecosystems Identifies landscapes that contain multiple ecosystem types, to protect their core areas and to maintain connectivity among these types.	Provisioning services: Endangered species, biodiversity functions, agriculture, energy
3	Rare or endangered ecosystems: identified desalinated ecosystems within a landscape that are naturally rare (e.g. karst forest) or endangered because of changes in land cover caused by humans. Management actions should ensure that natural ecological processes throughout a rare or endangered ecosystem – especially distinctive features of it – are maintained.	Ecosystem services and functions, biodiversity
4.2	Areas important for the prevention of erosion and sedimentation Management through land cover and/or soil conservation practices.	Key environmental regulating services, water supply, hydropower, risk of flood prevention , risk of forest fire prevention

Note: Details of the High Conservation Value Mapping can be found in the Central Kalimantan High Conservation Value Provincial Assessment (PILAR, 2016).

Map 1: High conservation values combined with overlaying land area under protected status by the Government of Central Kalimantan



More than half of the land area of Central Kalimantan could benefit from an improved land management approach, specifically aligning land use allocations with their conservation characteristics.

As indicated in **Map 1** above, the largest volume of area that would benefit from improved landscape management is in Murung Raya (2,718,914.81 hectare) followed by Katingan (1,240,925.32 hectare), Seruyan (738,563.78 hectare) and Gunung Mas (760,848.62 hectare). However, it is interesting to note that 100% of the area identified as high conservation value within Barito Timur and 97.42% of the area within Kotawaringin Timur are not currently defined as protected areas by the provincial government. The same is true for other districts: 87.43% for Gunung Mas, 86.81% for Lamandau and 85.90% for Seruyan.

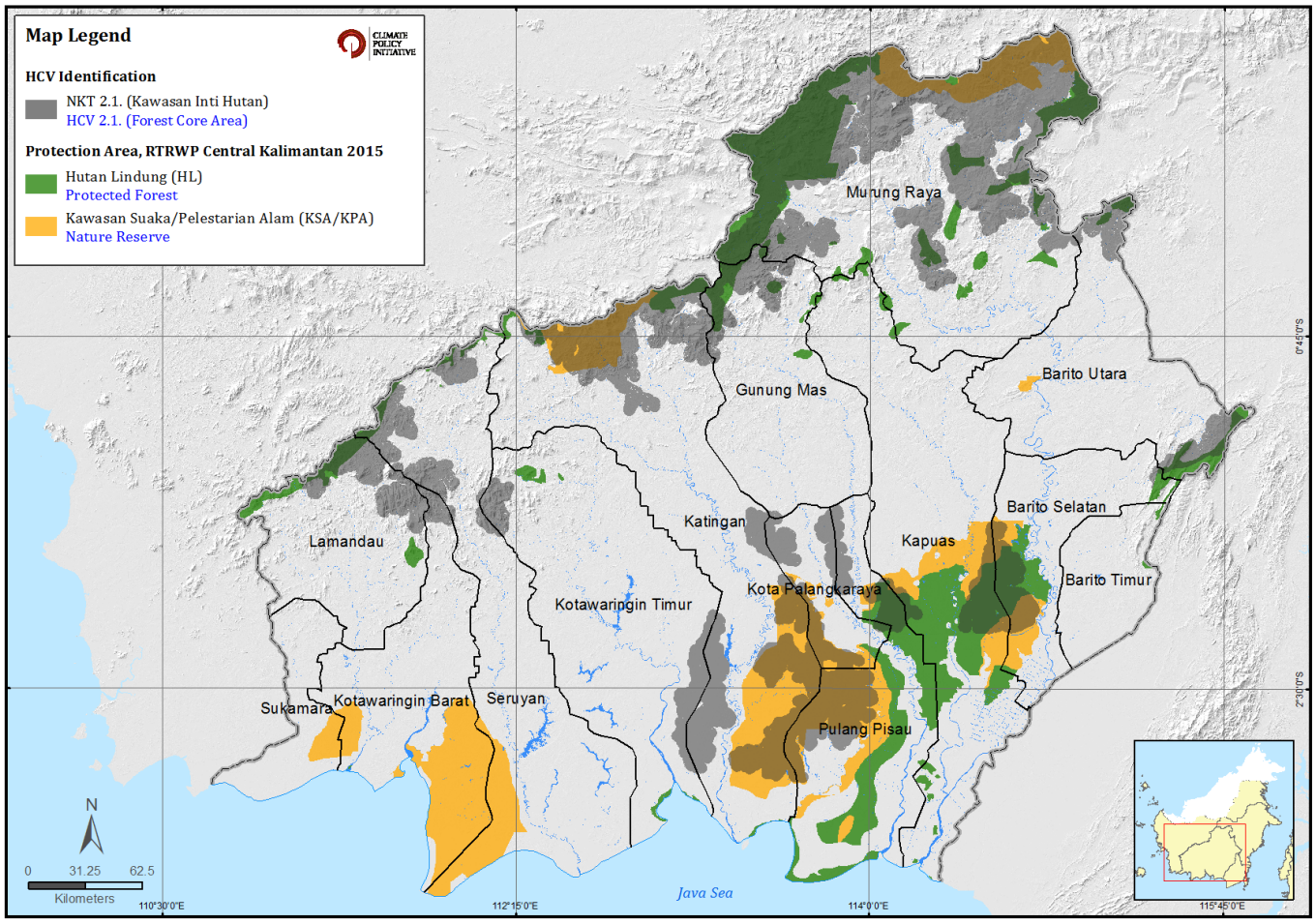
For a deeper dive, we looked at HCV 2.1 in particular (**Map 2**). This characteristic is defined as the core forest area, i.e. areas which are classified as bio-diverse rich core forests.[13] Management of this core area should guarantee that the core area and associated buffer zone are maintained as forest or other natural vegetation. Areas that have been defined by the Central Kalimantan's spatial plan (RTRWP) as protected forest areas and nature reserves have been indicated in green and yellow respectively.

Interestingly, HCV 2.1 identifies 20.39% of Central Kalimantan's area as under core forest while the spatial plan allocates 19.19% of the land as protected forests and nature reserve.[14] However, it is important to note the areas allocated are not the same.

13 The definition of a landscape with a core area is a forest block (or other natural landscape mosaic) with an internal core >20,000 hectare surrounded by a natural vegetation buffer of at least 3 km from the forest edge.

14 High conservation value mapping does not take peat dome into account.

Map 2: High Conservation Values 2.1 – Forest Core Overlaying Area under Protected Status by the Government of Central Kalimantan

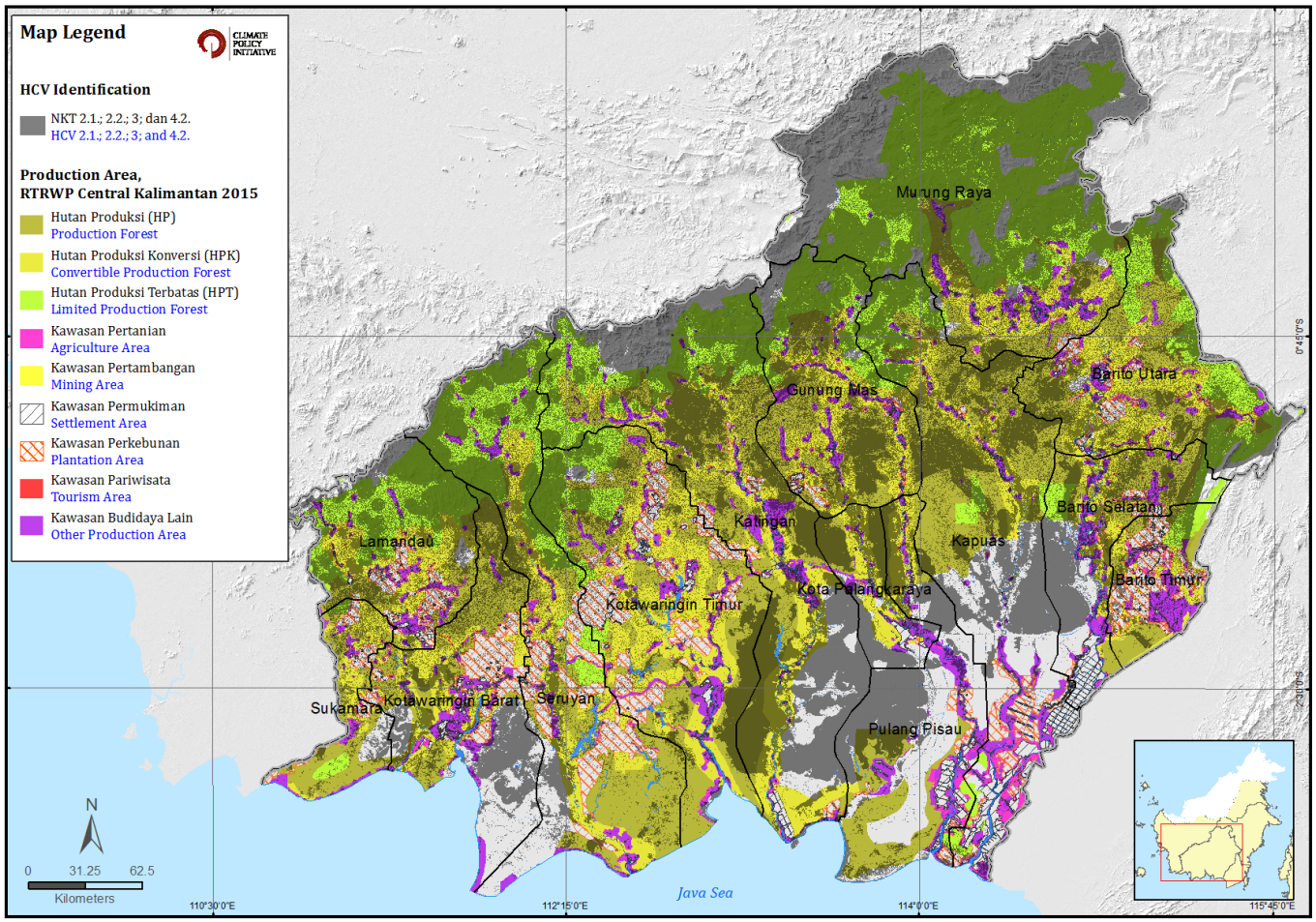


Our analysis shows that roughly half of the area showing core forest characteristics (10.85% of area of Central Kalimantan) lies outside legally protected areas and requires management strategies towards protection. District wise these misallocations (i.e. the highest percentages of unprotected land) are found in Kotawaringan Barat (100%), Kotawaringin Timur (100%), Seruyan (88.02%), Lamandau (78.7%) Barito Utara (70.12%), and Gunung Mas (68.77%). However, in terms of volume, the largest area (Hectare) not under protected status is in districts Murang Raya (683651.09 hectare), Katingan (321979.12 hectare), Seruyan (143021.14 hectare) and Lamandau with (106888.74 hectare) in that order.

Of these districts, it is interesting to note that Kotawaringan Timur and Barito Utara do not have any allocated protection forest or natural reserve while Kotawaringan Barat has 12% already allocated with Pulang Pisau having over 19% of its land and Katingan at 10%, based on the RTRWP, 2015. Hence the districts of Kotawaringan Timur, Kotawaringin Barat, Katingan and Seruyan are of critical importance. In these misaligned areas, the natural capital assessment will be able to focus on management strategies for forest products and services to take valuable and comprehensive variables so as to find their natural capital value addition.

Seruyan and Murang Raya have large parts within the district but also have one of the largest areas amongst districts which could benefit from landscape management. Further Kotawaringin Timur and Katingan have potential to benefit from forest conservation of forest core areas.

Map 3: Comparing High Conservation Value Characteristics with Productive Lands in Central Kalimantan



6.2 Opportunities to benefit from the PALM approach: Assessing current land use classifications for production and protection

The previous section details the need for the PALM approach by identifying areas in terms of volume, scale and districts, which would benefit from landscape management strategies. This section looks at these identified misaligned areas in more detail in terms of current allocated land use for productive purposes.

As per the provincial spatial plan, **Map 3** shows that roughly 80% of land in Central Kalimantan has been allocated for productive purposes. Productive purposes include productive forests covering 62.84% of Central Kalimantan and comprise of production forest (25.03%), convertible production forest (16.04%) and limited production forest 21.41%, plantations which cover 6.86% of Central Kalimantan's land and Agriculture (0.48%), mining (0.06%), settlement (2.11%), tourism and other production areas which are sparsely allocated.

Indonesian Law No.41/1999 and Presidential Instruction No.8/2015 define the licenses and usage as per land use classifications: Production or Protection Forests. The protected forests are either conserved or left standing as hunting parks or are allowed to be used as under the following forest licenses: Limited area utilization, Limited ecosystem service utilization Limited non-logging forest utilization. This makes oil palm expansion legally impossible on lands with protected forest status.

Under production forest status, forests can be used for other purposes, either for logging and timber products or to be cleared for other purposes subject to approval of licensing procedures. This is allowed under approved licenses for timber utilization, non-timber collection, area utilization and environmental services utilization. However, Plantations can only be established on convertible production forest (Hutan Produksi Konversi). Hence the following exercise assesses high conservation value lands falling under various land use classifications of production and protection and focuses on analyzing the convertible production forests as well as plantation areas.

Table 4: Key districts of interest and percentage of high conservation value land under different allocated land use classifications

LAND THAT COULD BENEFIT FROM PALM APPROACH	MURUNG RAYA	KATINGAN	SERUYAN	KOTAWARINGIN TIMUR	GUNUNG MAS
PRODUCTION FOREST (HUTAN PRODUKSI)	4.04%	**23.98%**	10.81%	40.83%	**29.29%**
CONVERTIBLE PRODUCTION FOREST (HUTAN PRODUKSI KONVERSI)	**1.59%**	**10.03%**	**13.78%**	**8.64%**	13.38%
LIMITED PRODUCTION FOREST (HUTAN PRODUKSI TERBATAS)	54.12%	25.68%	56.08%	39.45%	39.76%
AGRICULTURE (PERTANIAN)	0.00%	0.01%	0.01%	0.03%	0.01%
PLANTATIONS (PERKEBUNAN)	0.05%	0.49%	1.69%	**4.86%**	0.97%
SETTLEMENT AREAS (PEMUKIMAN)	0.04%	0.07%	0.07%	0.39%	0.20%
TOURISM (PARIWISATA)	0.00%	0.00%	0.00%	0.00%	0.00%
MINING (PERTAMBANGAN)	0.03%	0.00%	0.00%	0.00%	0.01%
OTHERS (BUDIDAYA LAIN)	0.83%	2.41%	2.95%	2.91%	3.47%
UNDER PROTECTED LANDS (HUTAN LINDUNG, PELASTARIAN ALAM)	39.30%	37.33%	14.61%	**2.89%**	12.91%

Our analysis finds that of this land allocated for productive purposes, over 58% land is high conservation value. As per our analysis presented in **Table 4** and **Figure 2**, we look closely at which classifications do 'misaligned' lands fall under in the following five districts – Murung Raya, Katingan, Seruyan, Kotawaringin Timur, Seruyan and Gunung Mas which are of critical importance in terms of volume and parts of land within the district which need to be protected.

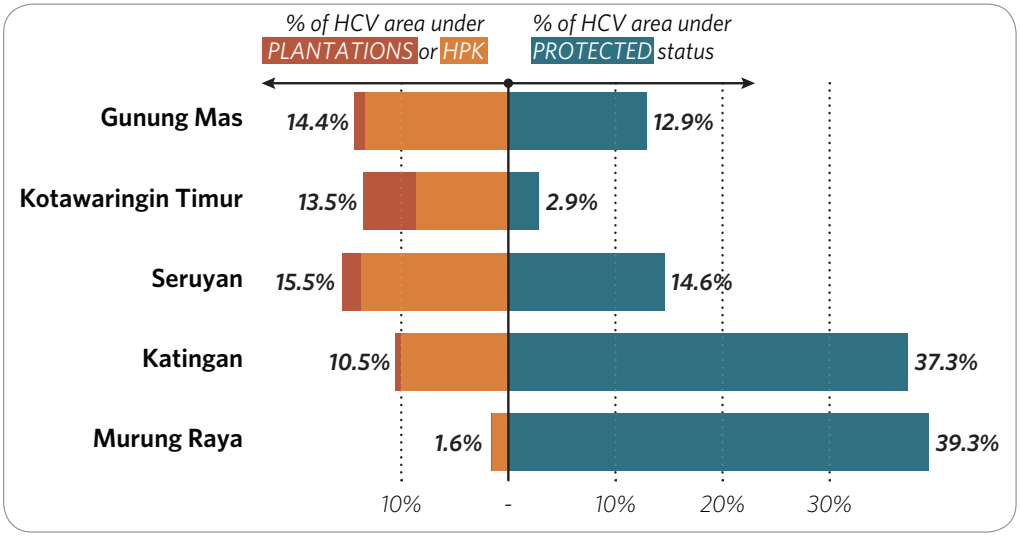
Murung Raya has the most amount of land which falls under protected status (39.30%), however it has over 54.12% of land under a limited production forest status. A limited production forest classification allows for production, however, not for use as oil palm plantations. Hence, even though Murung Raya has more than half of its lands in limited production forest, critical HCV lands are not at risk from palm oil expansion.

Katingan has 37.33% high conservation value land under protected status. However, it also has the highest amount left unprotected with 196,763.70 hectare allocated as convertible forest status, which increases the threat of oil palm expansion. However, Katingan has a significant amount of high conservation value area under production forest status, which would benefit from ecosystem service focused designs for management strategies to conserve land.

Seruyan has over 56.08% of high conservation land under limited production forests which reduce the risk of oil palm expansion. However, with 118.490,18 hectare it has over 13.78% of its area under convertible production forest status which faces a more serious threat to expansion of oil palm cultivation. Natural capital assessments in convertible forest areas in Seruyan would add value for estimating costs and benefits for oil palm expansion and reduction in risk for high conservation value land.

Gunung Mas has almost 40% of its area (or around 116,466.54 hectare) under limited production forest status which does not allow for palm oil cultivation. However it has almost another 13.38% of land under convertible production forest status that are under threat from oil palm expansion. Focusing on the ecosystem service functions of these areas will help shape management strategies which could secure land as standing forest.

Figure 2: High Conservation Value Lands at risk from oil palm expansion across districts



amount of companies—37 in total—covering a land bank of 506,003 hectare. (Dinas Perkebunan, Plantation Agency, Central Kalimantan, 2013).

Historically, based on new analysis from 1973 from 2012, Kotawaringin Timur and Seruyan have had the most severe levels of deforestation (PILAR 2016). Presently, 8.64% of HCV area in Kotawaringin Timur is under convertible forests and is therefore at risk of oil palm expansion. These areas would be important, especially in terms of valuing land in scenarios of forest versus cultivated oil palm.

Seruyan, Gunung Mas and Katingan have significant high conservation value lands which are under threat from oil palm expansion. The natural capital assessments could help design strategies to protect high conservation value areas.

There are significant opportunities that lie within the district for low emission expansion of palm oil cultivation over an estimated 365,407 hectare and for protection of 48,839 hectare of critical high conservation value area. This makes Kotawaringin Timur the most suitable case for applying PALM and conducting a needs-based natural capital assessment.

Kotawaringin Timur presents the greatest opportunity, as it has only 2.89% of high conservation value area that is under protected status as national reserve and protected forests, amongst the lowest compared to all districts. It also has the highest amount of high conservation value area, 27,501.54 hectare, amongst all districts under plantations.

Our preliminary analysis of the oil palm business economy and Central Kalimantan's oil palm value chain indicates that there is a concentration of oil palm supply chains in Kotawaringin Timur, and significant opportunity for productivity, profitability, and sustainability gains (Glenday et al 2015). Kotawaringin Timur has the highest installed capacity and concentration of palm oil mills (27 in total with 1585 ton Fresh Fruit Bunches/hour installed capacity) and palm kernel mills (4 in total with 39.5 ton kernel/hour capacity). After Kotawaringin Barat, it has the highest

Kotawaringin Timur provides significant opportunities for low emission palm oil cultivation with productivity gains from concentration of oil palm supply chains and protection of high conservation value areas, making it ideal for a pilot natural capital assessment.

Our preliminary analysis indicates significant opportunities for district-level natural capital assessments in Central Kalimantan, identified by high impact areas and relevant land use variables, which could guide strategies for optimal land use allocation in Central Kalimantan.

7. A more comprehensive and useful land valuation approach should be based on data availability and policy needs

In this chapter, we propose a methodology for a district-level natural capital assessment, in the context of Central Kalimantan, and detail an appropriate research design that accommodates the available level of data.

An integration of methods—tailored to conservation values at the district level and aligned with regulatory guidelines—increases comprehensiveness of land use taken into account and minimizes data challenges. Linking methodology to regulatory guidelines helps to apply results towards to evidence based policy making.

7.1 Methodology

Embedding the methodology within the Indonesian regulatory landscape for guiding land and ecosystem valuations will help apply the results as evidence for policy making in practice.

In order to encourage use of natural capital assessments in land use decision making, natural capital assessments need to be quantifiable, replicable, credible, flexible, and affordable. There is no single method to implementing a natural capital assessment. **Table 6** presents a comparison of different methods used to obtain data under a natural capital assessment. Each method has its advantages and disadvantages, depending on its context.

On the basis of this analysis, we've identified that a combination of geographic information systems (GIS), inventories, participatory approaches, and expert judgements is the most efficient and reliable approach for a natural capital assessment in Central Kalimantan. GIS will be used to identify and calculate the natural capital assessment land area from a spatial plan map. The inventories will be conducted from: 1) literature studies of existing natural capital assessment analysis in Central Kalimantan and Indonesia as discussed in **Table 1,** 2) results of CPI's high conservation value (HCV) analysis for Central Kalimantan[15], and 3) a field survey. And participatory approaches and expert opinion will be used to fill the data gaps that have not covered by GIS and inventories.

In order to ensure that the benefits of ecosystem services are aggregated correctly, valuation exercises for ecosystem services need to avoid double counting of benefits (Fisher, B. et al., 2008). **Table 7** shows the categorization of ecosystem services and their valuation methods. Double counting can occur because the same ecosystem service can generate multiple benefits, for example, nutrient cycling is a supporting service, water flow regulation is a regulating service, and recreation is a cultural service. However, the first two provide the same service, usable water, and the third (e.g., recreation on a clean, navigable river) can turn the usable water into a human benefit (i.e., the endpoint that has a direct impact on human welfare) (Fisher, B. et al., 2008). To avoid double counting, in this study we consider ecosystem services to be ecological processes, and the benefit to be the value that has a direct effect on human welfare. For example, from bees, food provision in the form of honey is accounted as a benefit, whereas pollination is an ecosystem service.

Our design proposal for a natural capital assessment of Central Kalimantan will include a methodology that integrates the economic valuation method for forest ecosystems described in Ministry of Environment and Forestry Regulation No. 15/2012 and the Ministry

15 The High Conservation Value Mapping provides a framework to help identify biological, ecological, social and cultural values considered exceptionally important, and to develop management plans to maintain these values or enhance them where appropriate. The methods used in identifying HCV areas are based on and adapted from a similar analysis in East Kalimantan completed in 2010 (see Wells, Paoli and Suryadi, 2010). PILAR (2016) outlines the results of the first attempt at mapping selected biological and ecological HCVs at a province-wide, landscape scale for Central Kalimantan

Table 6: Natural Capital Assessment Approaches

METHOD	SAMPLE USES	ADVANTAGES	DISADVANTAGES
Remote sensing Data obtained from satellite sensors or aerial photographs	Assessment of large areas, land cover/ land use, biodiversity	• Useful for analysis of a large area to minimize the cost of assessment and field work, but expensive for analysis of a small area.	• Data obtained are real time estimates and hence need to be calibrated and crosschecked.
Geographic information systems Software that spatially maps and analyzes digitized data (ArcGIS, ArcView, IDRISI)	Analysis of temporal changes in ecosystems; overlaying social and economic information with ecosystem information; correlating trends in ecosystem services with land use change	• GIS allows for the easy and immediate integration of other large data sets. For example, the technologies of GIS and remote sensing or GIS and acoustic SONAR imagery can be readily combined. • It also allows for producing multilayers of ecosystem variables in a single land. It is very useful to calculate the differences types of land use.	• GIS requires intensive input on social and economic data.
Inventories Lists	Tally ecosystem services and natural resources.	• It gives detailed and accurate data from field surveys. • Suitable for small areas.	• It is expensive and requires a lot of time and resources.
Ecological models Simplified mathematical expressions that represent the complex interactions between physical, biological, and socioeconomic elements of an ecosystem	Filling gaps in existing data; quantifying the effects of management decisions on the condition of ecosystem services; projecting long-term effects of changes in an ecosystem's condition; assessing the effects of individual drivers and scenarios on an ecosystem's condition and the supply of ecosystem services; exploring the links between elements in a system.	• It is suitable for filling existing data gaps with lower costs, less time, and fewer resources.	• The assumption used in the model can greatly affect the accuracy of the model in a real case.
Participatory approaches and expert opinion	Collection of knowledge not available in scientific literature; fills gaps in the literature; adds new perspectives, knowledge, and values to assessment	• This approach is important and very useful for assessing non-market value.	• It requires expertise in socio-economic science to obtain data using this approach. • It usually takes a longer time and continuous observation to collect data.

Note: Adopted from Ranganathan et al., 2008

Table 7: Categorization of ecosystem services and their valuation methods

TYPE OF ECOSYSTEM SERVICE	EXAMPLE	VALUATION METHOD
Provisioning services Ecosystem services that describe the material or products obtained from ecosystems	Ecosystems provide the conditions for growing food. Food comes principally from managed agro-ecosystems but also from marine and freshwater systems and forests. Wild foods from forests are often underestimated.	Unit resource rent (i.e. the difference between the return from resource products/ services sold and its respective extraction and production costs, including normal returns.
Regulating services These are the benefits obtained from the regulation of ecosystem processes.	Trees provide shade whilst forests influence rainfall and water availability both locally and regionally. Trees or other plants also play an important role in regulating air quality by removing pollutants from the atmosphere.	1. Production function method: by estimating their contribution to the value of the final product when sold on the market (i.e., net of labor and capital costs). 2. Damage costs: by production losses or damages due to degradation or loss of ecosystem services
Cultural services These are the non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences	Ecosystems and biodiversity play an important role for many kinds of tourism which in turn provides considerable economic benefits and is a vital source of income for many countries. Cultural and eco-tourism can also educate people about the importance of biological diversity.	3. Travel cost method: the amount that consumers are willing to pay for goods and services related to visits to recreational sites can be used as a proxy for the value of the ecosystem and its attributes. 4. Hedonic pricing: this involves disentangling the part of the price that people pay for marketed products or assets that can be attributed to the local ecosystem services. 5. Production function. It can be disentangled from the value of marketed products.
Supporting service Services that are necessary for the production of all other ecosystem services. However, their effects on people are either indirect or occur over a very long time.	Habitats provide everything that an individual plant or animal needs to survive: food, water, and shelter. Each ecosystem provides different habitats that can be essential for a species' life cycle. Migratory species including birds, fish, mammals and insects all depend upon different ecosystems during their migration.	Damage costs: by production losses or damages due to degradation or loss of ecosystem services.

(Adopted from WB, 2014)

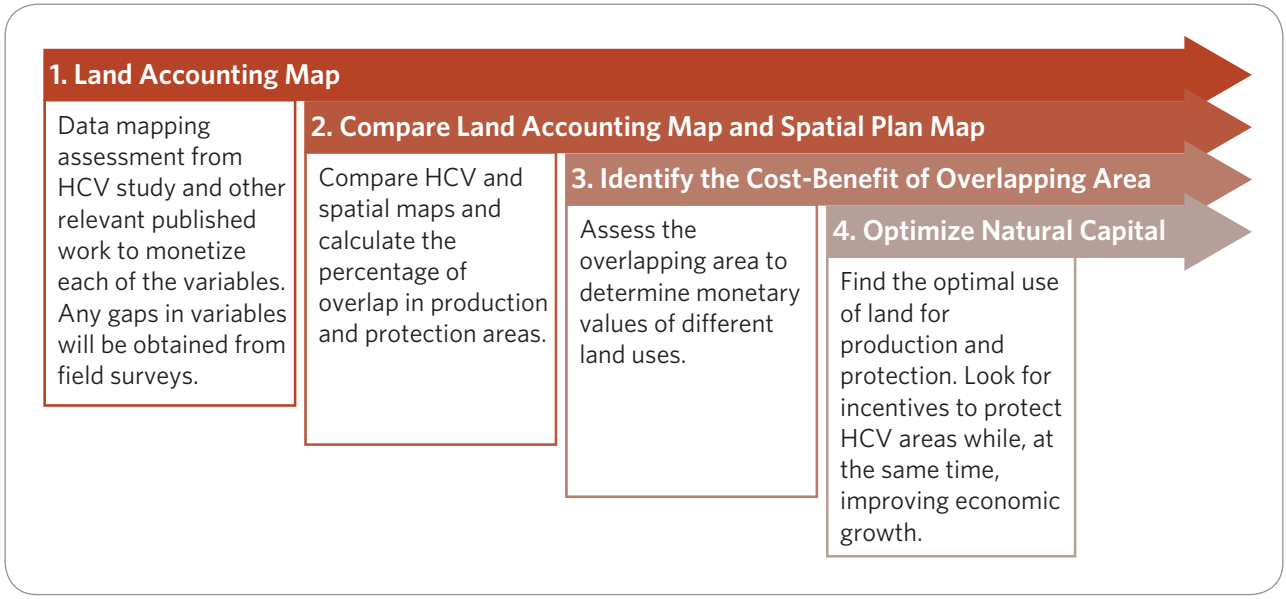
of Finance Regulation No. 98/PMK.06/2010 on the assessment of natural resource assets owned by the state (**Tables 2a and 2b**). In other words, the economic valuation under this design will assign quantitative economic values to ecosystem services, including services that are at least partially captured by the market (such as provisioning and some cultural services) and those that are not currently valued in the marketplace at all (for instance, regulating services such as coastal protection and erosion control).

7.2 Research Design

The complete proposed research design of the natural capital assessment, along with the stages, are illustrated in **Figure 3**. The natural capital assessment will be comprised of four stages: 1) Data mapping assessment from the high conservation value analysis, a literature study, and a field survey as the basis for a land accounting map, 2) comparing the land accounting map with a spatial plan map, 3) identifying the costs and benefits of overlapping areas (i.e. High Conservation Value areas versus their respective land use classifications as per the spatial plan map) and assessing the monetary value of various uses from the land, and 4) finding the optimal use of land for production and protection. This study completes stages 1 and 2 and provides the basis for upcoming field research for stage 3 and 4.

Considering the complexity of this assessment, it will be necessary to work with strategic partners to ensure involvement across all stages of the assessment, especially related to regulatory guidelines as well as

Figure 3: Four stages of a natural capital assessment of Central Kalimantan



spatial mapping. The details of the partners in this assessment are presented in **Table 8**. CPI has solid partnerships with Ministry of Finance (MoF) and Ministry of Environment and Forestry (MoEF), both of which are key stakeholders in ecosystem valuation. The coordination with both institutions is important to ensure that this natural capital assessment will contribute to the development of systems and regulation around ecosystem valuation in Indonesia. As for local stakeholders, CPI works with Palangka Raya Institute for Land Use and Agricultural Research (PILAR) and University of Palangka Raya (UPR) to build their capacity and knowledge around ecosystem valuation. Both institutions play important roles in Central Kalimantan in getting buy-in from local stakeholders and decision makers.

7.3 Availability of Data in Central Kalimantan and Challenges in Data Collection

To inform the research design for the natural capital assessment we've identified several existing studies on ecosystem valuation in Central Kalimantan, most of them at the provincial level (as shown in **Table 1**). We were looking to understand the breadth of land use values and geographical extents of land that had been valued. We find that current studies do not take into account all the variables and land uses comprehensively, and are largely undermined by the consistency and availability of data. Further data collection challenges include different objects and fields of study where samples are collected, inconsistencies in assumptions, and varied methodologies in economic valuation. Due to these challenges around extracting data from current studies, we find field surveys would

Table 8: Key stakeholders and roles

MINISTRY OF FINANCE (MOF) AND MINISTRY OF ENVIRONMENT AND FORESTRY (MOEF)	PILAR AND UPR	CPI
MoF and MoEF as the key decision makers have undertaken several test studies on ecosystem valuation. For example: DG of State Asset of MoF is working on a system for ecosystem accounting. They are required to design regulations towards green GDP which includes natural capital accounting and mapping asset revenues from natural resources	• Already have an high conservation value (HCV) analysis from recent studies • Will provide local resources for data collection and analysis. • Will build ownership and buy-in from local key stakeholders and decision makers	• Advisory support to determine the scope, boundaries and gaps in the methodology. • Will build local and national capacity on ecosystem valuation. • Will support project management and integration framework for the Production and Protection Landscape Management (PALM) approach under the land- use work stream • Will support harmonization of spatial regulations on optimal land use to incentivise low emission palm oil

be useful for the purposes of our natural capital assessment. To overcome data and methodological issues, we've planned for the following steps:

1. Check the similarity of land use indicators or variables taken into account in the existing summaries, for example (agriculture, forest, energy, ecosystem services etc). If there are similar variables to the ones in the research design, then the data that has been analyzed with the most comprehensive method will be included in our natural capital assessment.
2. If the data is consistent, then it will be considered in our natural capital assessment. If inconsistencies are found, a field survey will be considered.
3. For land use variables/indicators that have not been considered in any study, a field survey (both using inventory and participatory/expert opinion approaches) will be conducted to fill the data gap.

From a preliminary literature review, we've identified several variables to be considered in our natural capital assessment, as illustrated in **Figure 4**, and indicated their data sources.

Collecting data for economic valuation on non-market values can be a difficult and controversial task. However, the value to people can be measured by estimating the amount people are willing to pay to preserve or get the service of the ecosystem, or how much people would need to be paid in order to give it up, if they were asked to make a choice similar to one they would make in a market. **Table 9** gives an overview of valuation methods on non-market value.

Figure 4: Variables to be in included in the Central Kalimantan natural capital assessment

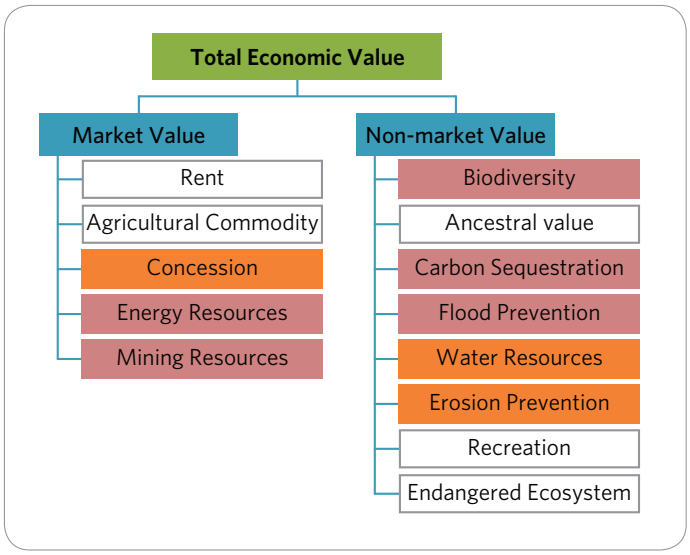


Table 9: Economic valuation methods for non-market values

NON-MARKET VALUE	METHODOLOGY OF VALUATION	CHALLENGES AROUND DATA COLLECTION
Recreation	Derive demand curve from data on actual travel costs to estimate recreational use value.	Data collection is quite easy for this variable.
Erosion prevention	Model comparison of the damages avoided by having protection against erosion and flooding.	Requires a comparison of economic and social losses of erosion and flooding disasters in other area with similar condition.
Biodiversity	Transfer benefits results from one context to a different, similar context (e.g., estimating the value of one forest using the calculated economic value of a different forest of a similar size and type).	There are a lot of factors of biodiversity to be assessed. Therefore, comparison with similar studies will be helpful to reduce time, resources and the cost of the assessment.
Ancestral value	Ask respondents directly their willingness to pay for a specified service.	Requires a direct survey through dialogue and observation.
Carbon Sequestration	Extract the effect of environmental factors on the price of air quality.	Data collection is quite easy for this variable.
Water resources	Use the cost of replacing the lost good or service.	Data collection is quite easy for this variable.
Endangered ecosystems	Transfer benefit results obtained in one context to a different, similar context (e.g., estimating the value of one forest using the calculated economic value of a different forest of a similar size and type).	Similar to biodiversity, there are a lot of factors in the endangered ecosystem to be assessed. Therefore, comparison with a similar study will be helpful to reduce time, resources and the cost of the study.

(Adopted from Ranganathan et al., 2008 and MA, 2005)

8. Conclusions

This paper looks at opportunities for optimizing land use allocation by designing management strategies based on a valuation of natural capital in Central Kalimantan. The mapping exercise helps to develop the research design and forms the basis of the key attributes of land which will be monetized for the natural capital assessment, in order to support tailored land management strategies for misaligned areas. It draws from the results and findings of existing studies and legal regulatory processes, which guide land use assessment and valuation to understand the link with spatial planning processes and policymaking towards low emission palm oil.

This paper finds that current valuations do not take all variables and land uses into account due to difficulty accessing consistent data, especially spatial data. The failure to capture the true value of resources in question underestimates the value of analysis of natural capital assessments. Opportunities exist to improve natural capital assessments with more comprehensive data and field surveys at the district level. Our literature review finds that data and methodology challenges undermine the quality of assessments.

Piloting district-level natural capital assessments in Central Kalimantan that use a methodology that integrates the methods of Ministry of Environment Regulation No. 15/2012 on economic valuation guidelines for forest ecosystems and Ministry of Finance Regulation No. 98/PMK.06/2010 on the assessment of assets owned by the state in the form of natural resources, would support a land management approach based on production and protection.

We conclude that an assessment at the district-level (as opposed to the provincial level) is the most suitable case for conducting a needs-based natural capital assessment. Amongst other key districts, we determined that the Central Kalimantan district of Kotawaringin Timur could benefit the most from our proposed natural capital assessment, and is an ideal area to pilot it. Of all the districts it has the highest amount of high conservation value area, 27,501.54 hectare which is currently allocated and licensed as plantations, the highest historical deforestation from 1973-2012 and amongst the least area under protected status, i.e. including national parks. Thus, Kotawaringin Timur provides significant opportunities to achieve low-emission palm oil cultivation with both productivity gains and protection of high conservation value areas.

Based on several findings, this paper proposes a new research design for a natural capital assessment that would harmonize the guidelines and regulations around land valuation across government agencies and contexts, and link these with spatial planning and policymaking processes. The research design is a combination of geographic information systems (GIS), inventories, participatory approaches, and expert judgment, which, together, are the most efficient and reliable approach to integrating economic valuation methods. This approach will be recommended for future natural capital assessments at the district level in Central Kalimantan.

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