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Rapid Feasibility Assessments Potential of Public-Private Partnerships to Drive Social, Economic and Ecological Recovery in Four Regionally Important Indonesian Mangrove Systems

AUGUST 6, 2015

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PART A: INTRODUCTION, METHODOLOGY AND SUMMARY FINDINGS

1.0. Introduction

Blue Forests, a registered non-profit, non-governmental organization with main offices in Yogyakarta and Makassar was contracted by the USAID IFACS program to undertake rapid feasibility assessments in critical mangrove landscapes in Indonesia. Blue Forests managed a multi-disciplinary team of ecologists and social scientists, to develop a research methodology, undertake a literature review, and engage in week long field assessments in four distinct mangrove management areas including; Kubu Raya - West Kalimantan, Mahakam Delta – East Kalimantan, Rawa Aopa Watumohai – SE Sulawesi and Bintuni Bay – West Papua. The main objective of the assessments was to determine the feasibility of the establishment of public-private partnerships to co-support management interventions including ecological rehabilitation, sustainable economic development and improved systems management, to improve the overall condition and resilience of the social-ecological mangrove system.

These assessments and their analysis, which ran from June 4 until August 10, 2015, are captured in this report in the following manner. The research methodology for all four sites is described in section 2.0 followed by a summary of the findings and analysis in section 2.1. Sections 3.0, 4.0, 5.0 and 6.0 detail the findings for each of the four landscapes individually. Each of these findings sections have been broken down per groupings of key research questions. The findings were broken down based on a) status and condition of the mangrove forest, b) social and cultural condition of local communities, c) utilization of the mangroves and adjacent resources for livelihoods and economic values, and d) governance and the role of key stakeholders.

After presentation of the findings, a series of analytical exercises were undertaken. These are captured in section 7.0. Analysis included the development of problem trees, objective trees and an options analysis. Problem and objective trees have been unified in one PDF document and presented as Appendix C due to formatting restrictions in this word document. Options analysis has been unified in an Excel document in four spreadsheets and also presented as Appendix A at the end of this document. This report also contains an Appendix B, which includes all figures and maps and is attached separately.

This report closes with a brief conclusion (Section 8.0), but also a recommendation that interested stakeholders from government and development agencies sit together after presentation of the findings and analysis and participate in a facilitated options analysis, the results of which can inform further project intervention planning.

The authors would like to thank USAID IFACS for supporting this critical activity. Critical analysis of how to move forward strategically with regards to improved mangrove management has been a missing link of both international development and national planning.

2.0. Methodology

Methodology development took place in over the course of a three-day workshop in Makassar, facilitated internally by Blue Forests, with in-kind assistance from Charles Darwin University – Research Institute of Environment & Livelihoods. The overall framework for the methodology was to apply a resilience lens and a social-ecological systems thinking lens to mangrove management histories and issues. A team of 14 ecologists and social scientists brain-stormed over key research questions and criteria to assess. These questions and criteria were further refined over several weeks, during literature review and preparation for field work. Two research teams were created, social-economic and ecological. These teams worked side by side during field work. Their individual research methodologies are available as appendices.

Field surveys lasted approximately one week in each of the four locations. Investigative techniques included in-depth interviews, observation and historical and biophysical transects. Secondary data was collected beforehand as part of a literatures review, and also in the field, primarily at government offices, local universities and local NGO offices.

Biophysical factors assessed were hydrological flushing, substrate elevation, sedimentation and erosion, canopy cover, substrate texture and soil type, community composition and species. Socio economic factors assessed were population, culture, livelihood, land tenure/land owner, government, role of mangrove forest, private sector partnership, social condition, poverty, gender, aquaculture condition and trend analysis.

Analysis of data took place using a trio of methodologies; the creation of problem trees for each site, objective trees, and options analysis using a scoring system to rate the risk of an intervention or strategy and also to determine potential impact of an overall intervention at each of the for sites. Eight criteria were selected during the options analysis including; 1) expected conservation benefit, 2) cost, 3) social risk, 4) likelihood of success, 5) whether funding is available, 6) available personnel, 7) experience with the methodology entailed and 8) development benefits to priority groups. No weighting factors were applied to these eight criteria, although that exercise is recommended if options analysis is to be run again with a multi-stakeholder group.

2.1 Summary of Findings and Analysis

Initial findings across the four regions can be compared using the options analysis as a guide. Recommended development activities or interventions run down the y-axis of the spreadsheet. The x-axis of the spreadsheet lists 8 criteria (listed in 2.0 above) which help determine the potential risk and impact of the individual interventions. These criteria could be weighted for importance but for the purposes of this rapid assessment have equal value. Individual activities or intervention strategies will have an average rating between 1-5, 1 being lowest and laden with risk and 5 being highest, with the lowest degree of risk and a high potential impact. At the bottom of the spreadsheet, these ratings are totaled and averaged. The grand total depicts the overall complexity of the intervention, meaning that many activities and strategies are required but also indicating the scope of impacts to be made. The average score also indicates the risk and degree of impact of the overall intervention.

Ascribing this method we see the results related to cost, total score and average score in the table below.

	Avg Cost (Scoring)	Total Score	Avg Score
Kubu Raya	2.6	951	4.0
Mahakam Delta	3.1	696	3.91
Rawa Aopa	3.5	414	3.67
Bintuni	2.75	375	3.90

Analysis of these above factors show that the lowest cost intervention (the highest score) to be in Rawa Aopa, followed by Mahakam Delta, Bintuni Bay and Kubu Raya. However, Kubu Raya, the most expensive intervention, also has a much higher total score, which indicates numerous activities and a high degree of impact. The average total score, of 4.0 indicates both lowest amount of risk and highest impact. Mahakam Delta and Bintuni Bay have average degrees of risk, and lower impacts per cost than Kubu Raya. In Rawa Aopa, the cost of an interaction is the lost of all programs, but the risk carried with that cost is the highest.

This leads use to select Kubu Raya as a high cost, but impactful and low risk initiative. Cost of an intervention can likely be shared with the private sector interests (captured by low risk of the program). A second choice might be the Mahakam Delta, where impact is high and risk is medium.

Pulling back from the numbers, we can briefly describe the different potential interventions in each landscape. The ecological state of mangroves and adjacent hinterlands in Kubu Raya is degrading overall, but the hinterland is impacted more than the mangroves. The loss of a managing presence in the region, in this case the logging concession, would likely mean further degradation of mangroves, as is the case in Indragiri Hilir, which was surveyed with support from WRI but is not reported on as part of this investigation. In any case, in Indragiri Hilir, the closure of a mangrove logging concession (owned by the owners of the concessions in Kubu Raya and Bintuni) lead to degradation due to lack of management. Social conflict in Kubu Raya and lack of government initiative to improve collaboration and management can be overcome with the usual attention of a funded intervention. The main interventions that are recommended; Ecological Mangrove Rehabilitation, sustainable livelihoods development, improved silvaculture practice and development of collaborative management and improved governance are well within the skill set of potential partners. There is also the opportunity for significant matching financial support from the London based NGO WeForests for rehabilitation and improved regeneration in the silvaculture area.

The Mahakam Delta is similar in many ways to Kubu Raya in that sustainable economic development is recommended to drive ecological recovery. The scale of degradation/conversion in the Mahakam Delta is unprecedented, but the path forward is clear. Investment in sustainable industries such as mangrove silvaculture, sustainable aquaculture and Nypah palm utilization for bioethanol or sugar production, developed in tandem with ecological rehabilitation of mangroves and some degree of upper watershed enhancement. The ecological repair techniques required have been demonstrated at a scale of 500 ha in South Sulawesi and 12,000 ha in Florida. A major potential stumbling block in the Delta is agreement by the defacto land-“owners” which needs to be overcome through a combination of government policy enforcement and significant investment in livelihoods alternatives. The former is the mandate of the Governor’s Mahakam Delta Economic Recovery Task Force, while the latter is being considered by Agence Francais Development.

Again, WeForest is interested in potentially co-financing the rehabilitation. A final challenge is to link economic recovery between scales, from small and medium to industrial. This requires the involvement of business partners with processes that take into account the necessity for distributed micro-collection of raw materials.

Rawa Aopa Watomohai is a dichotomous site. The state of mangroves and social systems within the National Park is currently good, however outside the park, mangroves have been wholly converted to aquaculture ponds, as is the pattern in much of Kalimantan and Sulawesi where Bugis and Makasarese migrant populations serve as willing participants in continued aquaculture expansion, driven largely by external factors. Addressing the issues outside of the park entails a high degree of risk, as a major cultural shift would need to take place amongst the aquaculture communities. This shift is not impossible, but time and resource consuming, perhaps requiring a generation of hard resource intense work. Maintenance of values within the National Park itself requires minimal investment in the community stewards who already care for the system, but also the maintenance and rehabilitation of a buffer between the park and the "outside world" which again will be resource intensive and imbued with risk. There are no major corporate partners likely to join the fray. The aquaculture industry is arranged informally and mining operations scattered around the park are largely in the exploratory phase. Even the operational mines are not at this point concerned with the state of mangroves or the ecosystem services they provide.

Finally we come to Bintuni Bay. The Bay and the logging concession, PT BUMWI, are in quite good shape, due in large part to the vastness of the mangrove resource, the robustness of hydrological flows and low population densities. BP Tangguh is relatively nearby and between the two industries there is genuine interest in investment in communities, sustainable resource management and conservation. There is little current direct threat to the mangroves. The threat that does exist likely comes from the potential expansion of oil palm plantations in the region, but the area is too vast for a rapid assessment to develop a pattern of understanding as to when and how oil palm may affect the region.

It is the final recommendation of this paper – to look more deeply at the cases in Kalimantan, both East and West. The opportunity to investigate Kubu Raya may come soon during the early assessment phases of LESTARI, while the issues in the Mahakam Delta have already been well described in a concept paper developed by Jim Davie, and members of the Mahakam Delta Economic Recovery Task Force presented to AFD. This group is also requesting support from AFD and DFID for a more in-depth funded assessment, the end result of which will be a proposal for integrated intervention. Working in either region has a high likelihood of matching support, support which is needed, as the scope of issues in both

PART B: FINDINGS TO KEY QUESTIONS IN FOUR (4) LANDSCAPES

3.0. Kubu Raya – West Kalimantan

Wetland systems of West Kalimantan consist of three habitat types; freshwater swamp forest, peat swamp forests, and mangroves (**Figure. 1**) (MacKinnon *et al.,* 1996). Kubu Raya District (Kabupaten Kubu Raya - KKR) is home to approximately 98,000 ha mangrove forest, constituting the largest expanse of mangrove forests in West Kalimantan (Laksono, Suhardi et al. 2014). Similar to other mangrove forests in Indonesia, the district's mangroves are officially owned by the Government of Indonesia, thus its management is regulated by the Forestry Ministry. The district's large expanse of mangrove has been utilized for a variety of subsistence and commercial purposes. The use by local community is mainly for traditional charcoal production, fishery activities, and fuelwood, whereas private sector use (operated by a single owner) is focused 90% on the production of chip for processing into pulp overseas in the making of paper. The other 10% is used for charcoal making, also for export markets. There is nothing inherently wrong with such activities, although the image of valuable mangrove resources being turned into paper is difficult for much of the public to digest. That being said, without a money-making management presence in the mangrove forests, the forest can be vulnerable to more damaging use and often times conversion to aquaculture.

Management of mangroves in Kubu Raya is difficult, as there is a large population and many use mangroves directly for small-scale charcoal production and other timber uses. Competition over limited resources and the circumscription of such a large area of mangroves for private use (approx 30,000 ha) has given rise to conflict between public and private parties. Questions have arisen surrounding the impact of harvest and extraction techniques, the subsequent regeneration and condition of logged areas, concession boundaries, encroachment, the condition of adjacent mangrove and hinterland forest, as well as social and economic impacts on local communities. Some researchers have concluded that there is significant evidence of degradation in the quantity and quality of mangrove forest cover in Kubu Raya, causing diminishing ecological services of the system (Laksono et al., 1996; Pahlevi, 2014).

This study is aimed at understanding the problems and issues that have arisen in the area, prioritizing which problems and issues should be addressed, developing objectives and ultimately analyzing options for future intervention. This assessment is being undertaken in conjunction with 3 additional assessments in East Kalimantan, Southeast Sulawesi and West Papua, and comparison between the sites is also called for, in order to understand where co-investment in public-private partnerships may create the most impact with a low degree of risk. The end goal is public-private investment in activities which will enhance social, economic and ecological values in the social-ecological mangrove system, building resilience and adaptive capacity.

3.0.1 Site Specific Assessment Methodology

The study employed social ecological system (SES) thinking which defines and integrates the KKR's social systems (human and mangrove management arrangements) and ecological system (biophysical aspects of mangroves and adjacent lowland swamp forest). Field assessments were conducted simultaneously for 1 week, from 7-12 July, 2015. There were two sites assessed by the Kubu Raya team, Kubu and Batu Ampar sub-districts (kecamatan), representing the areas in close proximity to mangrove concessionary industries. This rapid feasibility assessment used in-depth interviews, observation and historical and biophysical transects as data collection techniques. For the ecological system, the assessments were conducted in a total of 9 mangrove sites; 28 years post harvest (P.T. Kandelia), 17 years post harvest (P.T Kandelia), 9 years post harvest (P.T. BIOS), 7 years post harvest (P.T Kandelia), 7 years post harvest (P.T. BIOS), 6 years post harvest (P.T. BIOS), 1 year post harvest (P.T. BIOS), both outside of concession borders, and in protected buffer-zone (P.T. BIOS) (Figure 3). Factors assessed were hydrological flushing, substrate elevation, sedimentation and erosion, canopy cover, substrate texture and soil type, community composition and species. Additional to this, Nypah Palm areas were surveyed in the Kandelia concession, and coconut plantations (in ex-lowland swamp forests) in both Kubu and Batu Ampar were mapped.

3.1 Status and Condition of Mangrove Ecosystem

PT Kandelia Alam and PT Bina Ovivipari Semesta (BIOS) are two concessions operating within the mangrove systems adjacent to the villages of Kubu to the North of Kandelia Alam boundaries, and Batu Ampar to the North of PT Bios concessionary boundaries (**Figure. 2**.) These two concessions selectively log areas of mangrove forest on a 20 year rotational cycle and produce dry chip to be manufactured into pulp. Cleared areas are left fallow for two years before replanting *Rhizophora apiculata* at two meter spacing. There are also conservation zones in the concession. The entire concession measures over 28,000 ha. Logging effectively takes place in 16,000 ha (as some trees are inaccessible) and for every 1500 ha of logging area, 700 ha of conservation area has been dedicated – or approximately 9000 ha.

3.1.1 Hydrology

The hydrology of an area is by and large the main factor in determining extent, composition and health of any mangrove system. Frequency and duration of tidal inundation, and tidal range have significant influence on mangrove forest structure. Mangrove forest communities inhabit the intertidal zone from Mean Sea Level (MSL), which experiences daily inundation, to Highest Astronomical Tide (HAT) that only experience inundation once or twice a year. Mangrove tree species have adapted various coping mechanism to deal with the constant inundation of saline water, allowing each species to inhabit a specific zone within the intertidal area. Contributing to mangrove health and zonation is the regulation of edaphic conditions (biological, chemical and physical soil conditions) through consistent tidal flood and drainage.

The Kubu Raya district experiences a mixed, predominantly diurnal tidal regime, with a tidal range of 1.5 meters from 0.2 m at Lowest Astronomical Tide (LAT) to 1.7m at HAT (HHWL in table 1). Mangrove forests occur only in the upper 70 cm of this range. All sites measured have substrate elevations between MSL and Mean High Water Neap (MHWN). In comparison to Indonesia's other mangrove silvaculture forest (Bintuni – with a tidal range of 6 meters) this confined tidal range presents problems in terms of harvesting, maintenance of tree vigor, and regeneration.

Major hydrological issues identified were water logging of soils in sites of lower substrate elevation – such as the 7 year post harvest site in PT Kandelia Alam. There are few micro-tidal creeks present in this area and fluvial sediments piled on the edges of the rivers have created an obstruction to tidal flows carrying water out of the site, resulting in standing water and anoxic soils. These higher edges of the site have been colonized and reinforced with mid to upper mesozone species such as *Xylocarpus* spp. and *Bruguiera* spp, but the depressed waterlogged areas are barren or contain stressed mangroves which appear dry and brittle but are actually suffering from too much inundation (which leads to H_2S toxicity at the root hair level).

Another hydrological obstacle to healthy mangrove regeneration and growth in the concession is due to the creation of artificial harvest canals. These canals are made to facilitate transport of logs, but act to reduce the tidal prism, thus reducing the scouring capacity of draining water through natural tidal creeks. These natural tidal creeks are then at risk of sedimentation and closure, which leads to water-logging and mangrove stress or mortality.

This issue can again be exacerbated by mangrove planting. Straight rows of planted mangroves at 2 meter spacing, when the grow, can inhibit the formation of natural tidal drainage. Alternatives to the creation of harvest canals are an imperative. It is also important to identify and protect even the small tidal drainage canals in the pre-logged forest, and to devise a strategy to protect these crucial drainage systems, perhaps by leaving seed trees along their banks to protect the creeks. This would be quite possible if current seed tree policy and practice (protection of 40 seed trees per hectare at 17 meter spacing) were to be adapted.

3.1.2 Ecology

The mangrove forests habitat types of Kubu Raya are classified as fringing and riverine. Sediments and nutrients come into the system from the Little Kapuas river, with a high degree of total solids evidenced by silt laden waters extend 5 to 60 meters out to sea. Kubu Raya as an average annual rainfall of 3063.8 mm. The major soil type in this system is alluvial silt, often overlaying areas of peat soils.

Rhizophora apiculata was the dominant species in all sites surveyed. Although Rhizophora may be a dominant mangrove forest type in the region, its current distribution is not a natural reflection of the natural mangrove community structure in the Kubu Raya district as all cleared sites (regardless of previous species composition, are planted with predominantly *R. apiculata* at 2 meter spacing's, two years after clear felling. The pioneering species of *Sonneratia caseolaris* and *Avicennia alba* were present on the seaward lower mangal zones and on river edges further upstream with continuous fresh water inputs. Our findings were not consistent with that of Djohan (2014) which stated areas of cleared mangroves have grown back with *Xylocarpus granatum* at 99% dominance. *Xylocarpus* spp. are indeed naturally recruiting on higher substrate elevations but only with an estimated 5% coverage.

A major ecological issue related to current Indonesian silvaculture practice is selection of seed trees to be spared from logging in each felling area. Indonesian "sustainable" harvest regulations require 40 seed trees per hectare to be left unlogged within any site and are to be evenly spaced (17 m spacing). Consultation with concession workers clarified a large percentage mother trees die within 5 years post harvest. Much of this is to do with windfall as individual trees area exposed to harsher elements. Insufficient tidal flushing also appears to be contributing to mortality.

Rhizophora apiculata is the most desired species of mangrove for harvest both within the concessions and for community use, although all genus and all species in the Rhizophoracea family (genus *Bruguiera, Ceriops, Kandelia, Rhizophora*) are used in chip production and for charcoal, as well as *Xylocarpus* spp. which is not a member of the Rhizophoracea. The preference for *R. apiculata* is causing change in community dominance and forest structure. A move towards re-valuing diversity is essential for long-term forest resilience, as a high degree of natural biodiversity and redundance of functional roles increases resilience.

Outside of the concession, community logging appears to be rampant, with small -scale destruction of forest habitat. The increase in charcoal kilns from 80 to 400 in recent years is putting pressure on resources and sustainable harvesting techniques that would have traditionally supported a healthy mangrove system. This has also resulted in encroachment on the logging concession, especially noted in the concession's remote conservation areas. This issue is discussed in greater detail below.

3.1.2.1 Nypah

Nypah palm was present in extensive borders to rivers, averaging around 20 – 30 m width bans. Some areas however have Nipah stands of up to approximately 200m (Figure 4).Nipah stands within the concessions are considered no extraction conservation areas. The potential harvest of Nypa palm sap, and processing for palm sugar or bioethanol is recommended below as a sustainable economic development activity. Nypah grows in natural, monospecific stands, which can be viewed as nature's plantations. Harvesting of Nypah sap can be undertaken continuously without degradation of the Nypah forest or adjacent mangrove community.

3.1.2.2 Coconut plantations

Coconut plantations in Batu Ampar appear to be healthy. Plantations are established on areas of rich soils, on lands cleared of wetland swamp forest. Coconut plantations in Kubu are divided – the hind areas most far away from mangrove habitats are healthy and are used to produce sugar. Plantations closest to mangrove areas are experiencing salinization and are used only to produce copra, as little sugar sap can be extracted from the trees. Improvement of this condition is reliant on hydrological improvement in both the hinterlands and the mangrove areas, and recovery of natural mangrove cover which buffers salt-water intrusion. There are significant opportunities to work with communities and businesses around improved coconut plantation management, which would include hydrological repair, rehabilitation of natural lowland swamp forest areas (as a biogeochemical buffer or shelterbelt), and production of organic, high quality coconut palm sugar (in conjunction with Big Tree Farms). This would also be a useful stepping stone leading to the potential harvest for Nypah palm sap for the processing of Nypah palm sugar.

3.1.2.3 Food Security Zone

Adjacent to the mangrove concession in Batu Ampar, there is a recently re-zoned "food estate" measuring 5000 hectares. (Keputusan Bupati Kubu Raya, No. 108 – 2011 (Apr 6). This presents both an opportunity and a threat to mangrove management. The opportunity is for investment in hinterland rehabilitation and alternative livelihoods in Coconut and other food crops, and potentially ecological rehabilitation of shelter-belts or native forest buffers. The threat is if this designation is intended to legitimize continued oil palm development and the ramifications of continued monocultural plantation development in the landscape. (See Fig 1.45)

3.2 Social and Cultural Condition

Batu Ampar and Kubu are two sub-districts of KKR which consists of several small estuarine islands. Batu Ampar constitutes the largest sub-district in KKR, totaling 2002 km² (28 % of KKR's total area), which consists of 14 villages and 50 sub-villages. Having The assessment was focused in Batu Ampar village, which has greatest proximity to and interaction with the mangrove area. Batu Ampar village measures 1,120 km^2, bounding Teluk Nibung to the north, Tanjung Beringin Kerawang to the East, Kayong Utara District to the south, and Teluk Nuri to the West. The area was settled by Chinese and Melayu ethnic groups, who moved to the region to develop mangrove charcoal production. Over time, migration from nearby areas in West Kalimantan as well as Java and Madura took place. Most villagers have been allowed to clear forest and occupy the land. The village population has reached 6,328.

Meanwhile, Kubu sub-district has a total area 1,211 km² (17.35% of the total KKR area), and consists of 20 villages, with total population 37,434. The area is bounded by Rasau Jaya to the North, Batu Ampar to the South, Teluk Pakedai to the West and Terentang to the East. Based on recommendation from a village officer, from 20 villages Two out of twenty (20) villages were assessed during this study, Kubu and Teluk Nangka, based on recommendations from the sub-District head. due to their direct social-economic connection with the mangrove forests. Table 1 below provides a brief profile of Kubu and Teluk Nangka:

Table 1. Profile of Kubu and Teluk Nangka

Profile	Kubu	Teluk Nangka
Total area	238 sq km	234 ha
Population (household)	5401 (1402 HH)	3413 (973 HH)
No of sub-village	7	5
Ethnicity (majority)	Malay	Javanese, Sundanese, Madurese
Age of the settlement	since 1700s	since 1983
Main livelihoods	farmers (1628), fishers (918) and private sector workers (648).	small holder farmer and coconut sugar maker

The population of Kubu sub-district is ethnically diverse, with a Melayu majority and remaining Javanese, Dayak, Bugis, Chinese, and Madurese groups. These diverse ethnics have been living together since the establishment of some transmigration settlements back in 1983. Although each ethnic group maintains some degree of its cultural identity (such as language and traditions), interviews with members of each group reveals that they have been living in harmony. In addition, it can be observed that the population integration have stimulated socio-cultural assimilation, such as knowledge and technology transfer among the groups, resulting in increased economic opportunities, particularly in the plantation sector.

Unlike the village of Kubu (Figure 1.5), socio-economic conditions in Teluk Nangka apprear better and with a higher degree of well-being (Figure 1.6). This may be correlated to the intensity of attention provided by the government since the establishment of the village. The fulfillment of basic needs such as education, health, sanitation and clean water are relatively good. However roads are severely damaged. There have been a very limited number of aid programs beyond normal government services in both Kubu and Teluk Nangka. Villagers mention programs from Agriculture and Plantation extension service, and also an IFAD/Fisheries Department Coastal Community Development program. Interview with village officers from both Teluk Nangka and Kubu reveal that their communities are in need of intervention programs that can increase the knowledge and prosperity of the community.

3.3 Utilization of Natural Resources and Livelihoods

3.3.1 Kecamatan Batu Ampar

Minister of Forestry Decree Number 936 / Menhut-II / 2013 on December 20, 2013 about changes in forest use, function and non-forested lands, states that land use in Batu Ampar consists of Protected Forest (HL), Limited Production Forest (HPT), Production Forest (HP), Production Forest which can be converted (HPT) and other land use (APL).

In the District of Batu Ampar there are 65,585 hectares mangrove forest, which consists of 33,402 hectares of protected forests and 32,183 hectares of production forests. Beyond the mangrove areas, there exists former lowland swamp forest and other hinterland forest types, which has been converted largely into coconut plantations and more recently oil palm, and farms. The area was once depleted due to illegal logging concession between 1970 - 1990. Many of the loggers, once a migrant work force, have settled in the district of Batu Ampar and make a living from farming and fishing. The main commodities in Batu Ampar are coconut, coffee, bananas, and pepper.

Batu Ampar originally had abundant natural resources, including spring water, healthy, high-growth, diverse mangroves and abundant fisheries resources.

Batu Ampar communities traditionally use mangroves for charcoal production, fuel wood for cooking and to fire small scale sugar processing plants, and for both subsistence and commercial collection of crabs, shrimp and mollusks. (Figure 1.7). Traditionally communities have used sustainable harvest techniques, selecting only trees with a diameter at breast height of 20 cm or above for charcoal making. The charcoal making process has been passed down through generations, originally learned from Chinese ethnic groups. Over the past 6 years, there has been a significant increase in the number of kilns in the region, from 80 to 400 kilns (Figure 1.8). This has resulted in significant unmanaged logging outside of the concession, as well as encroachment on the concession, in both conservation and production areas. Local communities are beginning to express criticism that a foreign investment (PT BIOS and PT Kandelia Alam) are allowed to log a large area, and they themselves, who have lived in the region for centuries, have reduced access to quality mangrove resources.

The significant increase in the number of charcoal producers began in 2009 when the government committed significant resources to halt illegal logging in the hinterlands, resulting in more people losing their main job and move to charcoal production. Salinization of coconut plantations also influenced this trend, as coconut sugar production bordering mangrove areas ceased. Charcoal producers use *Rhizophora* spp. and *Bruguiera* spp. as both raw material for charcoal production and *Bruguiera* spp. and *Xylorcarpus* spp, to initially fire the kiln. An average kiln has a volume of 4 tons requiring 180 trees (dbh 15-25 cm) per cycle, with a total of 4-7 cycles per year. However, despite its popularity, the net income for

this activity is low, i.e. only 1,000,000 rupiahs per cycle (for 2 months of work). The process is inefficient, the product of relatively low grade and by-products are not captured. Improvement of charcoal production, in the form of improved efficiencies, quality and production of pyrolytic acid (wood smoke, or charcoal vinegar), would improve economic performance. Such improvements would require improved regulation and management in order not to result in increased instance of illegal logging. The Integrated Charcoal Training Center in nearby Toho, and the mangrove concessionaire are interested in supporting improved community charcoal production, technically and financially.

Besides illegal logging, mangrove conversion to aquaculture ponds is evident, although still small scale in KKR mangrove forests. Kompas (4/1/2008) reports that approximately 300 ha of KKR mangrove has been converted into tambak illegally, particularly in sub-district Kubu and Sungai Kakap. A forestry agency staff admits that the majority of fish pond farmers in Sungai Kakap are not native people, but migrants from South Sulawesi. These ponds are also reported to be unproductive, and there exists potential for the rehabilitation to mangroves. It is not advised to work with fish farmers to improve productivity, which could spur further investment and expansion of ponds into the mangroves. Kubu Raya Bureau of Statistics (2014) reports that there are 250 ha ponds also in Batu Ampar.

In addition, despite decreasing popularity, a proportion of villagers continue their profession as fisherman for both subsistence and sale. Fishing has become more difficult in both the open ocean and the estuaries/rivers. Cost of fuel is one contributing factor, as is depletion of fish stocks. The fishers blame the latter on the “large” areas of mangrove depletion, both in and out of the concession area.

3.3.2 Kecamatan Kubu

The diversity of livelihoods in Kubu is dependent on the existing natural resources and human resources. The Kubu district’s coastal resources are predominantly peat swamp, mangrove and Kapuas estuarine ecosystem. The majority of Kubu’s population work as farmers and artisanal fisherman. The skill of fishing has been passed down from generation to generation, while the farming skill has been partly influenced by the KKR’s agriculture and plantation extension officers. Generally the villagers practice tidal and rain fed rice farming system in their own farms (Kubu Raya Bureau of Statistics, 2013) and many others work as small holder farmers. While in Teluk Nangka, people mainly work as small holder farmers and coconut sugar producers (table 2).

Table 2. Varieties of crops which are grown in Kubu and their productivities in 2013 (Sub-district statistics, 2014)

Crops	Cultivated area (ha)	Productivity (tons/year)
Coconut tree (Dalam variety)	2076	1127
Coconut tree (hybrid)	1342	555
Pepper	11	1
Rubber	1788	262
Coffee	318	59

Crops	Cultivated area (ha)	Productivity (tons/year)
Rice	10,820	35,730

Livelihood preferences are changing in Kubu sub-district. For example, young generations prefer working as laborers at nearby palm oil plantations (trending since 1999) rather than becoming traditional farmers or fishers. This is in part a response to reduced fisheries potential, which is blamed on PT Kandelia Alam's operation, especially with regards to mangrove crab capture. This rapid feasibility assessment could not uncover the true impact on fisheries, however such a study is strongly recommended as part of a future intervention package. Lack of skills transfer between generations may also play a part, as well as lack of interest in a modernizing society.

Historically, the native people of Kubu has been practicing traditional charcoal making since 1912. Back in time their ancestors built several charcoal kilns on Gunung Timiang and Gunung Terjun, about one hour motorized canoe trip from the outer village boundary. At present, there are about 40 kilns operating in both sites, which are predominantly owned by local Chinese descendants. The native Kubu community (of Malay origin) serve as kiln operators, involved in felling logs, transport to the kiln, charcoal production and loading onto the boats of buyers (middlemen). A kiln operator will net 750,000 rupiah per month. The income is considered too low to meet their basic needs. However, despite the small amount of income generated, the operators persist with the job as they do not have other livelihood choices. According to rough calculations, charcoal making activities in Kubu sub-district require approximately 2,170 trees per month (See Box 1).

Box 1. Mangrove trees required monthly to supply Kubu's charcoal kilns.

40 kilns operated 6 times/year. Average 3 ton volume requires 62 trees/cycle.

40 x 6 x 62 = 26,040/yr divided by 12 months = 2170 trees/month (approximately 3 mature hectares but in practice spread out to source viable logs of sufficient dbh)

Since the introduction of hybrid variety coconut tree by the district's extension in 1996, a large number of Teluk Nangka residents have processed the coconut sap into marketable coconut sugar. The technology used by the sugar producer is still traditional and conducted in household level. As can be seen from figure 1.9, the producer uses mangrove firewood to cook the sap. The fuelwood is extracted from the nearby mangrove forest. The community has been using mangrove fuelwood since the nearby terrestrial forests were converted into palm oil estate circa 1999/2000. Currently, the source of timber in close proximity to the village is only the Kubu's mangrove expanse. A rough calculation estimates that the sugar producers in Teluk Nangka require approximately 2,520 trees per month (Box 2).

Box 2. The illustration of the total amount of mangrove trees required to supply Teluk Nangka's coconut sugar producers.

In the village there are approximately 90 sugar producers, who work 7 days a week, 10-11 hours daily, and produce 40-50 kg molded sugar per day. Each sugar production unit requires 1 boat fully loaded with mangrove logs (3-4 trees) to fuel the stoves for 4 days. Thus, on aggregate each unit needs 21-28 trees per month (3-4 trees x 7 boats fully loaded with mangrove logs). According to one village officer, there are about 90 producers in the village. Therefore, in order to supply Teluk Nangka's sugar producers, the wood cutters

would need to cut down 2,520 trees per month (90 unit x 4 trees x 7 boats fully loaded with mangrove logs).

3.4 Governance and Role of Stakeholders

Based on the field assessment and findings from Ritohardoyo and Ardi (2011), we conclude that participation of local governments (village, sub-district and district) in the form of policies and practices for mangrove forests management in Kubu Raya is inadequate which is echoed strongly by local communities.

When questioned about this, government representatives in Batu Ampar from the sub-district office and the forestry department responded that they assume that the control and management of mangrove forests has been running well according to current conservation and production regulations.

Two relatively new Ministry of Forestry regulations were issued in 2013 which directly relate to mangrove management in Batu Ampar. These include the designation of 8551 ha of protected mangrove forest in Padu Empat-Lebak Kerawang (Decree No. 127 / Menhut-II / 2013) and a Change in Forest Use, Function and Non-forested Areas (Decree No.936 / Menhut-II / 2013). These major regulatory changes have not yet been received by district, sub-district or village government officials. There is great need for increased communication and coordination both within government, and between stakeholders.

These specific pieces of legislation conflict with current land use designation both with regards to boundaries of the PT. BIOS concession and also village mangrove forests. The Head of Kubu Raya Forestry agency states that nearly 80% of protected mangrove forest is located in borders with conflicting use. Enforcement of regulations obviously becomes problematic in such instances where protection and production forests overlap.

Related to the interests of the local community to access the mangrove forests, the local government plan to propose the development of Community-managed Mangrove Forests to the General Director of Bina Usaha Kehutanan of Forestry Ministry. The idea of the policy is to issue community plantation forest (Hutan Tanaman Rakyat-HTR) permits so that the local community groups would have legal access to manage some parts of KKR mangrove forests to meet their needs of charcoal production materials within 60 year concessionary contract, with additional 30 year renewal contract. Moreover, the proposal is considered to be win-win solution towards the lateral conflict between community and concession companies. Such an arrangement would likely need to take place within the context of KPH, Integrated Forest Management Units, which has been discussed at the district (with the Head of the Forestry Department), and national level as a priority in the next mid-term (5 year) and long term (25 year) planning and budgeting cycle.

3.4.1 Stakeholder Analysis

Major government actors in the region consist of the typical cast of characters, from village, sub-district, district and provincial government, and also lead technical agencies such as Forestry, Fisheries, Agriculture, Planning and to a lesser extent Social Dinas and several others. In terms of multi-stakeholder forums, there is a Mangrove Management Working Group at the Provincial level but not yet at the Kabupaten level, which should be considered in the future. Also – there are nascent Integrated Forestry Management Units (KPH) with a mandate of developing community based forestry plans and integrated management in

cross-jurisdictional regions, which is a high priority in Kubu Raya mangroves and hinterland forests.

In the area of Kubu sub-district, there are several operating companies. Companies close to Kubu village include PT. Kandelia Alam, PT. BABL (oil palm plantations), and PT. Ichiko (oil palm plantations). PT. Kandelia Alam was granted a concession permit by decree No. 249 / Menhut -II / 2008 with a concession area of approximately 18.130 ha. The company extracts mangrove trees to produce wood chips for paper pulp. The relationship between the company and local community is tenuous. One interviewed informant said that the majority of population do not like the presence of the mangrove concession company. Tensions peaked in 2010 when villagers held a demonstration of the camp, which turned violent. Local villagers told concession workers to abandoned their settlement and proceeded to set the camp on fire, ending with the prosecution and jailing of the main antagonists. The roots of the conflict were formed as the concession was granted without proper socialization or consent by the local community. As a result the villagers do not fully understand or agree with the boundaries of the concession area, and the rights and responsibilities of the concession. Initially residents only accessed mangrove wood outside the concession, but due to dwindling resources, residents have begun to encroach the concession area in both conservation and production forests. This serious issue requires well planned conflict resolution and better coordination with government.

PT BIOS was granted a concession permit (Izin Usaha Pemanfaatan Hasil Hutan Kayu Hutan Alam or IUPHHK-HA) through decree No 68/MENHUT-II/2006 on 27 March 2006, with concession area ± 10.100 ha in Kabupaten Kubu Raya, Kalimantan Barat. PT BIOS has permission to operate for 20 years from the date of 2 July 2001 until 1 July 2021. Of the 10,100 hectare, 5.642 ha (57%) is used for production, the remaining 4,458 ha (43)% is either protected area, non-production area and non -forest areas.

PT BIOS has been operating since 2002 in a mangrove area covering 10,100 hectares in two blocks in the Tanjung Harapan village. PT Kandelia Alam has been operating since 2009 and covers 18,130 hectares of mangrove forests in the villages of Kubu and Batu Ampar. The wood harvest from these areas is used to produce wood chips in PT Bina Silva Nusa, which is also a member of the Kandelia Groups. This product is then sent to industries producing paper. It is important to note that PT BIOS, PT Kandelia Alam, PT Bina Silva Nusa and even Green Forest and Tech Products are parts of the same company. The CEO, Muljadi Tantra, has been in touch with USAID and Blue Forests, and is a open partner to future public private partnerships with genuine concern for not only his business but social, economic and ecological impacts on the surrounding community. Both PT BIOS and PT Kandelia Alam, as well as PT BUMWI (their concession in Bintuni West Papua) have recently been granted FSC certification. That being said, there are significant improvements that can be made in silvaculture practice, and improved community outreach and participation in collaborative management that can be made. These improvements should be considered with investment from both the public and private sides of the partnership.

This study did not gather significant information about the two oil palm plantation companies which are located near the village of Kubu. Yet, it is known that many local residents are employed as labor in the plantations. The development of oil palm plantation has clear potential impacts on mangrove hydrology, as well as competition for human resources, migration and increased resource use. Oil palm development has been witnessed abutting directly onto mangrove forests in the region (Figure 1.10). One company involved in oil palm development is PT FSL. This company gained their first concession of 15,500 ha in 2003 to extract forest timber. The permit was granted by the Bupati of Pontianak through decree No: 400/04-IL/2003 July 22, 2003. The company cleared 11,000 ha of forest as the remaining 4,500 ha was listed as protected peat forests, protected mangrove forest, settlement areas

and arable land. The 11,000 have has been entirely converted to palm oil plantation. The plantation recruits labor from Batu Ampar and Kubu. From 2008 to 2012 and has recently begun to harvest.

Bureau of statistics of Kubu sub-district (2014) reports that there are many cooperatives in the area, consisting of 10 KUD, 25 KSU, and 4 other cooperatives. However, one village staff mentions that there are only two active cooperatives in the sub-district of Kubu, i.e. Credit Union (CU) and PNPM-funded save and loan cooperative. The two cooperatives provide loans for their members with low interest. Since there are no banks in the sub-district, the cooperatives can be very useful to provide cash loans to the community who require financial assistance for livelihood development.

3.5 Initial Conclusions for Kubu Raya

Many actors directly benefit from Kubu Raya's mangrove forests, i.e. PT. Kandelia Alam, PT. BIOS, The Ministry of Forestry charcoal producers in Batu Ampar and Kubu, palm sugar makers in Teluk Nangka, and subsistence and small-scale commercial fishers in Batu Ampar and Kubu. Local residents have utilized mangrove wood for generations without any formal and traditional regulation and relatively little impact on the system, but with increased actors and populations, everyone currently impacts on the system. The mangrove concessions are run with a high degree of skilled management, yet can improve their performance in many ways. Both within and outside of the concession, the management of mangrove forests falls under the jurisdiction of the Forestry department, however, regulations are often confusing or contradictory, outreach and extension workers are under-capacity and enforcement on the ground is still weak. With existing pressures, and diminishing resource bases, the system is at risk of being directly impacted by on-land development (oil palm) or even direct conversion (aquaculture, oil palm, other industry).

Stakeholders well understand the function of mangroves the environmental services they provide and their importance for household and regional prosperity and protection. But the lack of capacity of local human resources to manage the system, in a modern to anticipate and adapt to modern pressures, is lacking. Of the four feasibility assessment sites supported by USAID in this project, and the three additional sites supported by World Resources Institute and Blue Forests, this site in particular stands out as in need of a coordinated effort to improve management. Investment in such an effort should greatly impact the region. In essence – this site provides the best sustainable development bang-for-the-buck.

This is revealed in the attached documents which contain a problem tree, objectives tree and options analysis. The shear number of boxes in the problem and objective trees as well as both the overall score and the average score generated by the options analysis, led us to prioritize Kubu Raya for a major intervention.

4.0 Mahakam Delta – East Kalimantan

4.1 Status and Condition of Mangrove Ecosystem and The Replacement Aquaculture System

The Mahakam Delta is considered one of the world's more important medium and large deltas due to its provision of high value ecosystem goods and services yet it has been severely degraded in the past 20 years due to large-scale illegal conversion to shrimp aquaculture. It's recovery has been declared of national importance by the Ministries of Forestry, Fisheries and Planning, and a Governor's task force has been set up for its

economic and ecological recovery. It is also in discussion as a demonstration delta for the embryonic UNEP led World's Delta Commission.

The fan shaped, lobate delta is comprised of 46 micro deltaic islands, created due to the deposition of sediment rich waters from the Mahakam River. Creocean, 2000 estimates the size of the delta at 150,000 ha, including 110,000 ha of vegetated area, dominated by 60,000 ha of *Nypa fruticans* (a non-woody mangrove species) and 50,000 ha of woody mangroves. This original Nypah coverage is amongst the large contiguous Nypah forests in the world, and can be considered a natural plantation with significant bioethanol or sugar production potential.

The Delta is home to a wide diversity of megafauna, including the endemic proboscis monkey (*Nasalis larvatus*), as well deer, wild pigs, raptors, fruit bats, and crocodile (experiencing a population boom). Suyatna (2006) reports 125 species of fish and 44 Genus of mollusks. More detailed biodiversity reports exist in the grey literature.

As stated at the outset, the delta, nearly pristine in the 1980s, has been under siege for 2 or more decades, with peak conversion taking place between 1996-2000. By 2001, 63% conversion had taken place, and current estimates show that roughly 80% (85,000 ha) have experienced conversion or significant degradation (Dutrieux, 2001). A trend analysis undertaken as part of this assessment with remote sensing imagery[1] reveals 13,354 ha of Nypa remaining and 33,452 ha of remaining mangrove with a total vegetation coverage of 44,564 (see Fig 2.1). In a way – this is encouraging news, meaning that the delta has recovered from approx 25,000 ha of vegetation in the early turn of the millennium to nearly 45,000 ha in just 15 years –due primarily to large-scale pond disuse, but also colonization of newly accreted micro-deltas.

Indeed it is the aquaculture ponds that are the main story of the modern day Mahakam Delta, and their conversion is largely a social issue which will be discussed below. Biophysically, to create brackish water shrimp ponds, a dike wall is created and water maintained within, to drown the mangroves (which die in 2 weeks due to constant inundation). Even though many ponds are disused, there is still on-going pond development, evidenced by dead and dying trees within newly built dikes. These ponds are highly extensive and very large, with a shallow central plateau (inefficient for rearing shrimp and fish) and only a relatively deep channel along the inner dike wall created during dike wall construction. It is very possible to reduce the footprint of aquaculture while increasing productivity – which will be discussed below. Aside from being shallow – the ponds suffer greatly from acid-sulphate conditions, a problem when highly organic, anoxic soils are exposed during pond and dike wall construction. Farmers say that 2-3 days after rain falls on a newly built or repaired dike wall, the pond water pH drops drastically and stresses or kills shrimp. This is one reason for the relatively large pond size in the Mahakam Delta, with ponds averaging 5.24 ha (to reduce the dike wall to pond ratio). Some ponds are as large as 20 ha

Ponds were created with heavy excavators between 1996-2002 and stocked with tiger prawn *(Paneaus monodon*), but disease and mortality were severe. Farmers switched to wild caught white shrimp (*Metapenaeus* spp.) but yields fell dramatically over the first two years of operation in each pond, and the fisheries department of Kutai Kartanegara reports 30% inactive ponds currently (see Fig 2.2) – although their statistics are likely padded. It is

[1] Landsat ETM, 2015

important to note that the ponds are “disused” but not abandoned for perverse socio-economic reasons described below.

Most disused ponds are readily colonized by mangroves (as their shallow pond bottoms are mostly still within the range for natural colonization, (Fig 2.4) especially considering high rates of sedimentation in the delta). Some ponds have proper forests inside with 10-15 years of growth (Fig 2.4), yet the trees will be cut down if farmers need to make claims against the petroleum industry for compensation (described below when discussing land tenure). Fish farmers (Sawi) and pond owners (Punggawa) do not like the idea of trees within ponds as has been promoted by recent silvafisheries programs, claiming that they only harvest leaves, not shrimp with high ratios of mangroves inside of ponds. Extensionists from NGO’s have recommended up to 80% mangrove cover inside ponds, while Professor A. Sidik of University Mulawarman Fisheries Faculty states that greater than 17% mangroves in a pond will be deleterious to shrimp production. (A. Sidik, personal communication, 2015)

The natural cover of deltaic mangroves in the Mahakam are riverine/estuarine in nature, subject to a range of salinities but buffered with abundant fresh water from the Mahakam River. There are at least 9 families of mangroves with 17 species recorded in the delta (Table 3), which is an expected diversity for a single large system within this longitudinal zone (Tomlinson, 1988).

Table 3. Mangrove Species of the Mahakam Delta

No	Species Name	Family	Position in Estuary and Tidal Frame
1	*Nypa fruticans*	Palmae	Mid- Upper estuary, upper tidal.
2	*Sonneratia alba*	Lythraceae	Low – Upper estuary, Lower – Upper tidal.
3	*Sonneratia caseolaris*	Lythraceae	Low – Upper estuary, Lower – Upper tidal.
4	*Rhizophora apiculata*	Rhizophoraceae	Low – Upper estuary, mesozone-upper tidal.
5	*Rhizophora mucronata*	Rhizophoraceae	Low – Upper estuary, mesozone-upper tidal.
6	*Bruguiera gymnorrhiza*	Rhizophoraceae	Low – Upper estuary, mesozone-upper tidal.
7	*Bruguiera parviflora*	Rhizophoraceae	Low – Upper estuary, mesozone-upper tidal.
8	*Bruguiera sexangula*	Rhizophoraceae	Low – Upper estuary, mesozone-upper tidal.
9	*Ceriops tagal*	Rhizophoraceae	Low – Upper estuary, mesozone-upper tidal.
10	*Avicennia marina*	Verbenaceae	Low – Mid estuary, Lower –upper tidal.
11	*Avicennia alba*	Verbenaceae	Low – Mid estuary, Lower –upper tidal.
12	*Avicennia officinalis*	Verbenaceae	Low – Mid estuary, Lower –upper tidal.

No	Species Name	Family	Position in Estuary and Tidal Frame
13	*Acanthus illicifolius*	Acanthaceae	Mid- Upper estuary, upper tidal.
14	*Acrostichum aureum*	Pteridaceae	Mid- Upper estuary, upper tidal.
15	*Aegiceras corniculatum*	Myrsinaceae	Low – Upper estuary, mesozone-upper tidal.
16	*Heritiera littoralis*	Sterculiaceae	Mid- Upper estuary, upper tidal.
17	*Xylocarpus granatum*	Meliaceae	Mid- Upper estuary, upper tidal.

The lower estuary is dominated by *Sonneratia* spp., and *Avicennia* spp, while *Rhizophora* spp, *Bruguiera* spp and *Nypa fruticans* can also be present where fresh water is significant. Greater diversity occurs in the central delta including; *Avicennia* spp., *Sonneratia* spp., *Rhizophora* spp., *Bruguiera* spp., *Xylocarpus granatum*, *Nypa fruticans*, grow together. Nypah stands begin to become dominate in the mid and especially upper estuary, nearer to the main stem of the Mahakam river. The border of the upper deltaic mangroves is signified by the presence of large Heritiera littoralis, beyond which a zone of mangrove associates transitions into lowland freshwater swamp forest dominated by species such *Oncosperma* spp. (Figure 2.3).

In terms of degradation, the significant loss of *Nypa fruticans* in the delta has reduced its biogeochemical buffering capacity significantly. This has caused saltwater intrusion into the Mahakam River, which is the water source for the city of Samarinda and its 700,000+ inhabitants as well as nearby districts. Closure of this municipal fresh water supply occurred each of the last two years during the dry season lasting two months each closure. This unprecedented closure cost the city more than $30,000,000 per year. Fortunately – the upper delta still maintains a healthy growth of *Nypa fruticans*, which, if lost, would cause the Mahakam River to cross a threshold and become significantly saline. Rehabilitation, sustainable utilization and conservation of Nypah dominant forest stands is essential to the long-term health of the delta, the city of Samarinda and the region in general.

Rehabilitation, restoration and enhancement of the delta is all biophysically feasible, thanks in great part to the sediment load which maintains essential surface elevation, even against current levels of sea level rise. However, the rate of sea level rise may be increasing, and the delta can also cross a threshold where it no longer maintains its surface elevation. This would be in part due to coastal subsidence as vegetation is lost (and root material), and also due to loss of biogenesis (the cycling of biomass by the mangroves themselves, which contributes material to the forest floor). Ensuring proper hydrology is also a key to mangrove recovery in the delta. Regular flooding and drainage of tidal waters, and natural pulses of fresh water from the Mahakam Delta are required to allow for renewal and subsequently conservative growth of mangrove forests. Increased incidence of storms are currently problematic, as they may flood enclosed pond areas (which have intentionally poor drainage) and kill off mangrove regrowth. This can be remedied by strategic breaching of pond dike walls, if “pond owners” allow. Current mangrove planting programs, by government, NGO’s, universities and CSR programs, fail to restore mangroves back to their original position in the delta, preferring to attempt to colonize shorelines. Where shorelines are eroding or mangroves are planted too low in the tidal frame, they die, and plantings only

"succeed" where shorelines are accreting. These plantings, however, are mostly redundant exercises, as natural propagules readily colonize all appropriate intertidal surfaces.

4.2 Socio-cultural Identify of Local Communities

A study from CIRAD (2002) shows that in the early 1900's, the Mahakam Delta was occupied only by small nomadic Bajo fishing camps and semi-permanent Bugis fishing villages. Increasing human populations did not begin in earnest until the 1970's, with the development of oil fields and production facilities. This sparked a migration from Sulawesi, especially Bugis, Makassar and Mandar ethnic groups – all of which had farmed shrimp and milkfish for decades and even centuries.

Cold storage for fish products was developed in 1974, the first in East Kalimantan Province. Access to international markets with better prices led to rapid expansion of aquaculture. Along with Sulawesi migrants came their patron-client (or feudal) system known as punggawa-sawi, with punggawa filling the role of lord, boss, pond-"owner" and sawi the indebted worker or fife, trapped in a cycle of debt, loan and "familial" obligation. This system began on the boats, and was transferred from shrimp trawlers to aquaculture ponds when the shrimp trawling industry collapsed in the 1980's. A willing migrant working class, coupled regional economic prosperity due to the petroleum industry, perverse financial subsidies from the World Bank, Asian Development Bank and other creditors, and ever increasing Ministry of Fisheries export targets fueled by greed for foreign currency and global shrimp demand, led to the rapid expansion of human populations and ponds in the 1990's. Communities now inhabit 75 permanent villages in the delta, with a population in 2010 of 178,776 people (Kutai Kartanegara dalam Angka, 2010), a 250% increase from 1980.

Along with expansion and migration came the following land use or tenurial problems;

a. Ponds were illegally developed in the Forestry Estate. Communication between local government and lead technical agencies such as forestry and fisheries department was non-existant. Pond "owners" were granted illegal land certificates from the District government up until 2010, and currently are granted certificates by village heads (who have no authority to do so) for 500,000 rupiah (US$40) per hectare in two hectare certificates. Some "owners" have certificates for up to 1000 ha.
b. Certificates are used to make claims against the petroleum industry. Small claims are made for damage of dike walls due to passing barges. Large-claims (up to 200,000,000 rp or $17,500) are made when a pipeline needs to transect a pond (locally known as "seismic")
c. Some ponds are constructed in areas zoned for oil and gas production.
d. Pipeline damage or spills are not anticipated by communities, which pollute their source of subsistence livelihoods and the ponds themselves.
e. Some disease and productivity issues in ponds can be related to oil and petroleum exploration (Prihandoko, 2008)

TOTAL-ELF was the recipient of the majority of these claims (although there are others) for compensation, but they are in the process of transitioning out of the delta, to be replaced by Pertamina. What has resulted is a climate of distrust and opportunism, as communities are desperate to offset economic losses due to ecological collapse, and have grown accustomed to holding their hands out to industry. In this climate, Public-Private partnerships have significant but important challenges to overcome. Not only the community, but a host of local officials have formerly pressured industry representatives for money for permits, etc.

This is starting to change, with the promotion of the Ombudsman as a one-stop shop for all permitting needs, promising transparency.

The role of the Punggawa (both resident and remote) in the regional economy is a crucial one. They control both the pond areas and the human resources working in those areas. Any attempt at economic or ecological recovery in the pond areas needs to take into consideration the role of the Punggawa. Head on attempts to dislodge them from power will result in conflict. Creativity is needed to avoid setting the Punggawa up as an obstacle and rather see them as an opportunity to catalyze sustainable economic development which is socially and environmentally responsible. As an example, a role managing a Central Processing Unit for Nypah palm sugar or Bioethanol based on distributed micro-collection by the sawi and other local villagers would potentially be a beneficial change. This could be demonstrated in an area like Sungai Meriam, Kecamatan Anggana where Nypah is still abundant, and a small subset of Punggawa can be approached. The same may hold true in the timber sector. Sustainable aquaculture in a smaller footprint of pond area theoretically sounds like a possible approach, but pond owners and workers alike are hesitant to believe that sustainable aquaculture is possible in the delta. Genuine buy-in and collaboration on behalf of the Punggawa, as well as no or low-interest investment is essential to enable change in the social-economic system.

Perhaps the biggest room for growth and change in this social system has to do with gender relations. Normative Bugis ethnic views on gender are summarized by this common saying when interviewed; “A good Bugis woman is always near the home.” That being said, women and men both hope that women can contribute to household livelihoods. Women, however, have a low level of access to and control over the resources which are the basis of their families livelihoods. A targeted gender sensitization and equity building program, with a gender-specific action plan will be essential to help reverse the trend of environmental exploitation and social inequity. The Restoring Coastal Livelihoods Program in South Sulawesi (www.rcl.or.id) provides a credible platform from which to build a solid gender-based approach.

4.3 Current Utilization of Deltaic Natural Resources

The majority of Delta inhabitants work in the petroleum industry, or as fish farmers and capture fishers. The service sector has risen in districts where the petroleum industry is present as well. Sungai Meriam, Anggana is the center for most Punggawa in the delta who, aside from being pond “owners,” have numerous other investments and businesses, from car rental and motorcycle sale to construction.

Capture fishers are at odds with fish farmers. Capture fisheries use a variety of low technology techniques and mainly fish around the mangroves and delta for fish, crabs and shrimp. A subset of fishers head farther out to sea. Fuel wood and fishing gear from mangroves and roofing thatch from Nypah are common subsistence uses off the forest products. Women are involved in fishing to some extent, and mostly in processing (drying of fish) and peeling of shrimp.

Oil palm is encroaching onto the delta in the upper estuary and even in more seaward areas adjacent to the mainland like Muara Badak. Other agriculture is also increasing its footprint. Former coconut plantations, like their seaward mangrove counterparts, have been converted to aquaculture ponds. Remnant coconut plantations and new oil palm plantations are also vulnerable to and experiencing problems with salinity due to the loss of the mangrove and Nypah buffer.

2002 saw a sudden decrease in pond production activities, related in large part to stabilization of the rupiah in reference to the US Dollar. There are numerous ponds with 12-14 year old mangrove growth inside now – a class of chronoseres which is interesting to note as a reference or analogue for further mangrove rehabilitation. Farmers in the last decade who have continued to raise fish/shrimp, due so largely sporadically. Many wait to receive subsidies from government or non-government agencies in the form of fertilizer, feed and finance for infrastructural repair. Farmers say they don't feel confident that their ponds can be operated longer than 3-5 years without a major break in the cycle – due to incidence of disease and troubles with low water pH from acid-sulphate contamination. Studies from Bone Bay, Sulawesi indeed show that larger ponds are difficult to make financially viable, recommending small polycultures of fish and/or crabs and/or prawns AND *Gracillaria* seaweed (Cordero et al., 1999). However, small pond operation in the Delta may be limited by acid-suplhate on exposed dike walls unless another solution is discovered (use of nets instead of dike walls, application of dolomite lime, etc.)

There is a clear shift in preference, due to the collapse of ecological productivity and also shifts in subsistence and market economies, for people to seek work in more formal sectors such as oil and gas, government, service industries but also on far-ranging fishing vessels. Local natural resource based alternatives in the Delta have yet to be developed, but government stakeholders and industry representatives alike (from businesses such as Unilever, Indofood, Big Tree Farms, Indobamboo and Arenga) have taken an interest. Ecological and economic recovery need to go hand in hand, but it is also clear that local communities from all large variety of sectors with conflicting agendas and different and socio-economic status must be engaged from the onset.

4.4 Governance and Role of Key Stakeholders

The Mahakam Delta is by law a Production Forest, based on Ministry of Agriculture (1983) and Ministry of Forestry legislation (1992 and 2001). In actuality the Delta is filled with aquaculture ponds and post-facto managed by lower level Departments of Fisheries. This legal mandate can only be broken by issuance of formal permission from the Ministry of Forestry, however, we have seen that sub-District (Kecamatan) and Village heads alike will gladly legitimize this conversion with issuance of illegal letter (known as SPPT or Surat Pernyuataan Penguasaan Tanah Negara) of ownership and use. The legal intent of such an SPPT is actually to provide a one hectare exemption for land use change in special circumstances, however, they are being used to develop hundreds upon hundreds of hectares of ponds at a time.

In the field, fish farming communities apply tradition – whoever clears the mangroves for ponds owns the ponds. The size of the "claim" is dependent upon capital outlay and the size of the family/clan that assists.

Four basic institutions should have proper jurisdiction over the management Delta; 1) Ministry of Forestry and Environment and their sub-National agencies, 2) Ministry of Fisheries and Oceans and their sub-national agencies (for aquatic areas), 3) the Kabupaten government of Kutai Kartanegara and the Provincial Government of East Kalimantan.

Because of conflicting and over-lapping policies and jurisdictions, external stakeholders such as Total E&P, UDP, The Nature Conservancy and the World Wildlife Fund have initiated interventions to integrated management of the Delta (see table 4). The most prominent of these initiatives has been the development of the cross-sectoral Mahakam Delta Regional Management Authority.

Table 4. Some initiatives to organize and structure the management of the Mahakam delta[2]

Year	Description
2001	Establishment of 'Integrated Management Council of Mahakam delta'
2003	Adoption of 'Detailed Spatial Planning of Mahakam delta Area'
2004	Creation of 'Mahakam Delta Regional Management Authority
2005	Adoption of a 'Land-Use Planning 2005–2025'
2006	Establishment of 'Mahakam delta Community Empowerment'
2007	Draft Spatial planning for the Coastal Zone 2008–2027'
2007	Strategic Planning for Integrated Delta Management 2008-2013

There is a dense recent history of discrete interventions carried out in the Delta by NGO's, academic institutions and through CSR. Total E&P for instance planted 646 ha of ponds with 3,549,997 mangroves between 2001-2005 (Simarmata), but survivorship data is not available. Waridin (2008) reports the Kuta Kartanegara Forestry Department planted 819 ha of mangroves between 2002-2007 as part of a silvofishery initiative, again without a robust data set of survivorship or growth. More recently, the small French NGO Planete Urgence in partnership with local NGO Yayasan Mangrove Lestari and Wetlands International – Indonesia have undertaken silvofisheries interventions as well, providing support for aquaculture inputs (fertilizer, feed) in exchange for mangrove planting. Fish farmers interviewed are mixed in their reviews of the intervention, appreciative of the inputs but wary of the mangroves in their ponds. Forestry Department representatives interviewed said that *Rhizophora* spp. and *Bruguiera* spp., were the main mangroves planted in ponds, although the areas were originally largely occupied by *Nypa fruticans*.

Although these discrete programs and opportunities should not be discouraged, they need to encourage learning and adaptation in order to maximize utility. What is more, discrete interventions in the huge expanse of the Delta is not enough to recover the major values of buffering capacity and productivity that the Delta has lost. These larger ecosystem goods and services, of immense Total Economic Value, can only be restored or enhanced through a coordinated, Delta-wide initiative. An initiative which recognizes the importance of developing sustainable economies, in order to drive ecological improvements and re-cross critical thresholds into a more productive, adaptive, sustainable and resilient regime.

5.0 Rawa Aopa Watumohai – SE Sulawesi

Methodology & Summary

Field assessments in Rawa Aopa Watumohai National Park were conducted simultaneously for 6 days week, from July 5 - 11, 2015. A multi-disciplinary team of ecologists and social scientists visited 3 villages, Roraya, Tetangge and Lanowulu. Roraya and Tetangge, located outside of Rawa Aopa National Park exhibit a high degree of conversion from mangroves to aquaculture, while Lanowulu within the National park is still a natural system with minimal

[2] Bosma et all, Challenges of a transition to a sustainably managed shrimp culture agro-ecosystem in the Mahakam delta, East Kalimantan, Indonesia

degradation and encroachment. This rapid feasibility assessment used depth interviews, observation and biophysical as well as historical transects for data collection. The ecology team conducted assessments in 7 mangrove sites; **Lanowulu Esutary** – 1) Lower estuary upper tidal and 2) low estuary lower tidal), **Lanowulu River** – 3) mid estuary mesozone, **Langkowala Estuary** – 4) low estuary mesozone, **Labasi River** – 5) mid estuary upper tidal, and **Labalu River** – 6) upper estuary upper tidall, 7) upper estuary upper tidal. Biophysical factors assessed were hydrological flushing, substrate elevation, sedimentation and erosion, canopy cover, substrate texture and soil type, community composition and spesies. Socio economic factors assessed were population, culture, livelihood, land tenure/land owner, government, role of mangrove forest, private sector partnership, social condition, poverty, gender, aquaculture condition and trend analysis. The results of the Rawa Aopa assessment is that the mangrove condtion of the National Park is still good but requires improved management between stakeholders and strengthening of local community access to and control over resources. The mangrove condition adjacent to the park is highly degraded and converted and would require large investment for any degree of social, economic or ecological rehabilitation. The buffer zone between the park and the adjacent systems is also highly degraded and requires both social and ecological intervention. Major private sector actors include the informal aquaculture producers (who are numerous) and the formal mining sector who show little current interest in investing for rehabilitation of ecosystem services and improved management.

5.1 Status and Condition of Mangrove Ecosystem

5.1.1 Mangroves Within Rawa Aopa National Park

The little known Rawa Aopa Watumohai National Park (RAW-NP) in SE Sulawesi is primarily comprised of lowland deciduous rainforest and lowland swamp forest, and mangrove. The parks 105.194 hectares spreads across four districts or kabupaten; Konawe Selatan, Kolaka, Bombana and Konawe. (Figure 3.1) There are approximately 6000 ha of mangrove in the park, located along 24 kilometers of coast from Lanowulu to Langkowala, and extending inland for 2-7 km. Fifteen (15) true mangrove species have been recorded in the park and are listed in table 5, although it is suspected there are additional species common to a mangrove area of that size at this longitudinal range. For instance, over 32 species have been recorded in Bunaken National Park in Northern Sulawesi. (Djamaluddin, 2004)

Table 5. True Mangroves of Rawa Aopa Watumohai National Park

No.	Species Mangrove	
	Latin name	**Local name**
1.	*Sonneratia alba*	Beropa
2.	*Sonneratia caseolaris*	Padada
3.	*Avicennia marina*	Api-api
4.	*Avicennia alba*	Api-Api
5.	*Bruguiera gymnorrhiza*	Cokke
6.	*Bruguiera cylindrica*	Cokke
7.	*Rhizophora mucronata*	Bakau

No.	Species Mangrove	
	Latin name	Local name
8.	*Rhizophora apiculata*	Bakau pandan
9.	*Rhizophora stylosa*	Bakau
10.	*Ceriops tagal*	Tanger
11.	*Aegiceras corniculatum*	Unga-unga
12.	*Lumnitzera littorea*	Kunyi-kunyi
13.	*Lumnitzera racemosa*	Kunyi-kunyi
14.	*Xylocarpus granatum*	Buli putih
15	*Xylocarpus molucuensis*	Buli merah

The lower mangal (lower mangrove ecotone) consists of the common pioneering spec genus, *Avicennia* spp., and *Sonneratia* spp., as well as *Rhizophora stylosa* in rocky or coralline substrates. The mesozone is dominated by *Rhizophora Apiculata* and *R. mucronata* although other members of the Rhizophoracea family are found in several types of community associations. The upper mangal is dominated by *Lumnitzera* spp. and *Ceriops tagal* leading to a transition into hinterland *savanna*. (Figure 3.2).

Mangroves in the park are healthy and exhibit good growth with a high degree of canopy closure. Secondary succession is evident, with abundant propagules and young seedlings underneath parent trees and in some, but not all, appropriate intertidal locations (there are some large unvegetated areas at seemingly suitable surface elevations for mangrove growth that confuse villagers and rangers alike and warrant further investigation). Trees are able to die of old age and be replaced by the next generation, an example that the ecological adaptive cycle is unhindered. (Figure 3.3)

Local communities within the park have agreements with the National Park management office to utilize mangrove wood in a sustainable manner to repair their houses or as racks for seaweed drying. Timber use for the expansion of settlements is not allowed. The local community favors the small, stout timber of the Ceriops tagal tree and thins the forest sustainably. There is encroachment on the park from Bajo communities who have been illegally harvesting *Rhizophora* spp., at a larger scale than the local communities within the park. The *Rhizophora* wood is used and sold for fuel wood and other uses. Although the park office is unable to currently control this activity, it is also not having a large-scale impact on the mangroves within the park, which is balanced by natural secondary succession. (Figure 3.4).

The geomorphological character of the coast determines its hydrology which drives system health in terms of new and conservative growth, and also renewal. Tidal flooding and drainage proceeds undisturbed and above and below ground freshwater inputs from the mainland, and rains buffer the salinity of the water and substrate (Figure 3.5).

The mysterious empty areas occur mainly in the upper mangrove, and it is possible that edaphic conditions are slightly inhospitable to mangrove recruitment (hypersaline, low pH, abundant H_2S, unconsolidated, high temperature?) Again the issue is not *too* serious (the largest of these areas measures 20 hectares) but park managers and communities would

like to understand the reasons mangroves will not grow there, at the very least so they can stop planting the areas which they have attempted and failed repeatedly. (Figure 3.6). The watershed management board (BPDAS) says it is the result of illegal logging, but curiously no stumps of logged trees remain above or underground.

At the mouths of rivers, sedimentation is taking place, which is normal and can encourage mangrove growth upon micro-deltas (Figure 3.7). Sedimentation rates, however, have been exacerbated by mining in the upper watershed, and it is possible that the sediment is contaminated, which would have an impact on shellfish and other benthic feeders and potentially biomagnify through part of the food chain.

5.1.2 Status and Condition of Mangrove Ecosystem – Adjacent to the Park

The contrast between mangrove condition in Rawa Aopa National Park and without is stark. Right up to the park boundaries, in lands that were once considered buffer zone in spatial plans, conversion to aquaculture ponds is near total. (Figure 3.8) Although aquaculture development began in the 1970's the final bit of rapid expansion into the buffer zone took place between 2005-2007. There are six villages surrounding the mangrove areas in the National park; Roraya, Panggoli, Asimi, Tinanggea, Atumi and Lasusuki, all of which have severely degraded or converted mangroves. Roraya village as an example has approximately 1400 hectares of contiguous ponds which were all formerly mangrove area. Expansion in Roraya took place when a Nickel mine (PT Baula Buana) developed road and port facilities.

Aside from conversion of mangroves to aquaculture ponds, illegal logging plagues the area, and as described above has begun to encroach upon the park. The National Park office (BTNRAW) and a local NGO (Lembaga Komunistas Mangrove) have begun to pursue some illegal logging cases through legal channels.

5.2 Socio-cultural Identify of Local Communities

The majority of community members in Rawa Aopa park are first hand natural resource users. Degradation of the resource base, or loss of access, would easily impoverish these communities. These communities live in 98 villages spread across 16 sub-districts and include the following ethnic groups; Tolaki (original from SE Sulawesi), Moronene (originally from SE Sulawesi), Bugis, Muna, Makassar, Jawa, Bali, and Torajan.

The Tolaki and the Moronene have existed in the area of Rawa Aopa since before 1820, evidenced by a Dutch map from that time with the name Hukaea on it – a village founded by the Moronene. The Moronene are good farmers and are considered to live in close harmony with nature. The Moronene were relocated outside of the park boundaries in the 1980's, for fear they would degrade the resource, yet the return daily to the mangroves where they have traditional rights and still carry out traditional use and conservation practices. Both groups are still allowed "non-permanent" structures within the park, yet these settlements are not allowed to expand.

Bugis and Makassarese communities dominate the coastline. The majority have developed ponds outside of the park, which they procured through trade and purchase with local communities. Haji Amir, a fish farmer for 20 years in Roraya village has said that ponds were first opened in this area in the 1970's. Initial success of fish and shrimp farming led pioneers to call for their neighbors and families, a common pattern of expansion by these highly mobile groups, who have been willing actors in the wholesale conversion of Kalimantan and

Sulawesi's mangroves, also driven by international demand for shrimp, national mandate for short-term foreign cash earnings, and perverse subsidies from the World Bank, ADB and national loaning institutions.

The identity of the various ethnic groups is still noticeable, for example through their architectural styles (Figure 3.9). Language, traditions and ceremonies also differentiate the groups, but there is by and large harmony between groups, evidenced during weddings (and inter-marriage), funerals and lack of conflict. In terms of economies, the newcomers have a greater degree of financial capital (and also greater variation – evidenced by in the Punggawa-Sawi client-patron relation common in Bugis communities) than the local communities, but more representative well-being studies have not been undertaken.

5.3 Utilization of natural resources and Livelihood

The Tolaki and Moronene live largely subsistence livelihoods, whereas the other ethnic groups practice more agrarian based livelihoods, alongside fishing with a subset of community members engaged in small business and government service. An example village is Tatangge, Kecamatan Tinanggia Konawe Selatan. This village has 151 households with a population of 521 including Tolaki, Moronene, Bugis, Muna, Makassar and Tana Toraja ethnic groups. The Tolaki and Moronene still harvest and process Sago palm as a staple food, but also eat rice which is the mainstay of migrant diets. The Tolaki and Moronene hunt both within and outside of the National Park (*Rusa* deer and *Anoa* or miniature water buffalo) and make woven Palm leaf mats for use and sale. They also gather cashews and nutmeg from the forest, as do the all ethnic groups except the Bugis and Makassarese who by and large are busy managing their ponds.

The average area that Bugis and Makassar's pond owners farm ranges from 3 – 40 hectares in size. The ponds themselves have recently become plagued with disease and low productivity. Overuse of urea and other industrial fertilizers, factory feed and indiscriminate use of pesticides has resulted in high degree of mortality, such as has been reported in South Sulawesi (Brown and Fadillah, 2014). Although many ponds are currently disused or non-productive, the Punggawa class maintains the perception (deception) of high value. The ponds were purchased for the equivalent of 1,000,000 to 2,500,000 rupiah per hectare, but now are valued at 40 times that amount. A study to uncover this paradox of how and why the perception of high pond values are maintained, even when the ponds become perennially unproductive is critically in determining ways forward with rehabilitating this landscape.

An interesting point about this economic activity is that it is "industrial" in scale, yet managed as a collection of distribute micro-systems. For the purposes of this assessment, the "aquaculture industry" is in essence the most impactful economic use in the region, but what type of strategy can be put in place, for instance, to convince several thousand individual pond owners and fish farmers to invest in Ecosystem Service protection? Yet this is a crucial question, because the actual, physical buffering capacity which separates the Park and its richness of natural values and the impoverished sprawl of ponds has been eroded. The threshold between regimes is paper thin. More on this important dilemma later during analysis.

In the process of land conversion (which was mirrored in the hinterland by conversion of terrestrial forest and savannah into rice fields), many local community went landless. By the 1990's and 2000's, this forced the next generation to seek employment outside of the village, working in the Nickel mine or emigrating to Kendari, the Provincial capital.

Not only the type, but the intensity of resource use by different ethnic groups in the Rawa Aopa region is different. Lanowulu village exists inside of the National park. It is small,

comprised of 50 semi-permanent households, permitted by the National Park office. Villagers mix subsistence with small commerce, harvesting several varieties of wild shrimp, blue swimmer crab (using dried shark skin for bait) and mangrove crab. They also raise a small amount of seaweed, allowable in the park if it doesn't degrade from aesthetics or ecological value. The community cares greatly for the mangroves of Rawa Aopa and has formed the LKM, a small NGO, surprisingly enough as a result of a small study tour to Bunaken National Park during the USAID NRM II program in 2001. This resulted in the park office providing them with a two-way radio to report infractions such as illegal mangrove logging.

When examining natural resource use and livelihoods over time and across the landscape, both within and outside of the park, it becomes clear that any intervention strategy will need to take into account three focal systems; 1) the Park, 2) the degraded coastlines adjacent to the park and 3) the degraded buffer system in between. A strategy begins to evolve where maintaining the ecological and social values within the park becomes important, which includes legitimizing local community access to and control over their high value resources. A strategy is also needed to address the wholesale landscape degradation of the natural resource base adjacent to the park. Finally, the physical buffer, which has all but disappeared, needs to be restored, through a process of biophysical restoration, but also development of some sort of social buffer.

5.4 Governance and Role of Stakeholders

The main stakeholders in the region include a range of government agencies, traditional and resident migrant communities, and the informal aquaculture industry. The mining industry is prevalent in the region, although they may not perceive a connection mangroves or coastal systems in general, they are certainly connected; through infrastructure development and economic development that impacts on regional development, their through their tailings, and through their work force. A list of mines is accompanied by a map (Figure. 3.10) of their proximity to the park.

Mining companies with "pinjam-pakai" permits from the Ministry of Forestry for survey/exploration in Forestry lands:

a. PT Bahtera Sultra Mining (No 1.)
b. PT Cahaya Gemilang Sentosa (No.2)
c. PT Ganesha Delta Permata (No 3)
d. PT Majumulia Agungtama (No 5)
e. PT Sultra Utama Nikel (No 6)

Mining companies with "pinjam-pakai" permits from the Ministry of Forestry for alternate use but not mining in the region:

a. PT Baula Petra Buana (No 2)
b. PT Toshida Indonesia (No 14)
c. PT Anugerah Alam Buana Indonesia (No 21)
d. PT Panca Logam Nusantara (No 22)

The various layers of government stakeholders, from local to national, require a significant coordination and communication strategy. A bridging strategy is also needed, to consider the integrated management needs of the region, even though it is divided into National (within the Park) and Local (adjacent to the park) jurisdictions. The managers of the National Park, which include the Park Office (BTNRAW) as well as regional and national park management authorities from the Ministry of Forestry (BKSDA and PHKA) have a long history of support and pro-active negotiation with communities within the park. To this point, conflict has been minimal. The park management authorities are willing to negotiate with and grant rights to traditional community groups to ensure traditional uses of park resources, although they guard against community expansion, which is potentially problematic in terms of re-generation of the communities themselves.

Aside from the local communities within the park, very few of the stakeholders have a firm understanding of the many aspects of mangrove management. A regional strategy is a logical place to start – to develop this understanding, but even that first step needs to be pre-cursored with on-the-ground sensitization to mangroves, for all stakeholders. The traditional communities within the park, who have traditional mangrove use and management systems, have a relatively small degree of power and a small voice. Their views and traditional practices need to be understood, valued and integrated into any future system.

During stakeholder analysis, local participants identified actors in the region with a high degree of influence. These include land owners, Punggawa, business owners and community leaders. Leaders of the mining sector were singled out in one focus group discussion. Employees of PT Baula Petra Buana were able to secure a “pinjam-pakai” permit from the Forestry Department for development of a road in the mangroves and the creation of a port. This was mentioned earlier as an enabling factor for the continued conversion of adjacent mangroves into aquaculture ponds. Such a permit – issued by the Forestry Department, which enabled large-scale deforestation underscores a set of problem related to landuse planning, direct and indirect impacts.

Aquaculture has not yet encroached upon the national park, so there is not yet conflict between BKSDA/PHKA under the Ministry of Forestry and Environment with Fish Farming communities or the Fisheries Department. That being said, the wholesale conversion of forested lands outside of the park – and subsequent support from the Fisheries department warrants attention. This is a classic landuse disconnect in Indonesia that requires resolution. The Ministry of Fisheries, specifically the Directorate General of Aquaculture claim that Indonesia has no active policy of pond expansion. However, the Ministry does have ever increasing aquaculture export targets. If these targets cannot be met through intensification of aquaculture, they are happy to claim the increase in production accrued through expansion. This is the case adjacent to Rawa Aopa National Park, where the Fisheries Department currently supports aquaculture activities through provision of fertilizers, pesticides, feed, shrimp fry and milkfish juveniles through a variety of extension programs. Additional support includes the development of fresh water wells for use by fish farming families in the vast expanse of ponds. Investment by the Ministry of Fisheries in perpetuating this landuse change needs to be called into question as it runs counter to other National mandates to conserve and restore mangrove cover, sequester and store carbon, reduce GHG emissions, and deliver Payment for Ecosystem Service schemes. The aquaculture sector, with support from regional government and the Ministry of Fisheries, is amongst the strongest actors in the region.

Closing with the community perspective themselves, it seems that very few people are currently concerned about the future of mangroves. Conversion of mangroves to ponds outside of the park has long been accepted as part and parcel of Bugis and Makasarese culture. The long term impact in terms of degradation has not yet been taken seriously,

despite the numerous communities around Kalimantan and Sulawesi whose livelihoods and natural resource bases have collapsed. What is most needed to understand and eventually resolve this dilemma of landscape degradation is a means of affecting a lasting cultural shift. That likely requires a long process of skills and knowledge development, change in behaviors and attitudes and ultimately empowerment of a individuals and groups of individuals until a critical mass is reached. One can say that the Bugis and Makasarese fish farmers have long ago crossed a threshold in terms of sustainable resource management behavior, and that a significant amount of resources are required to re-cross that threshold. On the other side of the threshold sit groups like the Tolaki and Moronene, separated from the threshold by the thinnest of buffers.

6.0 Bintuni Bay – West Papua

Sites Specific Methodology

Field assessments were conducted for a period of 1 week, from 24 - 29 June, 2015. There were three sites assessed by the Bintuni team, Babo, Kuri, & Aroba sub-district, representing the areas in close proximity to mangrove concessionnary industry, PT. Bintuni Utama Murni Wood Industry (BUMWI). This rapid feasibility assessments used in-depth interviews, observation, & biophysical and historical transects as data collection techniques. For the ecological system, the assessment were conducted in a total of 9 mangrove sites & adjacent hinterland areas within the Bay including; 25 years post harvest (concession), 15 years post harvest (concession), 3 years post harvest (concession), 2015 harvest area (concession), lower estuary (concession), upper estuary (concession), lowland-mangrove (mezosone) boundary area (pristine), Bintuni Bay Nature Reserve (Cagar Alam Teluk Bintuni) and in the protected buffer zone between the concession and the reserve. Factors assessed were hydrological flushing, substrate elevation, sedimentation and erosion, canopy cover, substrate texture and soil type (edaphic condition), community composition and species. Additional to this, Sago palm areas (Aribena) in Amutu Besar island were mapped in the PT. BUMWI conservation area.

6.1 Status and Condition of Mangrove Ecosystem

Bintuni Bay, located in the province of West Papua exhibits is one of the world's top three most expansive contiguous mangrove forests, along with the Sunderbans of Bangladesh and the Southern Papuan Coast of Indonesia across Mimika and Asmat districts. It is highly productive, highly diverse and sparsely inhabited by people, and its condition is resultantly quite resilient. The 82,000 hectare PT BUMWI mangrove silvaculture concession is nestled into an approximate 240,000 ha contiguous mangrove forest which is part of a larger non-contiguous extent of mangroves measuring 618,500 ha and extending up to 30 km inland (Alongi, 2007). The concession has high potential for sustainable management due larger to its position in such a large and unpopulated, vigorous landscape. Rotational logging of up to 1000 hectares per year seems to have limited impact on the overall ecological value of the system, even if it may reduce some degree of diversity and productivity in the logging areas themselves over a series of several cycles. The occurrence of the concession in the forest – also serves the purpose of maintaining an active management presence, which is helpful in staving off potential illegal operations including illegal logging mining, conversion to aquaculture or illegal hinterland oil palm development. More on this function will be discussed below in relation to economic utilization.

6.1.1 Hydrological Aspects

The health of the Bintuni mangrove system is owed in larger part to the geomorphology of the bay itself which results in a vigorous exchange of tidal waters twice a day (semi-diurnal) with an annual tidal range of over 6 meters. This high degree of tidal exchange, coupled with abundant inland rainfall causes the formation of powerful tidal creeks, able to maintain their channels without sedimentation or failure. This drives regular flooding and drainage of the mangroves, and also assists with propagule dispersal and an excellent degree of natural regeneration. The banks of the Bay experience normal patterns of erosion and accretion, in a dynamic equilibrium, comprising a complete adaptive cycle as described in Brown, 2007 and Brown et al, 2014. Mean sea level appears to occur between 2.5 – 3.0 meters above 0 (lowest astronomical tide), where the lowest adult and young mangroves occur respectively. Where accretion is occurring these areas are colonized by *Avicennia* spp. and *Sonneratia* spp. as well as occasional salt marsh grasses. Where erosion is taking place – some of the mesozone mangrove species, *Rhizophora* spp. and *Brugueira* spp. may topple into the Bay, occasionally to be replaced by the above mentioned pioneer species. The implications of a vigorous hydrology are a self-maintaining mangrove system, which significantly reduces the potential impact of managed timber harvest.

6.1.2 Ecological Aspects

6.1.2.1 Community Ecology

The major forest type encountered during this feasibility assessment was dominant *Rhizophora apiculata – R. mucronata,* both in the concession and nearby nature reserve (Cagar Alam Teluk Bintuni or CATB). Other community associations in mangroves encountered and reported include

- Avicennia marina var. eucolyptyfolia – Sonneratia alba: in the lower estuary, lower tidal frame
- Avicennia-Rhizophora-Bruguiera-Xylocarpus in the mid estuary, mid-tide frame (Onrizal,2003).
- Ceriops tagal – Brugueira – Xylocarpus in the mid estuary, mid tide frame
- Xylocarpus granatum – X. moluccensis: in the upper estuary, mid to upper tide frame
- Lumnitzera racemosa – extreme upper tide frame
- Nypa fruticans– upper estuary, lower tidal frame

From a logging perspective – the genus in the Rhizophoracea family (*Brugueira, Ceriops, Kandelia, Rhizophora*) are best suited for timber, pulp and charcoal production, and occur largely in the mid-estuary. The *Xylocarpus* in the upper estuary are also valued. The fast growing pioneer mangroves Sonneratia and Avicennia exhibit lower density timber and are not harvested or sold, which is fortuitous for greenbelt protection along the coast, rivers and tidal creeks. Nypa resources are quite remote from the concession and have not been considered for economic utilization.

6.1.2.2 Autecology (individual species ecology)

Diversity is high in Bintuni Bay with 25 species of true mangrove recorded in the concession area alone (Table 6). Many of these species occupy a similar functional role. This redundance in functional roles enhances resilience. These mangroves are used in a subsistence manner for their ethnobotanical properties in Bintuni Bay by local communities and employees of the concession, but are not commercially utilized.

Table 6. 25 known species of true mangroves found in the PT BUMWI concession

No	Spesies	Local Name	Family	Habitat position
1	*Rhizophora apiculata*	Parai	Rhizophoraceae	Low – Upper estuary, mesozone-upper tidal.
2	*Rhizophora mucronata*	Blukap	Rhizophoraceae	Low – Upper estuary, mesozone-upper tidal.
3	*Bruguiera cylindrica*	Paproti?	Rhizophoraceae	Mid- Upper estuary, upper tidal.
4	*Bruguiera gymnorrhiza*	Sarau	Rhizophoraceae	Low – Upper estuary, mesozone-upper tidal.
5	*Bruguiera parviflora*	Paproti	Rhizophoraceae	Low – Upper estuary, mesozone-upper tidal.
6	*Bruguiera sexangula*	Sarau	Rhizophoraceae	Low – Upper estuary, mesozone-upper tidal.
7	*Ceriops decandra*	Parum	Rhizophoraceae	Mid – Upper estuary, mesozone-upper tidal.
8	*Ceriops tagal*	Parum	Rhizophoraceae	Low – Upper estuary, mesozone-upper tidal.
9	*Avicennia marina*	Pai	Verbenaceae	Low – Mid estuary, Lower –upper tidal.
10	*Avicennia marina* v. eucalyptifolia	Pai	Verbenaceae	Low – Mid estuary, Lower –upper tidal.
11	*Avicennia alba*	Pai	Verbenaceae	Low – upper estuary, Lower –upper tidal.
12	*Avicennia officinalis*	Pai	Verbenaceae	Low – upper estuary, Lower –upper tidal.
13	*Sonneratia alba*	Sopo	Lythraceae	Low – Upper estuary, Lower – Upper tidal.
14	*Acanthus illicifolius*	Kafenisa	Acanthaceae	Mid- Upper estuary, upper tidal.
15	*Acanthus ebracteatus*	Kafenisa	Acanthaceae	Mid- Upper estuary, upper tidal.
16	*Schyphyphora hydrophyllaceae*			Mid- Upper estuary, upper tidal.
17	*Nypa fruticans*	Nipa	Palmae	Mid- Upper estuary, upper tidal.
18	*Lumnitzera littorea*		Combretaceae	Upper estuary, upper

No	Spesies	Local Name	Family	Habitat position
				tidal.
19	*Lumnitzera littorea*	Api-api (sic)	Combretaceae	Upper estuary, upper tidal.
20	*Acrostichum aureum*	Yatesa	Pteridaceae	Mid- Upper estuary, upper tidal.
21	*Acrostichum speciosum*	Piyai lasa	Pteridaceae	Mid- Upper estuary, upper tidal.
22	*Aegiceras corniculatum*		Myrsinaceae	Low – Upper estuary, mesozone-upper tidal.
23	*Heritiera littoralis*		Sterculiaceae	Mid- Upper estuary, upper tidal.
24	*Xylocarpus granatum*	Mokmof, Kabau	Meliaceae	Mid- Upper estuary, upper tidal.
25	*Xylocarpus moluccensis*	Parasar, Kabau	Meliaceae	Mid- Upper estuary, upper tidal.

6.1.2.3 Ecotones (Ecological variants within an ecosystem)

Five major ecotones exist in Bintuni and are each productive, vigorous and connected. This connectivity provides the system with a high degree of ecological resilience, able to adapt to shocks and disturbances while maintaining the value and character of the system.

1. **Lower mangrove ; Avicennia marina – Sonneratia alba**
2. **Mesozone; Rhizophoraceae (Rhizophora apiculata, R. mucronata, Bruguiera gymnorrhiza, Ceriops tagal, B. parviflora)**
3. **Upper estuary mangrove ; Xylocarpus granatum, X. moluccensis, Lumnitzera littorea, Schyphiphora hydrophyllaceae, Pandanus spp.**
4. **Sago Palm forest (Aribena) – only on Amutu Besar island**
5. **Lowland swamp forest; Nibung (Oncosperma tigillarium), Meranti (Shorea spp.), Merbau (Intsia bijuga), white rattan (Calamus aruensis Becc), etc.**

6.1.2.4 Natural Secondary Succession

Eight major factors have been described which regulate mangrove recruitment, early growth and conservation. (Tomascik et al, 1997; Lewis and Brown, 2014)

1. Temperature
2. Low energy coast
3. Currents
4. Edaphic conditions in the substrate
5. Sedimentation/erosion pattern
6. Salinity and salt water

7. Frequency and Duration of Tidal Inundation
8. Functioning of tidal creeks

Including hydrological conditions discussed above, the growth and health of mangroves in Bintuni Bay owes itself to an ideal suite of the above mentioned conditions. Nutrients from the land, a plentiful supply of sediment and fresh water, powerful tides surging through the sheltered above water conditions of the bay, and balanced erosion and accretion patterns are all fortuitous.

Regeneration in the concession has been studied in depth and has been rated as a high growth site – exhibiting an allometric growth curve which was highest amongst 5 high growth sites from Malaysia to Papua. (Inoue et. al, 1999) Again, ideal conditions for silvaculture.

PT BUMWI relies to some extent on natural regeneration in their felled plots, but also augments with hand planted material. Their practice has evolved over time. In 1988-1993, they would plant 2 trees per planting hole at close spacing, but ended up with sub-maximal timber with two smaller mainstems. Their practice changed to what it is today in 1993, planting 1 seedling at 4 meter spacing (2500 seedlings./ha; Fig 4.3). The sites fill in with natural recruits reaching over 20,000 seedlings/ha, before naturally thinning to 800 – 1200 stems/ha at harvest age (20 – 25 years).

The planted trees become co-dominant in the canopy cover, while the natural recruits may exhibit either co-dominant, intermediate or over-top forest structure. Planting, thus, changes forest structure from the natural type. PT BUMWI is interested in promoting natural recruitment only – but that would require a change in Indonesian mangrove silvaculture policy and practice.

6.1.2.5 Rare/ Endangered Species

A High Conservation Value Survey was undertaken by the IDEAS team in 2015. A summary of the results follow;

1. For species of protected mammals exist in the concession and conservation area; Rusa Deer (*Cervus timorensis),* Brown Dorcopsis Wallaby (*Dorcopsis muelleri),* Northern Common Cuscus (*Phalanger orientalis),* Common Spotted Cuscus (*Spilocuscus maculatus),* dan Common Bottlenose Dolphin (*Tursiops truncates*)
2. Twenty eight (28) protected birds
3. Four protected reptiles: Estuarine crocodile (*Crocodylus porosus),* Amboina Box Turtle *(Cuora amboinensis),* Crocodile Monitor *(Varanus salvadorii),* and New Guinea Crocodile *(Crocodylus novaeguineae)*
4. Three protected sharks/rays: Brown stingaree (*Urolophus westraliensis),* Silvertip shark (*Carcharinus albimarginatus),* Whitecheek shark (*Charcarinus dussumieri).*
5. Ten protect flora *Cupaniopsis sp.,* Merbau (*Intsia bijuga),* Wedetoto (*Ceratopetalum succirubrum),* Bintangur daun halus (*Calophyllum insularu.),* Chinese Pholidota Orchid (*Pholidota chinensis), Claderia viridiflora, Corymborchis veratifolia*, Sotoro Orchid (*Dendrobium acerosum*), Mangrove Orchid *Dendrobium scheulleri* and *Dendrobium spectabile.*

Bintuni has two formal protected areas, the Nature Reserve and the Conservation area of the BUMWI concession, where these high conservation value species proliferate. For every 1500 ha of logging area in the concession, BUMWI is committed to maintaining 700 ha of conservation, no cutting area. Strategic placement of these conservation zones could be re-

evaluated to maintain buffering capacity of the system, biogeochemical flows and ultimately system resilience.

6.1.2.6 Ecological thresholds

Compare to the 7 other sites which have been assessed by the Blue Forests Team, Bintuni has yet to cross over a major threshold, is not considered degraded and can still be managed to maintain distance from any potential thresholds, including sea level rise and climate change. Any potential development threats that may shock and disturb the Bintuni system, such as potential hinterland conversion of lowland swamp forest to oil palm, need to be identified early for preventative management actions

6.1.3 Potential/Need for Eco-hydrological Rehabilitation or Enhanced Regeneration

There is no significant need for rehabilitation in or adjacent to the concession. Natural generation is adequate to reforest logged and minor degraded areas and there has been little permanent conversion in this forest. Improved regeneration in concession plots is possible, but only should be considered on a trial basis and does not require major investment.

6.2 Cultural and Social Identity

A recent census shows that 56,597 people live in Bintuni Bay spread across 24 districts, a low population density even for this remote region. (BPS, 2014) There are four main ethnic groups in and around the concession, the Kurri, Wamesa, Irarutu and Sumuri. These groups frequently inter-marry and are less distinct than larger mangrove dwelling communities such as the Asmat and the Kamoro in Southern Papua. (Fig.4.4). These groups live largely subsistence livelihoods based on hunting and gathering, while some work at the concession and many earn incomes selling forest products to the PT BUMWI. The concession owner buys whatever is brought forth, as a means of stimulating the economy, maintaining relations and informal CSR. An interviewed Wamesa woman exclaimed, if we bring them “shit” they will buy it, and smiled.

Average prices for commodities purchased by PT BUMWI are;

- Wild pig 300,000 – 500,000 Rp.
- Orchids 20,000 - 25,000 Rp.
- Deer (live) 500,000 Rp.

The staple starch of these groups are sago palm and rice. The rice is subsidized by the government, sold for 50,000 rp for 15 kg, a bargain in this remote expensive area. The main livelihood and subsistence activities of local community members are;

- Mangrove (Scylla serratus) crab capture
- Fishing/shrimping – low tech
- Vegetable farming and local sales
- Deer hunting
- Government employee
- Porter (offloading and loading ships).
- Gathering of valuable commodities (ant nests (for medicine), mangrove orchids and gaharu seeds for jewelry

Livelihood strategy is dictated by level of assets owned and/or education attained. People with Junior high school educations will open small stores or enlist to become civil servants, those with a long boat will fish while those with no assets or education offload boats or gather bivalves.

The majority of human resources at PT BUMWI and also BP Natural Gas (the area's largest employer) are by and large migrant laborers meeting specific skill requirements such as mechanics, engineers, foresters, human resource managers, accountants, etc. These migrants have developed the area, adding stores, commerce, transportation etc. Development of this sort can be seen in Babo, the major village and airstrip nearest to PT BUMWI – where migrants and local Papuans live fairly well integrated lives. Local clans to sometimes extract compensation for things such as use of certain trees, fishing grounds or development of temporary shelters in the forest. Local groups are free to harvest fish and crabs in any area at any time due to abundance, but limits in time and space are placed on newcomers in traditionally owned areas (Hak Wilayat), most often with respect to mangrove crab capture – where some form of retribution is required. (Fig. 4) Serious conflicts based on race, religion, economic status, etc are uncommon in Bintuni Bay. The local ethnic groups maintain traditional custom, leadership, conflict management, natural resource management, etc, and newcomers learn to live side by side with these systems without encroachment. Socially – no serious thresholds seem to have been crossed.

Social services to Bintuni groups are sometimes lacking, especially in the health and education sector. The community members interviewed do not by and large feel impoverished with the exception of difficult access to education.

6.2.1 Gender Analysis

Women's roles in daily life active and fulfilling, involved in economic activities including managing their own finances. Main livelihoods contributions from gardening, gathering crabs and mollusks, grating coconut and gathering fuel wood. Women also run the household, in charge of care for children and cooking. The day is full, with only 5-7 hours a day for sleep or rest. Women do not have significant decision making power in the community or the household. Access to resources may be adequate, but control is lacking. At higher levels of governance, there are also no female members of congress in Bintuni.

6.3 Utilization and Economic Value of Mangrove Resources

Crabs and fish bladders from species of snapper and Barramundi are the most sought after resources. Price of crabs range from 20,000 – 50,000 rp per kilo, while dried swim bladders sell for millions of rupiah per dried kilogram and the market is always buying. Crabs, fish, shrimp and bladders are sold in Babo, while crabs, fish and shrimp can also be sold to PT BUMWI. Fishing effort, equipment and coordination differ between newcomers and local Bintuni community members, captured in Table 7.

Tabel 7. Comparison of daily mangrove crab yield between local and migrant fishers:

Community	Fishing method	Yield	Average per day per person
Local community member	Traditional by hand, in forest nearest to home by long boat,	10-20 crabs per day (3 – 7 kg) per person	15 crabs = 5 kg 100,000 – 250,000 rupiah/day

	no overnight trips.		
Migrant (Buton, Maluku, Bugis, etc)	Use of traps. To forest areas far off by covered boat. 5-7 day fishing trips. (Fig. 4.4)	500 – 1200 crabs per week (200 – 400 kg) per boat (3 people)	48 crabs = 16.66 kg 300,000 – 750,000 rp/day

6.3.1 Changes in Social and Economic Attributes

With the presence of PT BUMWI – local communities had much greater interaction with foreign people and ideas and gained access to new services, especially transportation, education, etc. Some resources, especially mangrove crabs, became more scarce in logged forests – and people had to adapt their subsistence hunting patterns. The local people are compensated by the industry for inconveniences, and also have the industry as a new and accessible market. A UNIPA social study has concluded that dependence of the community on compensation from PT BUMWI is significant and related to mangrove conservation, there is a worry that reliance on and acceptance of compensation will reduce communities negotiating power with other stakeholders and may reduce vigilance in terms of forest conservation.

6.4 Governance and Role of Stakeholders

Papuan communities have constitutional rights to manage their traditional lands, granted by 1 UU No. 21; 2001. Of the total 618,500 ha of mangrove area in Bintuni, however, 124,850 ha are in the Bintuni Bay Nature Reserve (CATB) under the management authority of BKSDA and PHKA and 82.120 ha are managed as concession by PT.BUMWI (Ministry of Forestry Legislation: 213/MENHUT-II/2007 on IUPHHK-concessions). The need for collaboration around management, in an integrated way, to resolve this contradictory land tenure arrangement should be considered as a pre-emptive measure to avoid future conflict.

6.4.1 The Roles of those who hold Power

Administrative – power flows down from Governor to Bupati to Camat to the Village head and Head of traditional community (LEMA). In practice, power sites with the Village head – who sometimes also plays the dual role of traditional leader even in the absence of that level of traditional system in Bintuni.

The strongest influence in the mangrove area are the clans who live amongst the mangrove and have constitutional law on their side, notwithstanding management authority of PT BUMWI and the Forestry Department in the concession and the Forest Conservation Department in the nature reserve. An Integrated Forest Management Unit (KPH) may be an interesting consideration for Bintuni – if it doesn't simply add a layer of complexity to mangrove management in a system which currently has major issues. It would be recommended in a non-Papuan landscape where Hak Ulayat did not exist. Other groups with influence include migrant economic and community leaders, local government and private industry (PT. BUMWI, and British Petroleum (BP) LNG Tangguh Indonesia)

6.4.2 Major Private Sector Actors

As stated above the two major private sector actors in Bintuni are PT. BUMWI and BP LNG Tangguh Indonesia. PT. BUMWI manages mangrove silvaculture for chip production to feed

the pulp/paper industry and has recently received FSC certification (August, 5, 2015), while BP LNG Tangguh Indonesia mines natural gas and petroleum including some direct mangrove exploration. Local communities have few serious claims against these industries. The Indonesian government values the silvaculture in Bintuni, having certified the operation nationally – making it available for international FSC recognition. The current CEO of PT BUMWI is actively collaborating with mangrove scientists, has invested in modern research and development around logging efficiency, sustainable energy production (tidal), and development of mangrove timber for engineered lumber production. These activities have been accused in the past as in genuine by national and international NGO's, but the willingness to learn and collaborate appears quite genuine. That being said – it is not perhaps the Bintuni landscape which requires investment in intervention. The more problematic concession managed by the same owner in Kubu Raya has a host of silvaculture and community issues, the resolution of which would lead to a host of social, economic and ecological benefits. This is later revealed in options analysis – not so much looking at the average score generated by the analysis, but the total score which indicates potential impact.

Partnership with BP LNG cannot be initiated from the field in Bintuni, but needs to take place through talks in Jakarta that the assessment team did not undertake. BP runs a CSR program to mitigate their impact of the Tangguh gas field, however there is not yet any indication that they are willing to invest in increased CSR or PES schemes. Current CSR includes port development for impacted villages, and a scholarship program for students. Community members in Kuri say that BP CSR does not reach their area which is focused around Babo, although they are impacted by BP's operations.

PART C: ANALYSIS AND CONCLUSION

7.0 Analysis

7.1 Conceptual Models: Problem Trees and Objective Trees

Analysis of each of the four landscapes investigated was undertaken by first creating a pair of conceptual models for each site. The paired conceptual models include a problem tree and an objective tree for each site. The problem tree looks at causes and effects of the major issues uncovered at the site across social, policy, cultural, economic and ecological aspects. The tree is created to reveal root causes of larger issues observed in the field. The objective tree is then created by addressing the various layers of problems. General problems turn into Goals and over-arching objectives of a potential intervention, while more specific problems and root causes turn into immediate outcomes and activities.

Problem Trees and Objectives Trees are attached as a separate appendix (Appendix C) in PDF format.

7.2 Options Analysis

The development of an objective tree easily lends itself to a future project planning process, such as the creation of a logical framework analysis matrix or other logical model. Prior to project planning, however, the objective tree was analyzed using an options analysis approach. The options analysis lined up activities, outcomes and purposes on the y axis of a spreadsheet along with eight (8) project feasibility criteria on the x-axis. These criteria included; expected conservation benefit, cost, social risk, likelihood of success, whether funding is available, available personnel, experience with the methodology entailed and development benefits to priority groups. Scores are then ascribed to each activity based on a single criteria. Scores range from 1-5. Low scores of 1 or 2 show that there is some degree of risk inherent in the activity or intervention, while high scores indicate low-risk or conversely high-likelihood. The criteria themselves have not been weighted. The scores can be analyzed individually against activities, or cumulatively against the entire intervention. A high total score shows that the project is complex (comprised of many activities) which, if successful will translate to significant impacts. High average scores show that a project is low-risk, whereas low average scores indicate a high degree of risk.

Once scored the information generated can be used to help develop an intervention strategy, or to determine that no action is required. This is best undertaken by stakeholders interested in developing an intervention. The problem and objective trees are attached as a single PDF file to this report. The results of the options analysis are attached as an Excel file with 4 spreadsheets.

The options analyses for each of the four landscapes analyzed in this assessment are presented as an appendix (Appendix A) at the end of this report.

8.0 Conclusion

The mangrove landscapes of Kalimantan, West and East, have the greatest potential impact for management intervention. The resource base of West Kalimantan mangroves has been greatly impacted by the charcoal and timber harvesting culture of the West (Riau, Sumatra) while the Mahakam Delta has been more deleteriously impacted by the fish farmers of Southern Sulawesi, who convert rather than cut and regrow mangroves.

In West Kalimantan, logging concessions, as major direct user of mangroves, have a high degree of interest in both the rejunvenation of the forest as well as the welfare of surrounding communities. In the Mahakam Delta, the fish farmers of South Sulawesi have largely colonized the region, and are less interested in mangrove rejuventation or even the welfare of their own people who are mired in an antiquated client-patron system. Partnership in the Delta will rely in large part on cooperation from the Punggawa lords, which is a risky proposition. To add to that risk, although the Provincial government and several large development agencies (AFD, DFID, and potentially World Bank) are interested in investing in sustainable economic development in the Delta, the likely cast of industries, Nypah Palm, Timber and Sustainable Aquaculture would all need to be trialed during periods of Research and Development before potentially providing benefits to the the Delta and its people. On the other hand, investment in Kubu Raya has a much higher likelihood of short term impact, improving silvculture practices and productivity, resolving local conflict, and developing a sustainable natural resource base for longer term prosperity.

Moving further East, interventions in Rawa Aopa and Bintuni Bay are less complex than those required in Kalimantan. Subsequently, potential impact is lessened, but perhaps still important. The paradigm in Rawa Aopa, where a National Park and its communities stand vulnerable to shocks and disturbances caused by neighboring land uses is a crucial one often repeated in other landscapes around Indonesia. Resilience in the region as a whole has been degraded, both within and outside of the park. The buffering capacity of the system, including the actual designated buffer zone has been degraded. The coastal landscapes adjacent to the Park have been entirely converted. Using Resilience terminology, they have crossed multiple thresholds and now exist as impoverished regimes, from each of social, economic and ecological aspects. With regards to investment, it would cost relatively little to improve management and build resilience in the Park itself, more to rehabilitate the buffer system and would be resource intensive to attempt to re-cross thresholds in the degraded aquaculture system to establish a more productive and sustainable landscape mosaic. With regards to neighboring industries, the informal and disorganized aquaculture sector and the nascent artisanal Nickel mines, investment in transformation, rehabilitation and enhancement is unlikely.

Finally – with regards to Bintuni Bay, the system is still quite resilient, able to recover after large-scale logging, and still able to provide subsistence benefits to local communities. An important role of the current logging concession, and to some extent BP Tangguh, is that of a watch dog, able to report suspicious unplanned economic activities, maintaining vigilance of the system by means of their own economic staying power. The concessionaire at PT BUMWI clearly has genuine interest in partnering with USAID, but it seems focus on the problematic landscape in West Kalimantan is a more appropriate use of the world's finite resources.

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APPENDIX A: OPTIONS ANALYSIS FOR ALL FOUR LANDSCAPES

Options analysis

The analysis of the problems and objectives may produce a range of approaches but these may be incompatible or choices may have to be made based on cost or time. The function of this process is to review the consequences of all options for action, including doing nothing. These options can be taken from the steps of the objective tree. One approach is to list the options in rows of a table and label columns with those criteria considered most important. The criteria could include; expected conservation benefit, cost, social risk, likelihood of success, whether funding is available, available personnel, experience with the methodology entailed and development benefits to priority groups. Each option can then be scored on each criteria and this information used to select a strategy.

Note*: This analysis is based on projected interventions derived through problem and objective analysis - and considers the over-arching goal of improved management, rehabilitation and sustainable utilization - also considering the desire to develop public-private partnerships*

OPTIONS ANALYSIS -KUBU RAYA											
MAJOR ACTIONS		Expected Conservation Benefit	Cost	Social Risk	Likelihood of Success	Funding Available	Available Personnel	Experience with entailed methodologies	Development benefits to priority groups	Total Score	Average Score
Rating	1	Low	High	High Risk	Low	Not identified	Low	Low	Low		
	3	Medium	Medium	Nominal Risk	Medium	One source	Medium	Medium	Medium		

	5	High	Low	High Social Support	High	Multiple sources	High	High	High		
Improved Silvaculture Practice, Regeneration and Mangrove Rehabilitation											
Improved Silvaculture Practice/Regeneration		3	3	5	3	5	2	3	3	27	3.375
In PRACTICE at the concession		3	3	5	4	5	2	3	3	28	3.5
POLICY shift		4	3	2	3	5	3	3	3	26	3.25
Ecological Mangrove Rehabilitation		5	3	4	5	5	5	5	5	37	4.625
Training (Capacity Building)		5	4	4	4	5	5	5	3	35	4.375
Implementation in degraded areas in the Concession		5	4	5	5	5	5	5	3	37	4.625
Implementation adjacent to Concession		5	4	3	4	5	5	5	5	36	4.5
Changing rehabilitation policy (gov't)		4	3	1	3	5	5	5	5	31	3.875
Address Encroachment/Trans-boundary Issues											
Improve and diversify charcoal production		5	2	3	4	5	4	4	5	32	4
Clearly demonstrate improved fisheries benefits from improved silvaculture mgmt/rehabilitation		5	5	5	5	5	5	5	5	40	5

Development of Forest Management Learning Groups and Community Forestry Plans		5	3	5	3	5	5	4	5	35	4.375
Formalize and Build Capacity with Multi-stakeholder Mangrove Management Working Group (KKMD) and Integrated Forest Management Unit (KPH)		4	2	5	4	5	5	4	5	34	4.25
Develop CSR Fund		5	1	4	4	5	5	4	5	33	4.125
Achieve Sustainable Utilization of Mangrove & Hinterland Forest											
Economic Improvments in Silvaculture Sector		4	2	4	4	5	5	3	4	31	3.875
Improved fuel efficiency for concession		3	1	5	3	3	3	2	4	24	3
Improve strategic logging/harvest plan		4	2	5	5	5	5	4	4	34	4.25
Improve HR recruitment (based on research findings)		2	3	3	3	3	5	4	2	25	3.125
Improve public perception of mangrove timber		3	2	2	3	5	5	5	2	27	3.375
FSC cert		3	2	2	3	5	5	5	2	27	3.375
Multi-disciplinary research on co-benefits		4	2	3	5	5	5	4	4	32	4
Product Diversification											
Engineered Lumber		4	1	3	4	5	5	5	4	31	3.875
Efficient Charcoal		4	2	5	4	5	5	5	5	35	4.375
Torrefied Wood		3	1	3	3	3	3	2	2	20	2.5

Improved Hinterland Forestry Practice		5	3	4	4	5	4	5	5	35	4.375
Coconut plantation management – organic palm sugar		5	3	4	4	5	4	5	5	35	4.375
Hydrological management		5	3	5	4	5	5	5	5	37	4.625
Natural forest enhancement		5	4	3	3	5	5	5	5	35	4.375
Additional Community Livelihood Development											
Nypah palm utilization		5	2	4	4	5	5	3	5	33	4.125
Capture Fisheries		4	1	4	3	3	3	3	5	26	3.25
Community based mangrove Timber and Non-timber products		3	3	4	4	5	5	5	4	33	4.125
TOTALS		124	77	114	114	142	133	125	122	951	4.0
		Avg Cost	2.6							Total Score	Average Rating

OPTIONS ANALYSIS - MAHAKAM DELTA											
MAJOR ACTIONS		Expected Conservation Benefit	Cost	Social Risk	Likelihood of Success	Funding Available	Available Personnel	Experience with entailed methodologies	Development benefits to priority groups	Total Score	Average Score
Rating	1	Low	High	High Risk	Low	Not identified	Low	Low	Low		
	3	Medium	Medium	Nominal Risk	Medium	One source	Medium	Medium	Medium		
	5	High	Low	High Social Support	High	Multiple sources	High	High	High		
Socio-economic											
Improved forest tenure arrangements - considering community rights, restoration of legal status and opportunity for sustainable economic development											
Application of "pinjam-pakai" legislation enabling forestry and non-forestry economic use		4	1	2	3	5	3	3	4	25	3.125
Improved economic development from a smaller aquaculture footprint "intensification"		5	3	1	3	5	5	5	5	32	4
Shrimp consumer awareness campaign		2	4	2	2	3	3	3	2	21	2.625
Economic development from rehabilitated (restored) pond areas		5	3	3	3	5	5	5	5	34	4.25

(Nypah, mangrove, etc)											
Increase community access to and control over natural resource base		5	4	2	3	5	3	3	5	30	3.75
Develop gender action plan		5	4	4	5	5	5	5	5	38	4.75
Realize regular government support for sustainable livelihoods support - including Coastal Field Schools and business development		5	3	3	3	5	5	5	5	34	4.25
Ecological-Economic											
Ecological rehabilitation (mangrove and riparian) integrated with invesment in sustainable economic development to restore natural biogeochemical buffer capacity & productivity										0	0
Sustainable Aquaculture Development		4	3	3	3	5	5	5	5	33	4.125
Fish farmer field schools		4	4	4	4	5	5	5	5	36	4.5
Demonstration of intensification		3	1	3	3	3	3	3	2	21	2.625
Rehabilitation of Mangrove & Nypah Forest										0	0
Ecological Mangrove Rehabilitation		5	3	3	5	5	5	5	5		

Nypah palm utilization for bioethanol/sugar in existing stands		5	2	3	4	5	5	3	5	32	4
Nypah palm rehabilitation in unproductive ponds		5	4	3	5	5	5	5	5	37	4.625
Rehabilitation of Upper/Mid Watershed Riparian Zone										0	0
Watershed Field Schools and Forest Management Learning Groups		5	4	4	4	5	5	5	5	37	4.625
Livelihoods development (agroforestry, sustainable timber, etc)		5	2	3	4	3	4	4	5	30	3.75
Government sponsored Climate Compatible Development model based on appropriate valuation of Total Economic Value - linked to Development Scenarios										0	0
Development of Adaptive-Co-mgmt system										35	4.375
KKMD Formation and Capacity Building		4	2	5	4	5	5	5	5		
KPH Capacity Building and Integration with KKMD and SDPEM		4	2	4	3	5	5	3	5	31	3.875
Investment in Key Sectors for Economic Development across scales (small, medium										0	0

and industrial)											
Nypah		5	2	3	3	5	5	3	5	31	3.875
Timber		3	1	2	2	5	5	3	4	25	3.125
Sustainable Aquaculture Development		3	2	4	2	3	5	5	5	29	3.625
Capture Fisheries										0	0
Consensus on Developed Conceptual Models and Scenariosfor Climate Compatible Development										0	0
Total Economic Valuation (participatory and academic)		4	4	5	4	5	5	3	5		
Capacity building of multi-stakeholder forums on scenario development, trade-off analysis, well-being analysis etc.		5	3	5	3	5	5	3	5	34	4.25
										0	0
										0	0
TOTALS		95	61	71	75	102	101	89	102	696	3.91
		Avg Cost	3.05							Total Score	Average Rating

OPTIONS ANALYSIS - RAWA AOPA											
MAJOR ACTIONS		Expected Conservation Benefit	Cost	Social Risk	Likelihood of Success	Funding Available	Available Personnel	Experience with entailed methodologies	Development benefits to priority groups	Total Score	Average Score
Rating	1	Low	High	High Risk	Low	Not identified	Low	Low	Low		
	3	Medium	Medium	Nominal Risk	Medium	One source	Medium	Medium	Medium		
	5	High	Low	High Social Support	High	Multiple sources	High	High	High		
Improved traditional communities' acces to and control over resources											
Negotiation and collaboration with government		5	5	4	4	3	3	3	5	32	4
Studies depicting impact of traditional management on the environment		3	5	5	3	3	3	3	3	28	3.5
Development of innovative livelihood options within the park		5	3	5	4	5	5	5	5	37	4.625
Rehabilitated Buffer Area (social and ecological)											
Ecological rehabilitation/shelterbelts		5	3	3	3	3	5	5	5	32	4
Development of a social buffering system		5	4	4	3	3	3	3	5	30	3.75
Coastal Field Schools for livelihood improvement		5	4	5	5	5	5	5	5	39	4.875

outside of the park											
Transforamtion to a sustainable productive landscape mosaic											
Improved Aquaculture Management in a Smaller Footprint		5	3	1	4	5	5	5	5	33	4.125
Technical demonstrations		4	1	3	3	5	3	3	4	26	3.25
Fish Farmer Field School		5	5	5	4	5	5	5	5	39	4.875
Ecological mangrove rehabilitation demonstration in 500 ha of ponds		5	3	2	5	5	5	5	5	35	4.375
Advocacy to Regional and Nat'l Gov't to Reform Aquaculture Policy and Practice											
Development of PERDA and SDPEM regionally		4	4	4	4	3	4	4	4	31	3.875
Strategic action plan to learn about and address global drivers											
Examination of aquaculture certification schemes		2	2	3	2	3	3	3	2	20	2.5
Promotion of natural fisheries values of mangrove systems.		5	3	4	4	3	3	5	5	32	4
TOTALS		58	45	48	48	51	52	54	58	414	3.67

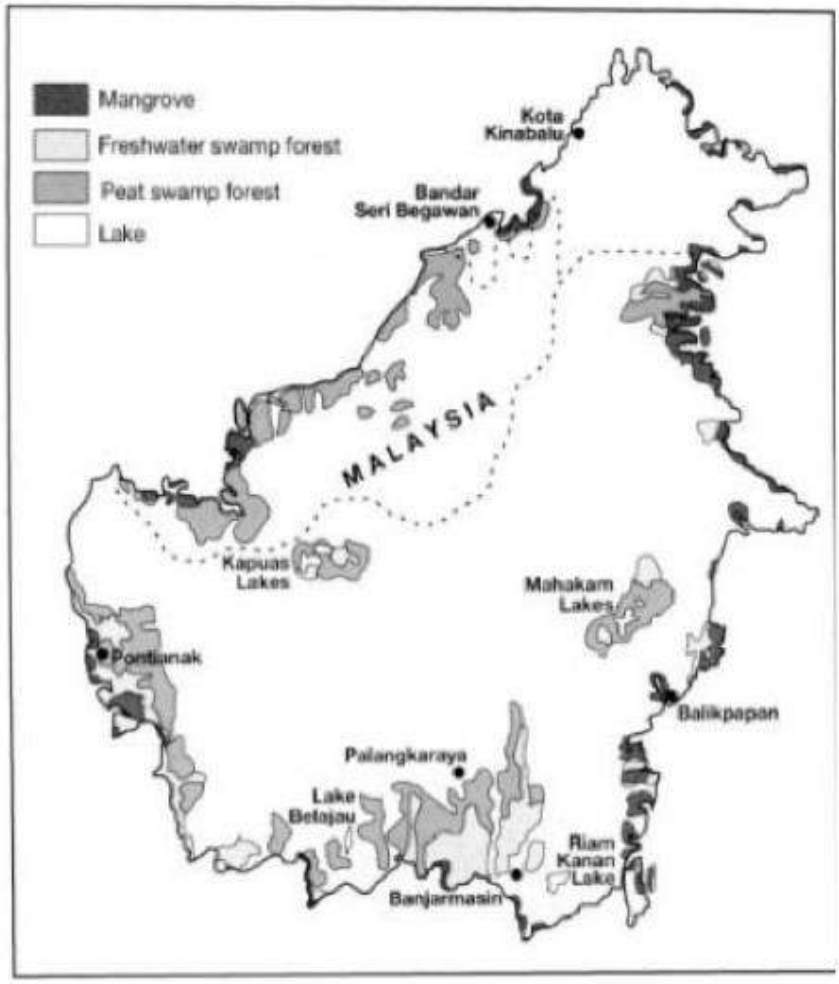
		Avg Cost =	3.5							Total Score	Average Rating

OPTIONS ANALYSIS - BINTUNI BAY											
MAJOR ACTIONS		Expected Conservation Benefit	Cost	Social Risk	Likelihood of Success	Funding Available	Available Personnel	Experience with entailed methodologies	Development benefits to priority groups	Total Score	Average Score
Rating	1	Low	High	High Risk	Low	Not identified	Low	Low	Low		
	3	Medium	Medium	Nominal Risk	Medium	One source	Medium	Medium	Medium		
	5	High	Low	High Social Support	High	Multiple sources	High	High	High		
Develop Strategic Harvest Plan											
GIS and Ground Truthing Surveys		4	4	5	5	5	3	3	3	32	4
Improved Extraction Tech		4	2	5	3	5	3	3	3	28	3.5
Silvaculture TOT and Capacity Building		4	3	5	4	5	4	4	4	33	4.125
Diversification of Products through R&D, Training, Development and Market Analysis											
Charcoal		3	2	5	5	5	4	4	3	31	3.875
Torrefaction		4	1	5	4	3	3	3	2	25	3.125
Lumber production		4	2	4	4	5	5	5	3	32	4
Maintain current and cultivate new Buyers											

Increase production through improved silvaculture practice		4	3	4	4	5	5	5	3	33	4.125
Increase number of producers - potentiallhy community based logging areas		4	1	4	3	3	3	4	5	27	3.375
Improve public perception of mangrove timber		4	3	3	4	5	5	5	3	32	4
Academic research		4	3	5	5	5	5	5	4	36	4.5
Secure FSC certification		4	4	4	5	5	5	5	3	35	4.375
Media campaign		3	5	4	3	3	5	5	3	31	3.875
TOTALS		46	33	53	49	54	50	51	39	375	3.9
		Avg. cost =	2.75							Total Score	Average Rating

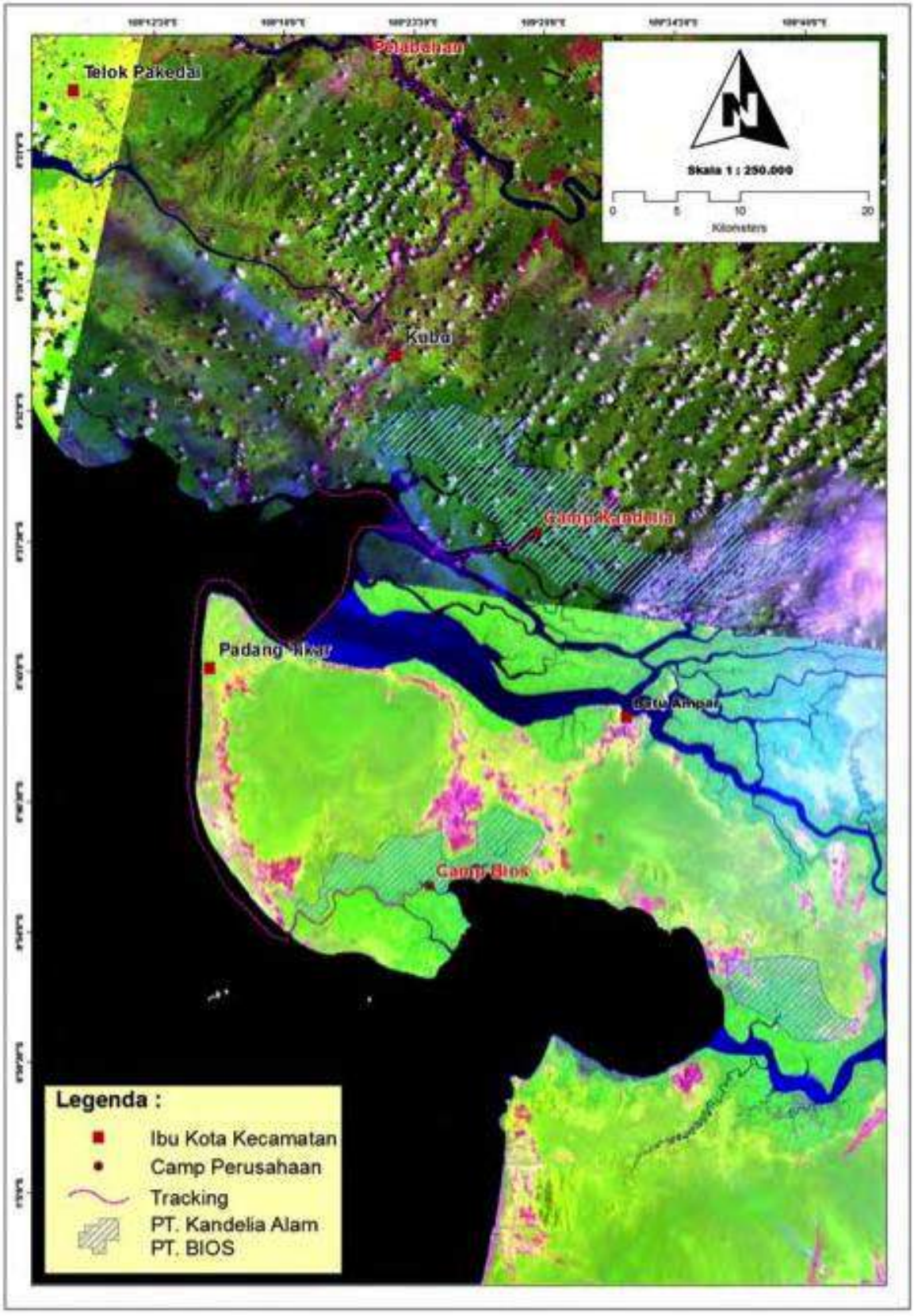
APPENDIX B: FIGURES AND TREND ANALYSES

Figure 1.1. Mangrove distribution in Borneo[3]



[3] MacKinnon, K., G. Hatta, H. Halim and A. Mangalik (1996). The Ecology of Kalimantan, Periplus Editions (HK) Ltd.

Figure 1.2. PT. Kandelia Alam's and PT. BIOS' concession areas



Alokasi Lahan untuk Program *Food Estate*

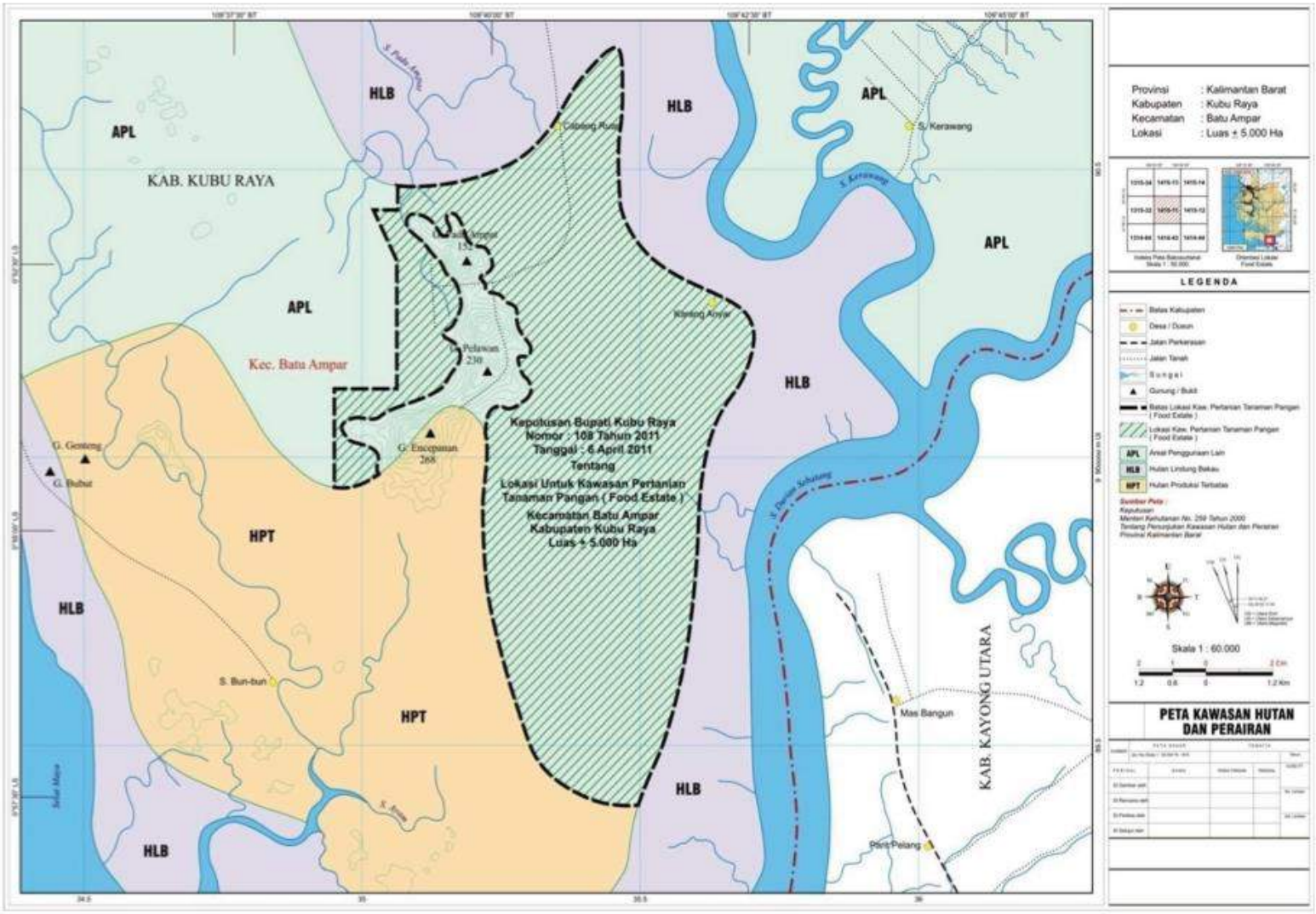


Figure 1.5. The settlement conditions in Kubu

Photograph: Woro Yuniati

Figure 1.6. The settlement condition in Teluk Nangka

Photographs : Woro Yuniati

Figure 1.7. Mangrove resource uses by local community: charcoal (top left), firewood for coconut sugar making (top right), firewood for household (bottom left), and fishing habitat (bottom right).

Photographs : Woro Yuniati (charcoal, sugar making, *Rhizophora* sp. for household fuelwood) Aseanty Pahlevi (fishing) accessed on August 4, 2015 from http://www.mongabay.co.id/ 2014/10/30/bakau-penjaga-bibir-pantai-kubu-yang-terancam/

Figure 1. 8. The production cycle of mangrove charcoal in Batu Ampar (see clockwise from top left picture)

Photographs: Woro Yuniati

Figure 1.9. Coconut sugar making process

Photographs: Woro Yuniati

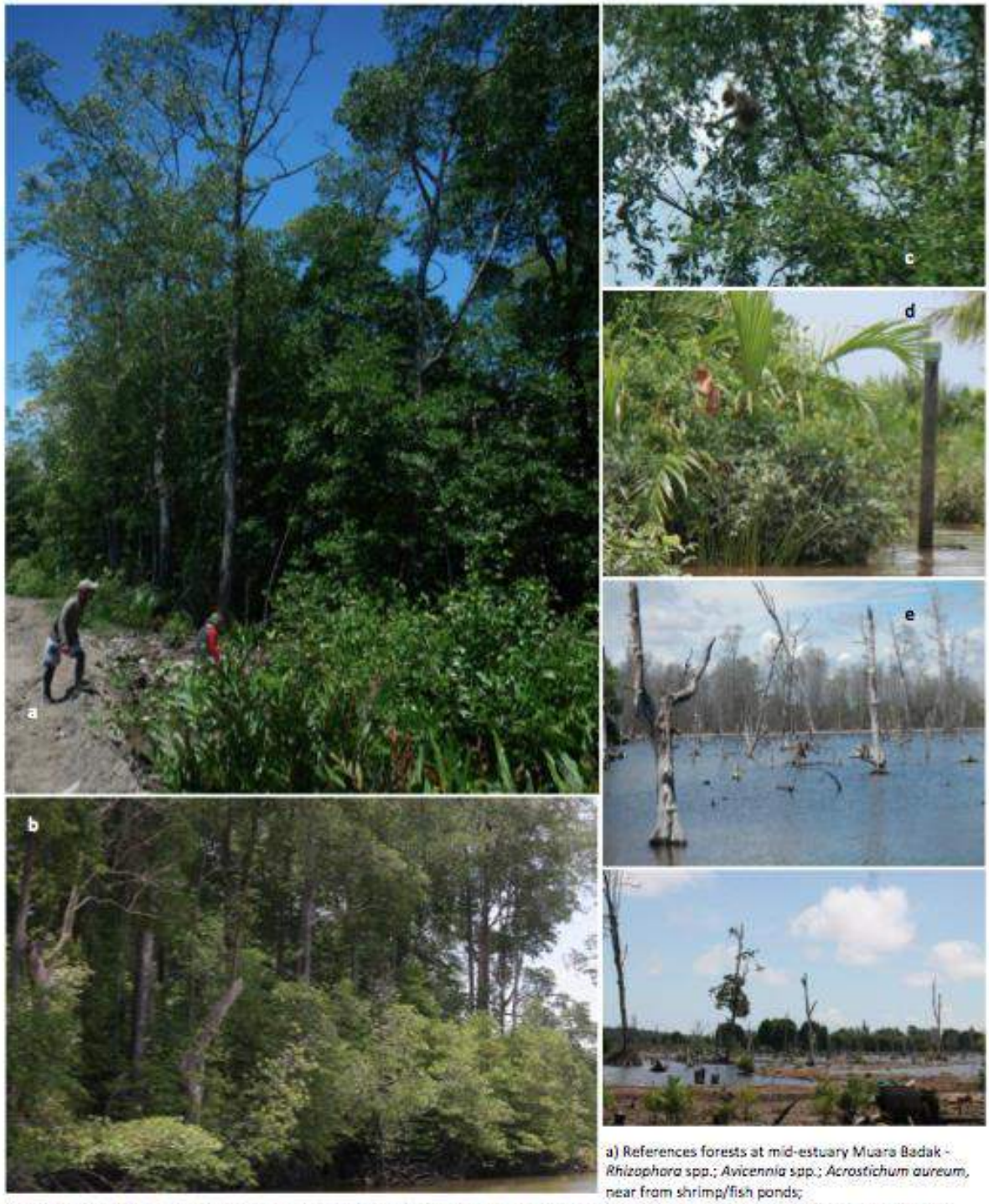
Figure 1. 10. The oil palm estate which is in close proximity to community's settlement and mangrove forest (The estate was used to be forest and the hill is adjacent to mangrove forest)

Photographs : Woro Yuniati

Figure 2.2. Proses Konversi Mangrove Menjadi Tambak[4]

[4] Jim Davie, et all, 2012, Concept Note Environmental Rehabilitation Supporting the Low Carbon, Regional Economic Recovery of the Mahakam Delta, East Kalimantan

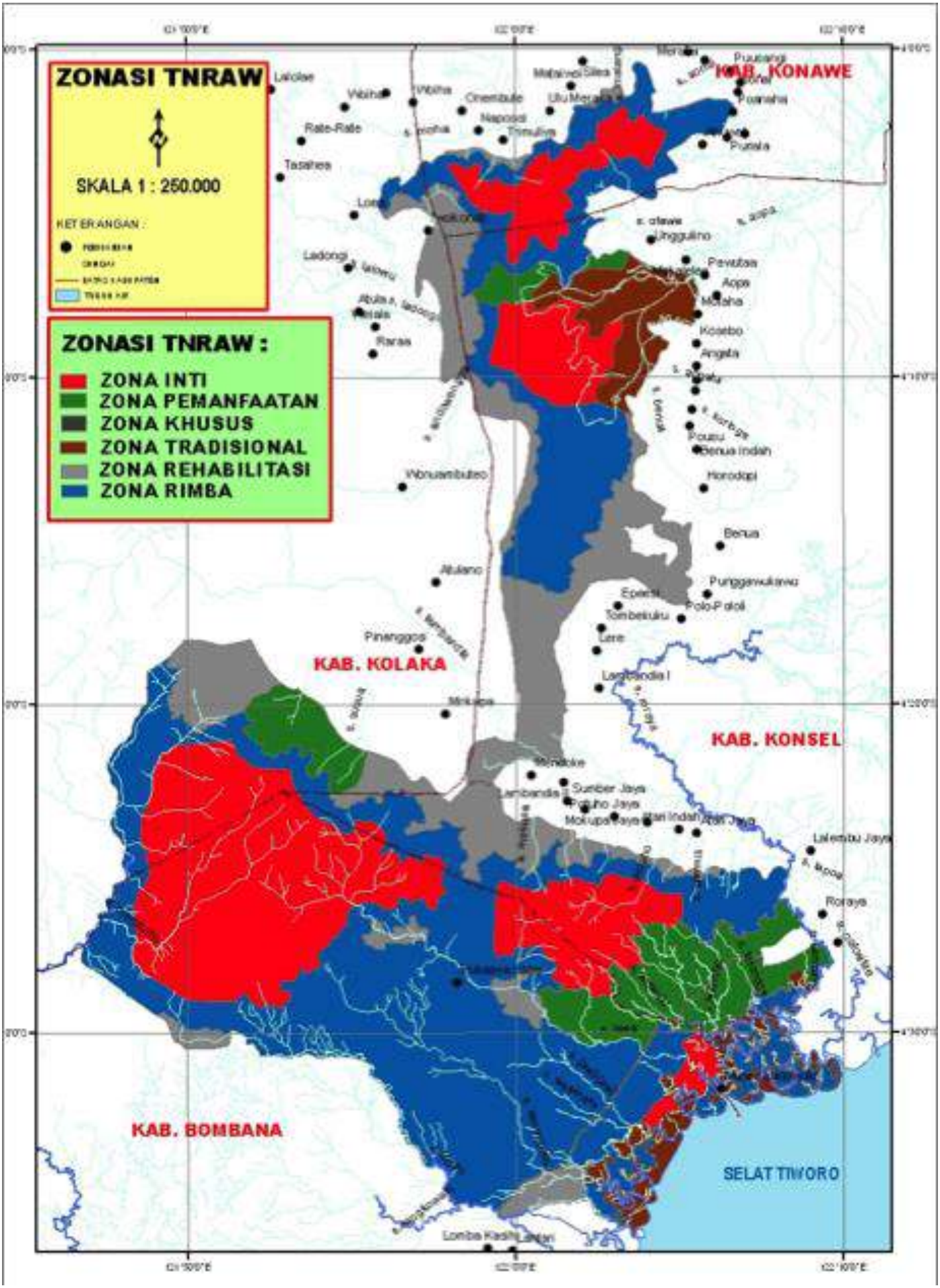
Figure 2.3 Condition of Mangrove Ecosystem in Mahakam Delta



a) References forests at mid-estuary Muara Badak - *Rhizophora* spp.; *Avicennia* spp.; *Acrostichum aureum*, near from shrimp/fish ponds;
b) References forests at lower-estuary – Pulau Selete; c & d) Bekantan - Nasalis larvatus; endemic spesies Mahakam Delta; e&f) condition of ponds

Figure 2.4. Chronoserre – natural recruitment on abandoned shrimp/fish ponds

Natural secondary succession on the abandoned pond (Muara Pantuan)


ZONASI TNRAW
SKALA 1 : 250.000
KETERANGAN :
ZONASI TNRAW :
ZONA INTI
ZONA PEMANFAATAN
ZONA KHUSUS
ZONA TRADISIONAL
ZONA REHABILITASI
ZONA RIMBA
KAB. KONAWE
KAB. KOLAKA
KAB. KONSEL
KAB. BOMBANA
SELAT TIWORO

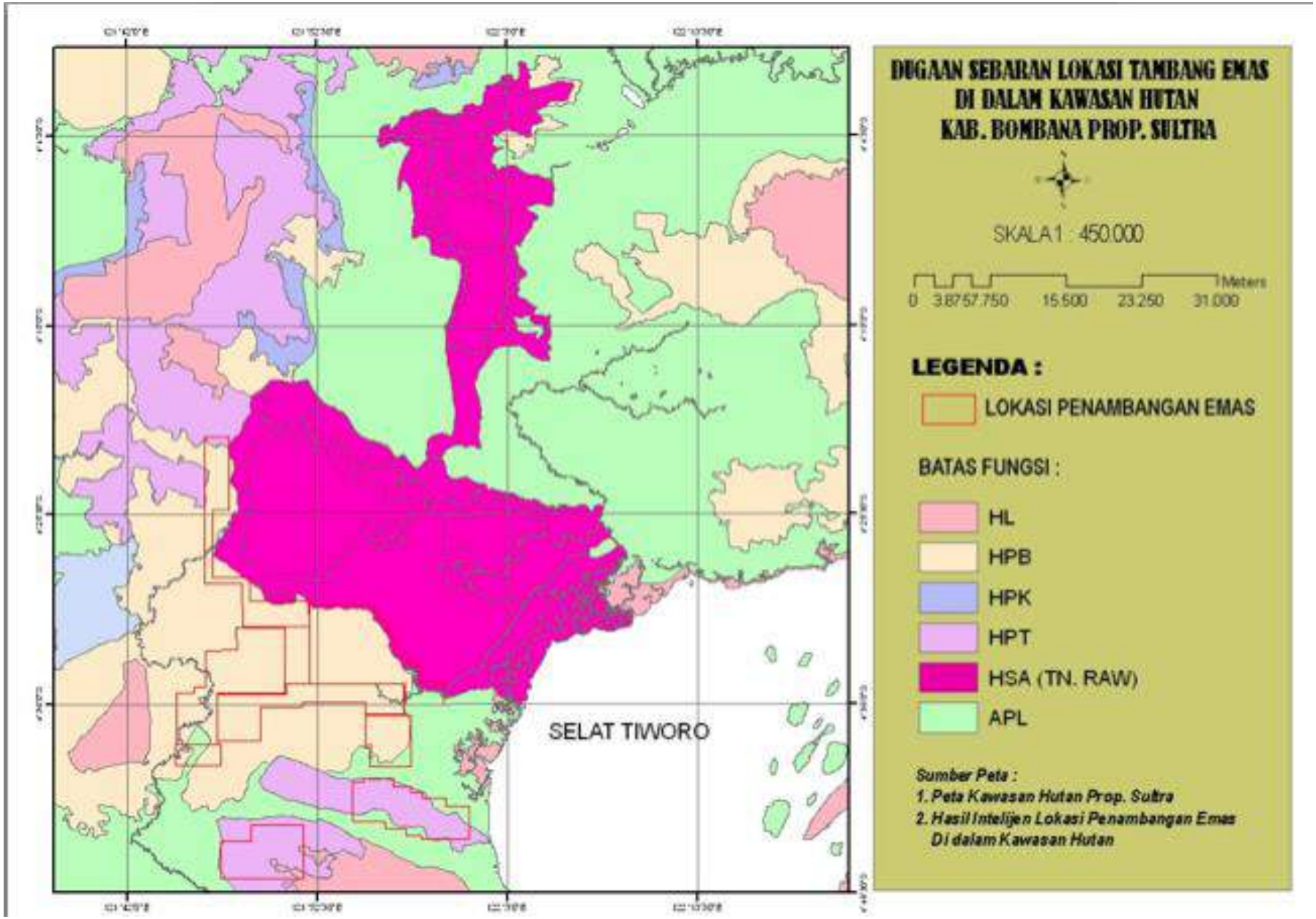

DUGAAN SEBARAN LOKASI TAMBANG EMAS
DI DALAM KAWASAN HUTAN
KAB. BOMBANA PROP. SULTRA
SKALA 1 : 450.000
Meters
0 3.8757.750 15.500 23.250 31.000
LEGENDA :
LOKASI PENAMBANGAN EMAS
BATAS FUNGSI :
HL
HPB
HPK
HPT
HSA (TN. RAW)
APL
Sumber Peta :
1. Peta Kawasan Hutan Prop. Sultra
2. Hasil Intelijen Lokasi Penambangan Emas
Di dalam Kawasan Hutan
SELAT TIWORO

Figure 3.11

Figure 3.2. Condition of Mangrove Ecosystem in Rawa Aopa National Park

Rhizophora spp.

Lumnitzeraracemosa

Sonneratiaalba

Figure 3.3. Natural recruitment

Figure 3.4. Secondary Successions on the mangrove forests

Figure 3.5. Natural recruitments of *Lumnitsera racemosa* on the well draining area.

Figure 3.6

Figure 3.7. Sedimentation area and Delta

Figure 3.8. Shrimp/Fishpond in the buffer zone of TNRAW

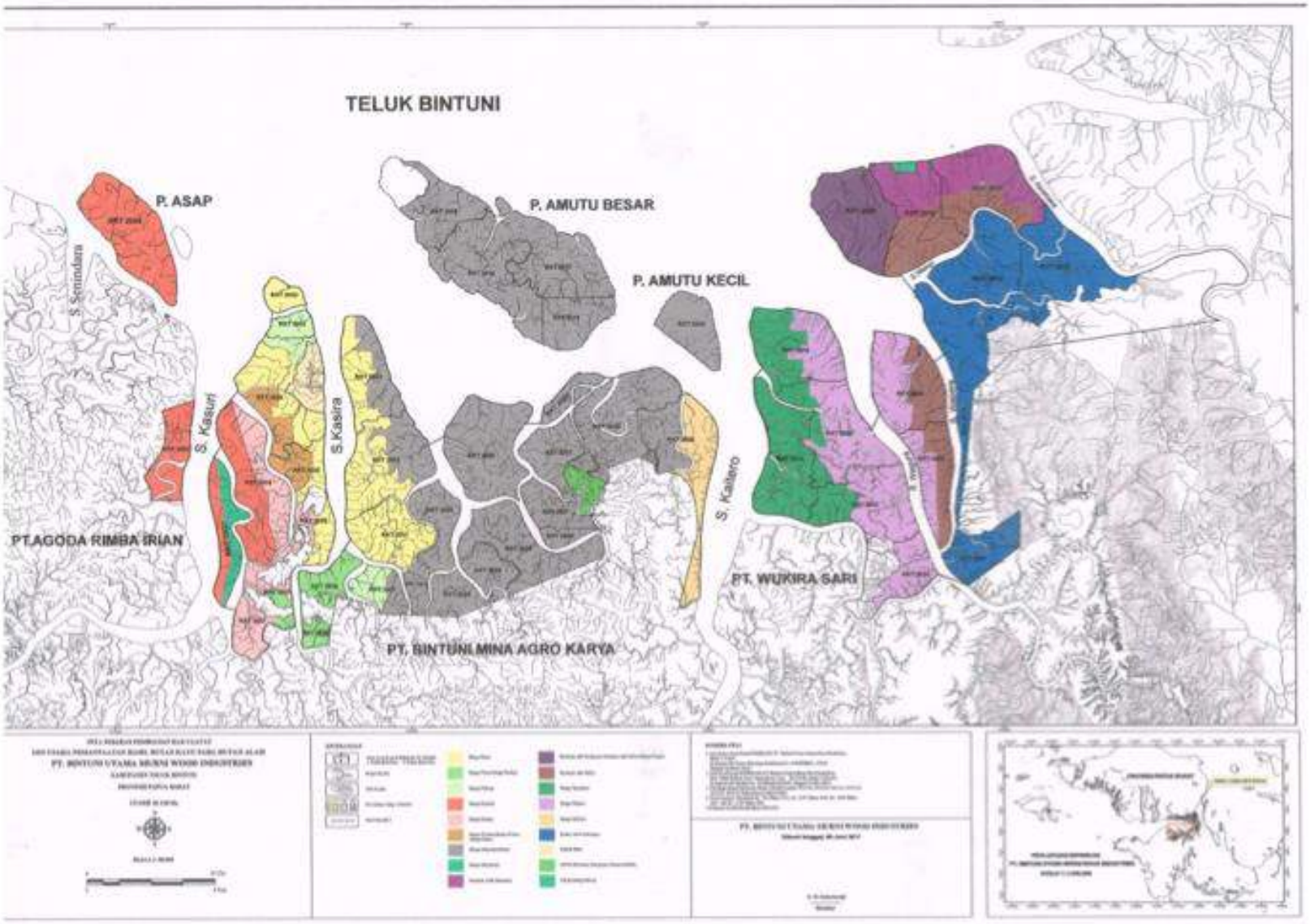
Figure 3.9.

Figure 3.10

Figure. 4.1 Nypa fruticans community

Figure. 4.2 The clear boundary of lowland forest and mangroves

Figure. 4.3 The 1990s log area, the trees growth with the 'branching' trunk.


TELUK BINTUNI
P. ASAP
P. AMUTU BESAR
P. AMUTU KECIL
S. Semudara
S. Kasuri
S.Kasira
S. Kaitaro
PT.AGODA RIMBA IRIAN
PT. BINTUNI MINA AGRO KARYA
PT. WUKIRA SARI

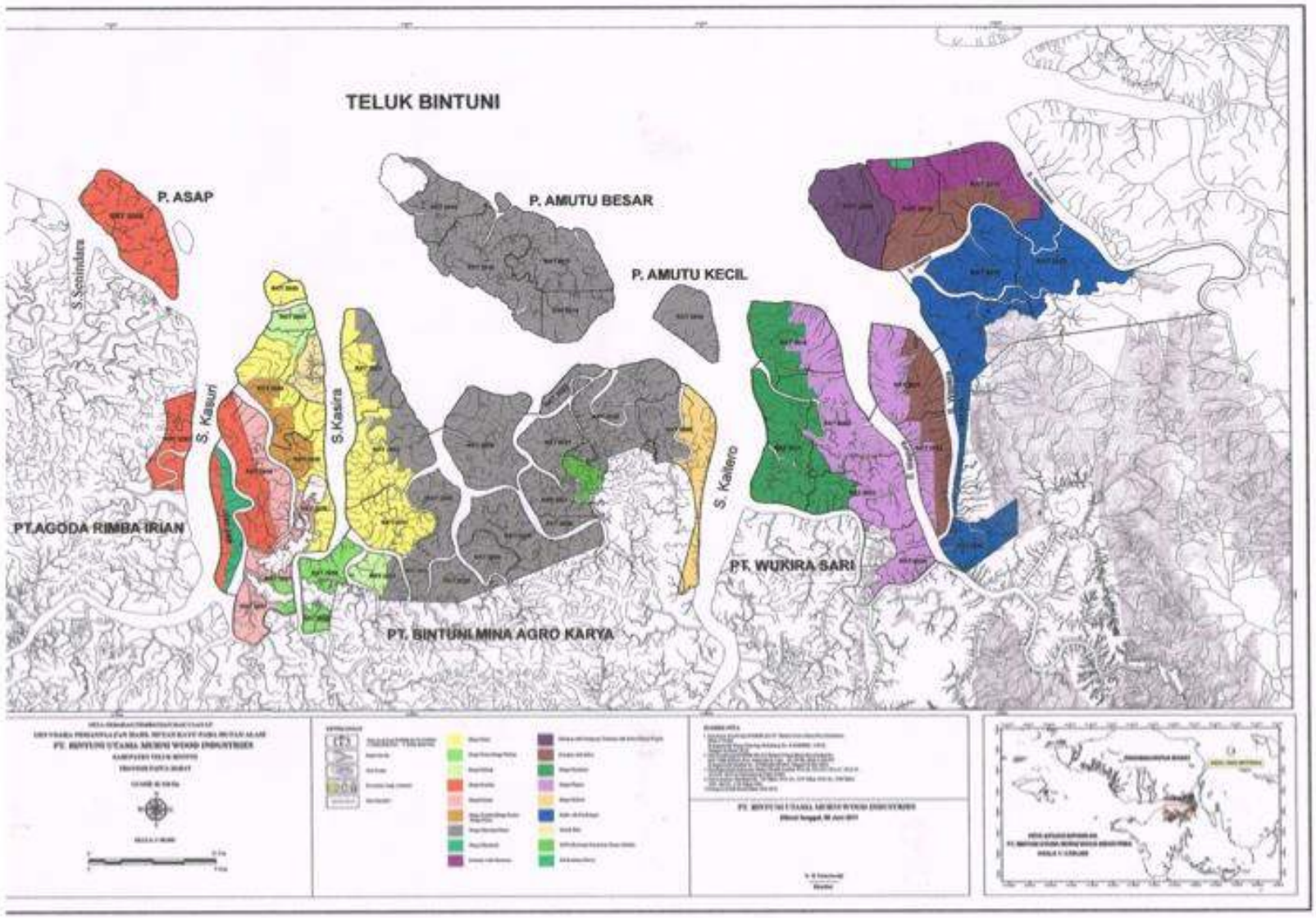

TELUK BINTUNI
P. ASAP
P. AMUTU BESAR
P. AMUTU KECIL
S. Senindura
S. Kasuri
S. Kasira
S. Kaitero
PT.AGODA RIMBA IRIAN
PT. BINTUNLMINA AGRO KARYA
PT. WUKIRA SARI

Figure. 4.4 Peta persebaran hak ulayat

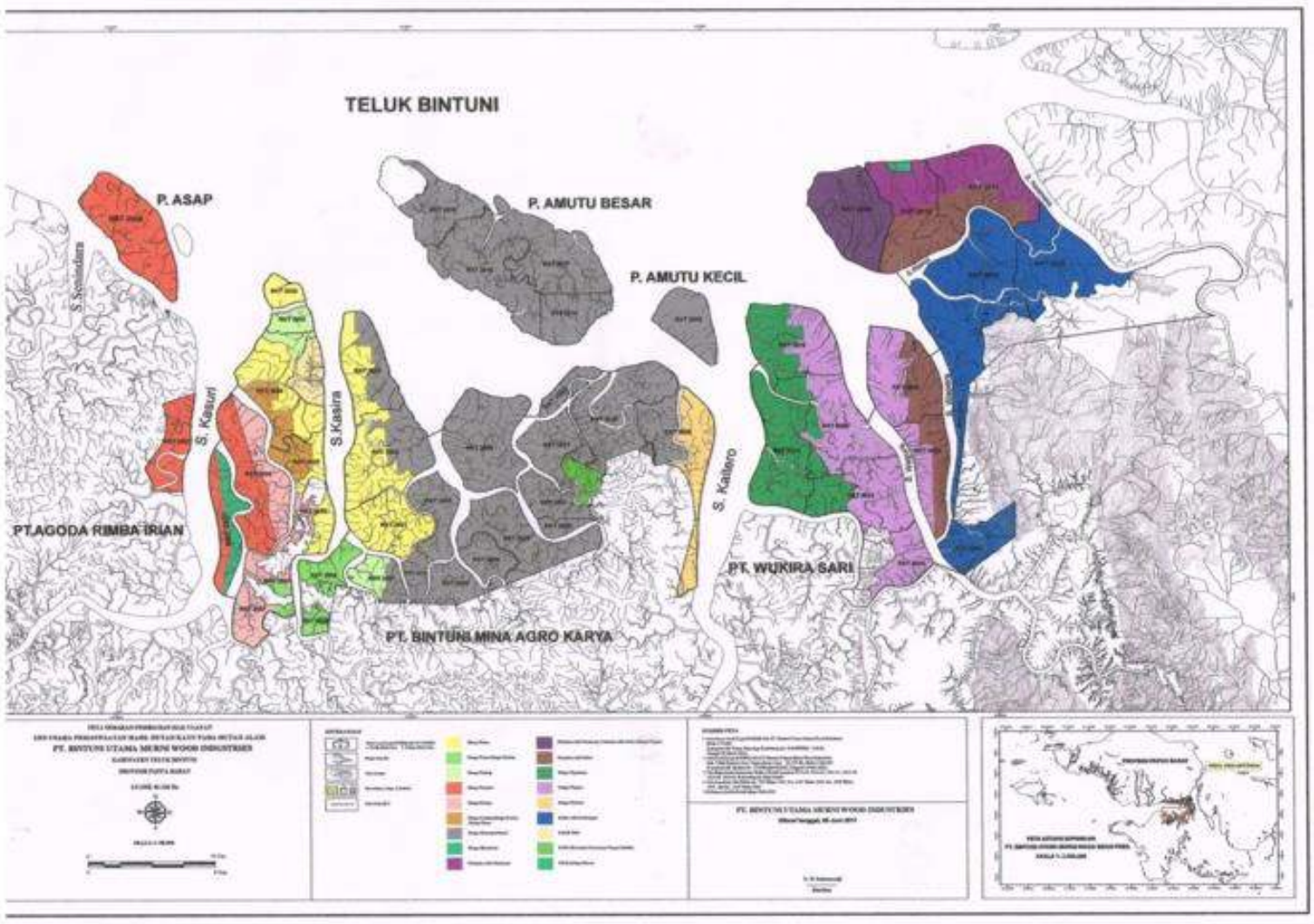
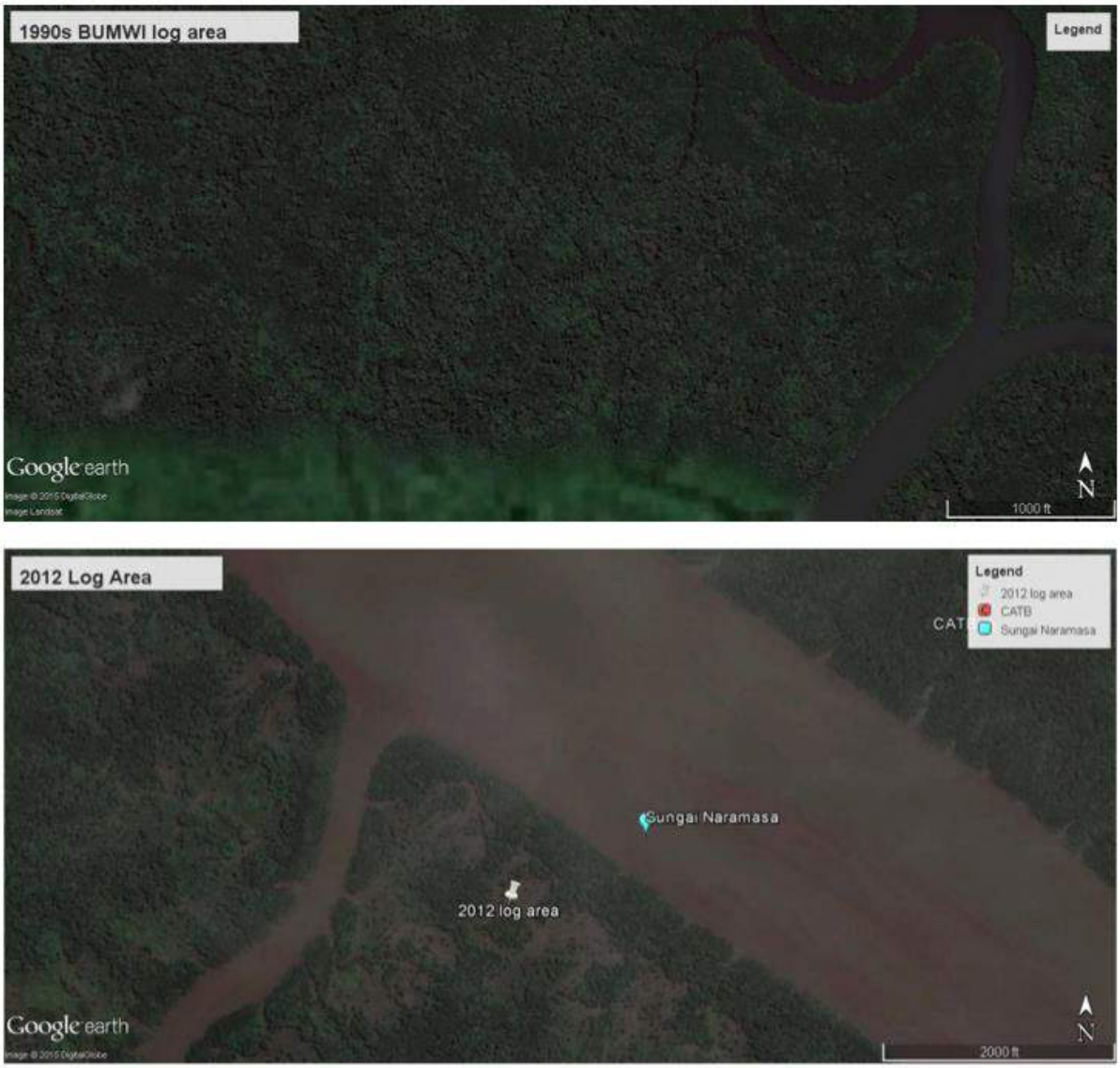


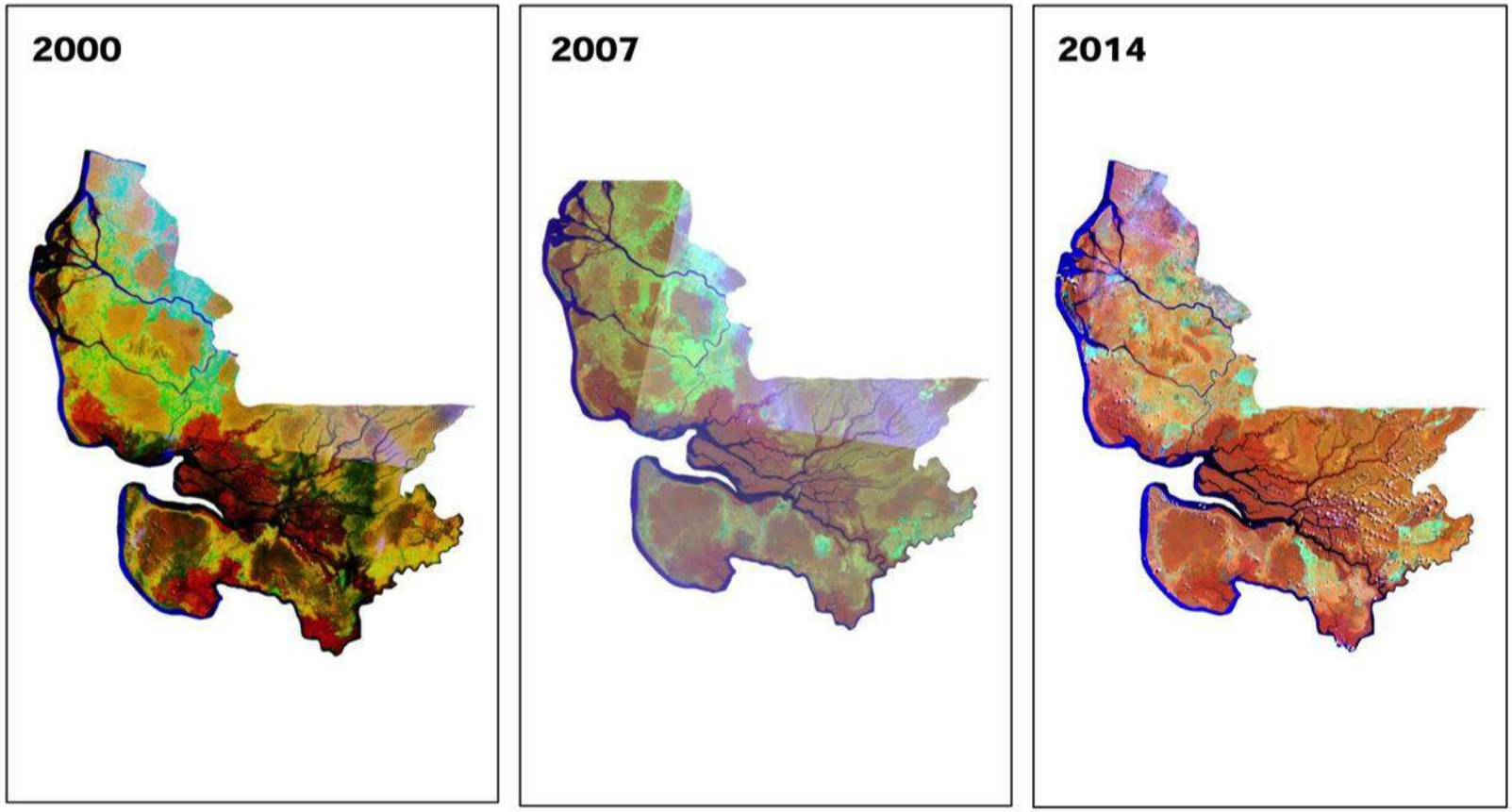
Figure. 4.5 Pencari Karaka

Figure. 4.6 Perbandingan area penebangan PT.BUMWI. (Foto diambil dari Google Earth dengan imagery date tahun 2014)



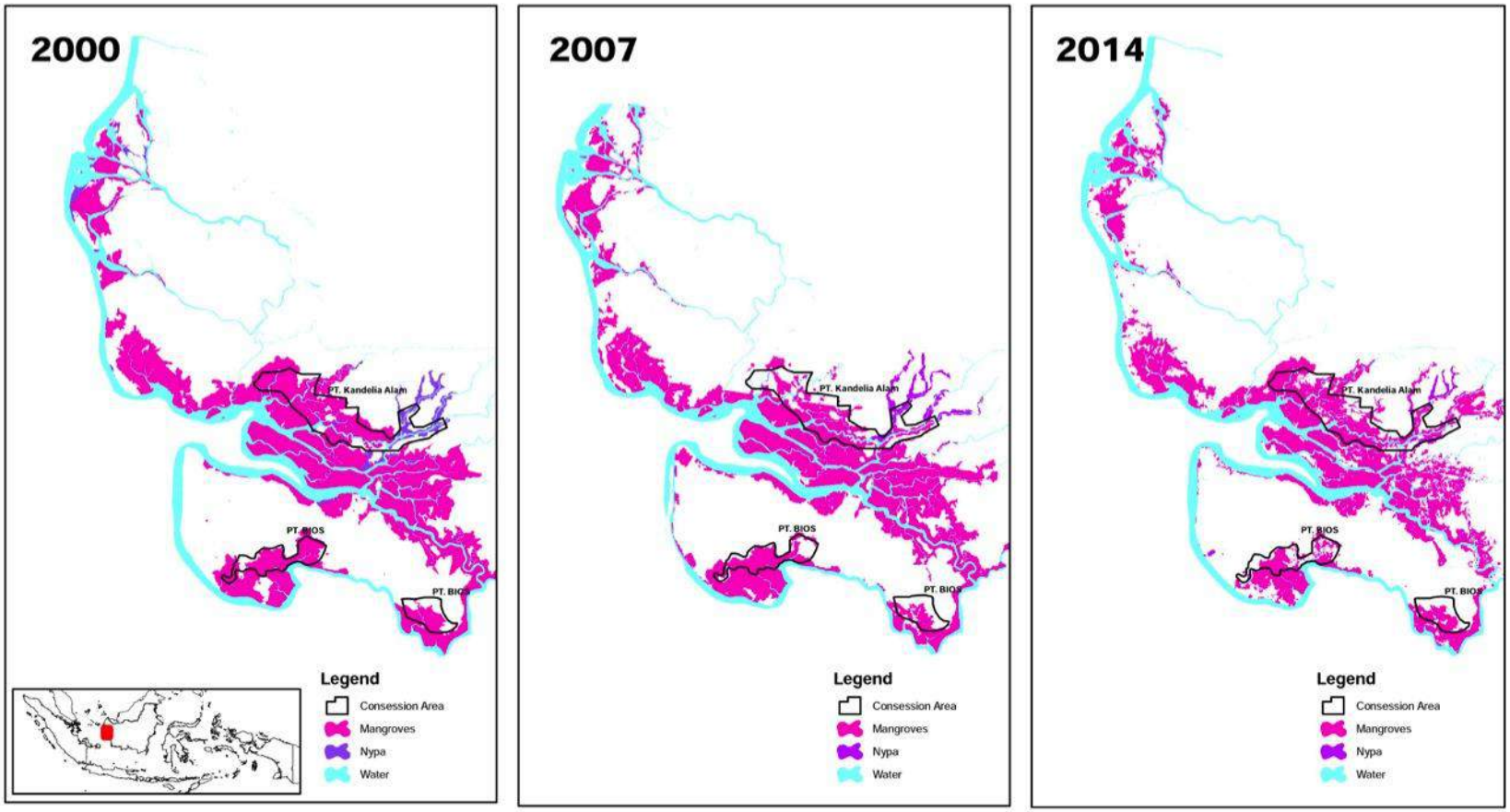
Satellite Imagery of Kubu Raya District, West Kalimantan 2000 - 2014

Indonesian Mangrove Conservation Public-Private Partnership Assessment



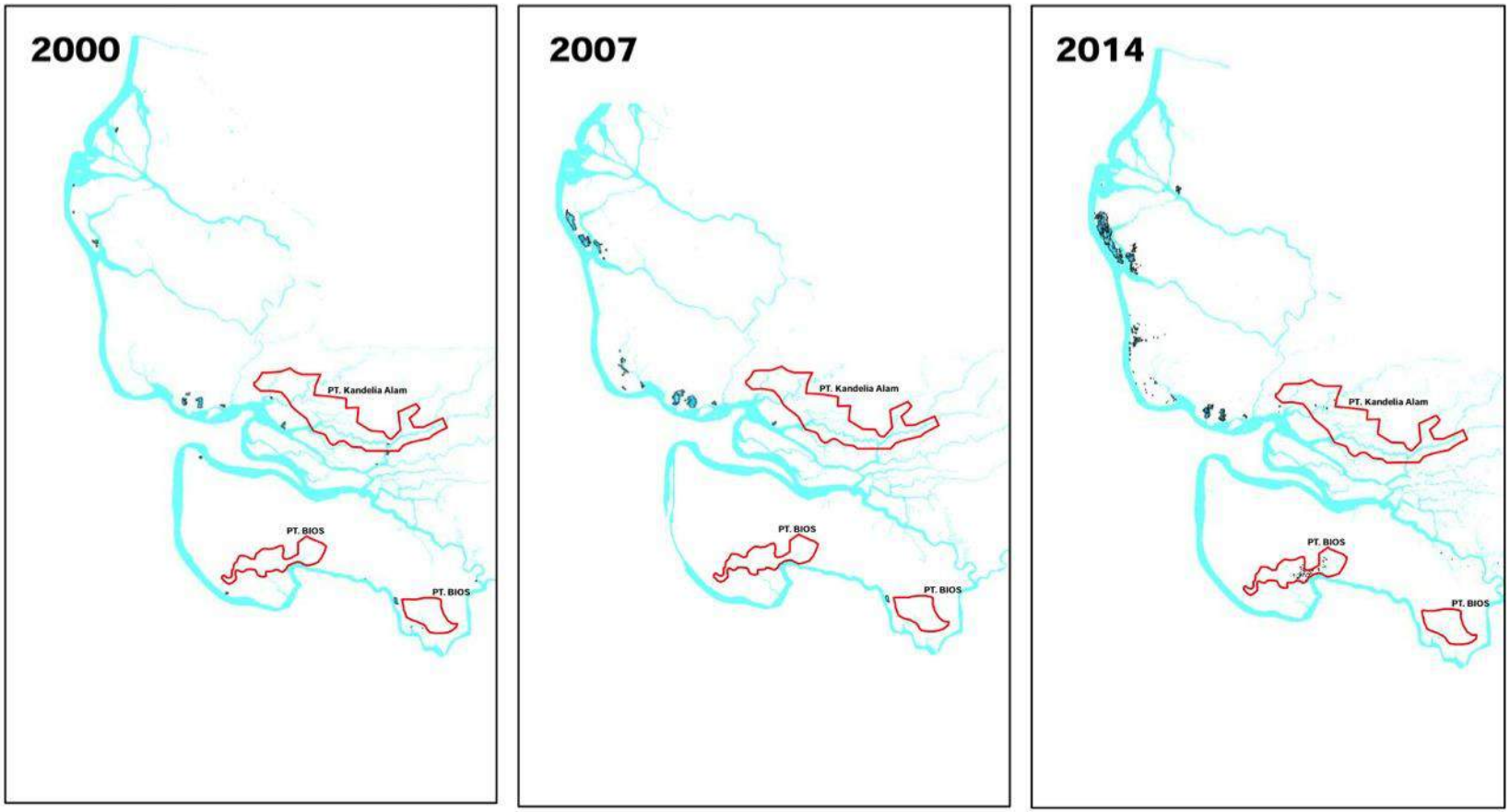
Change Cover of Mangroves in Consession Area, West Kalimantan 2000 - 2014

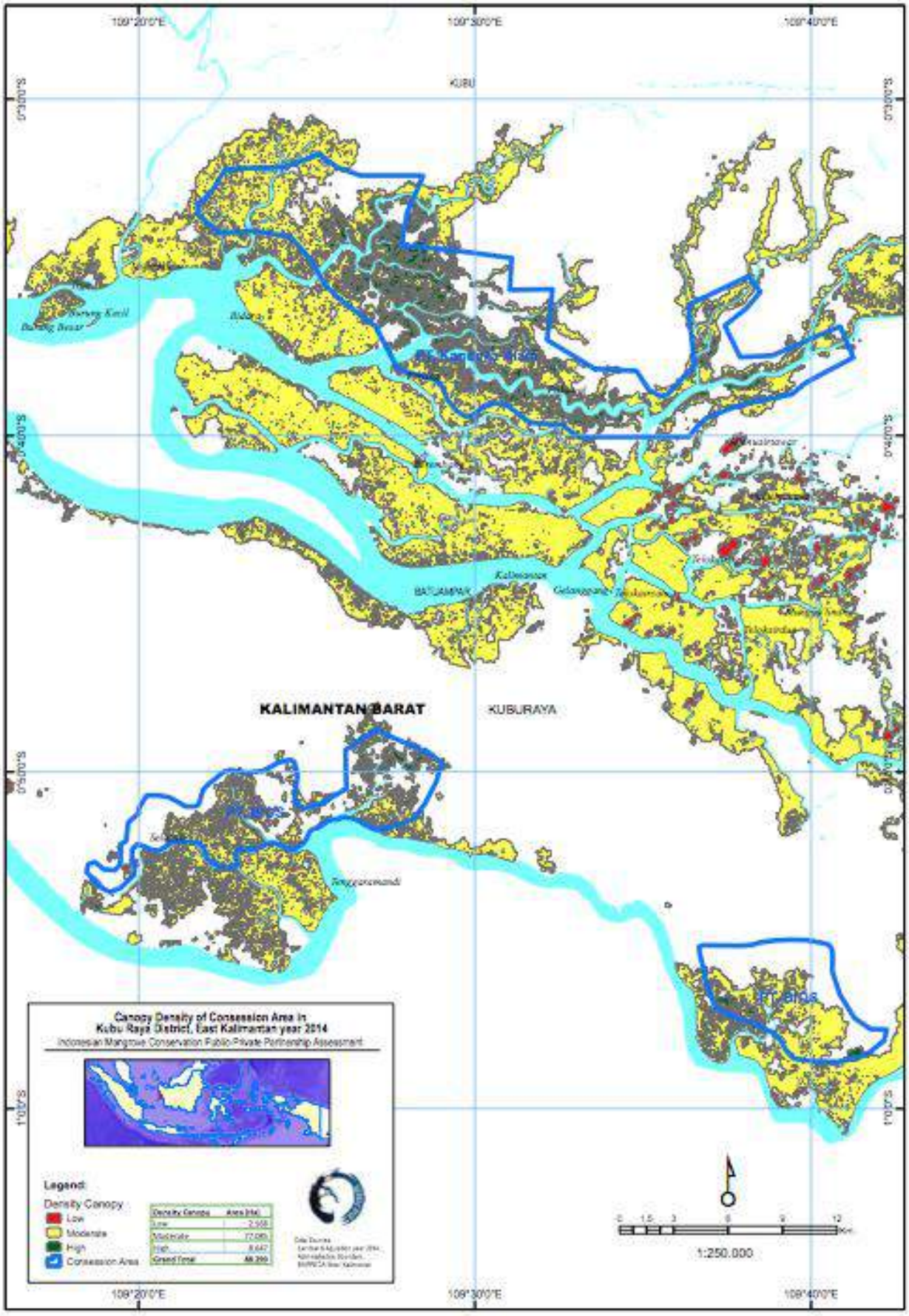
Indonesian Mangrove Conservation Public-Private Partnership Assessment

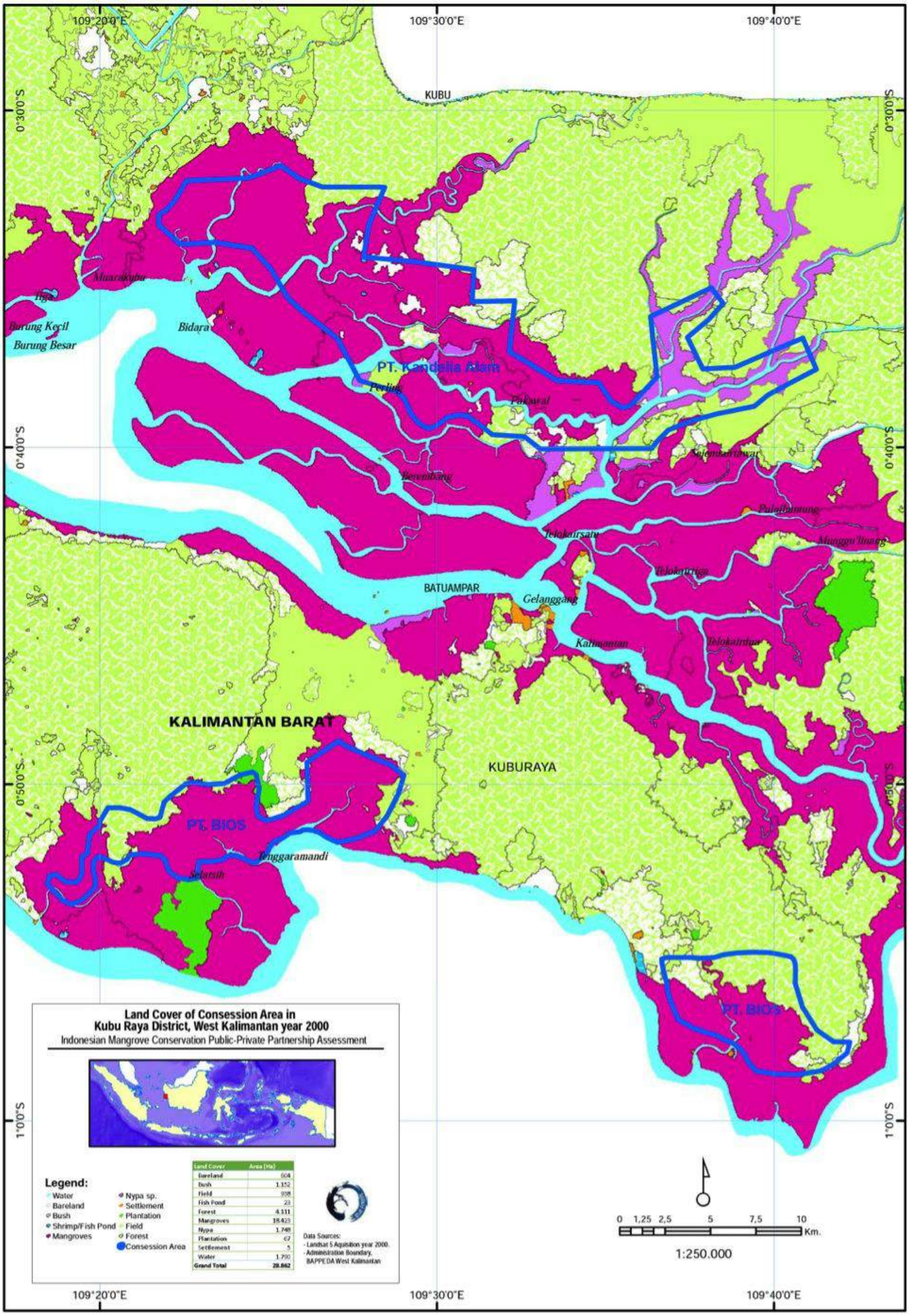


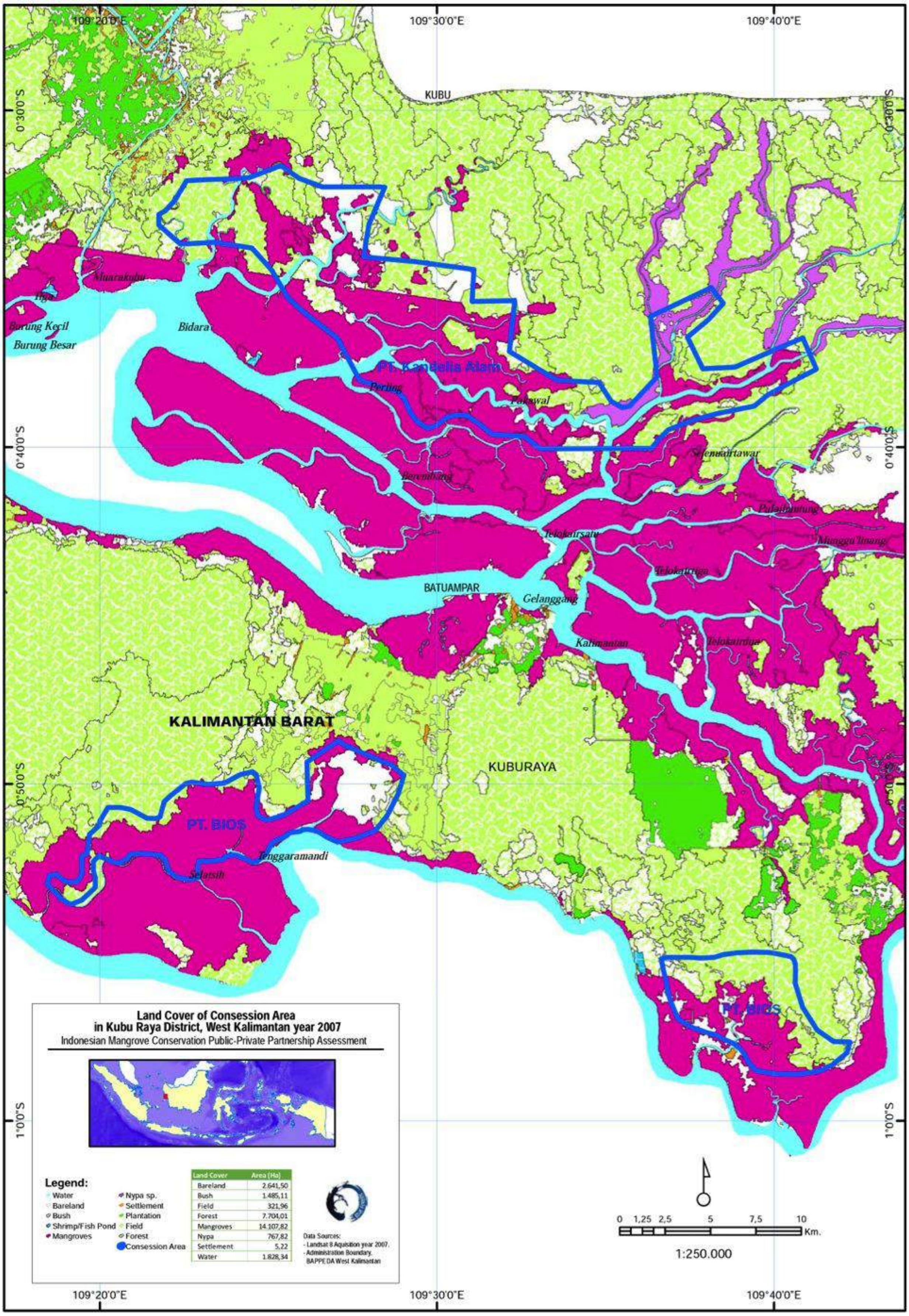
Change Cover of Shrimp/Fish Pond in Consession Area, West Kalimantan 2000 - 2014

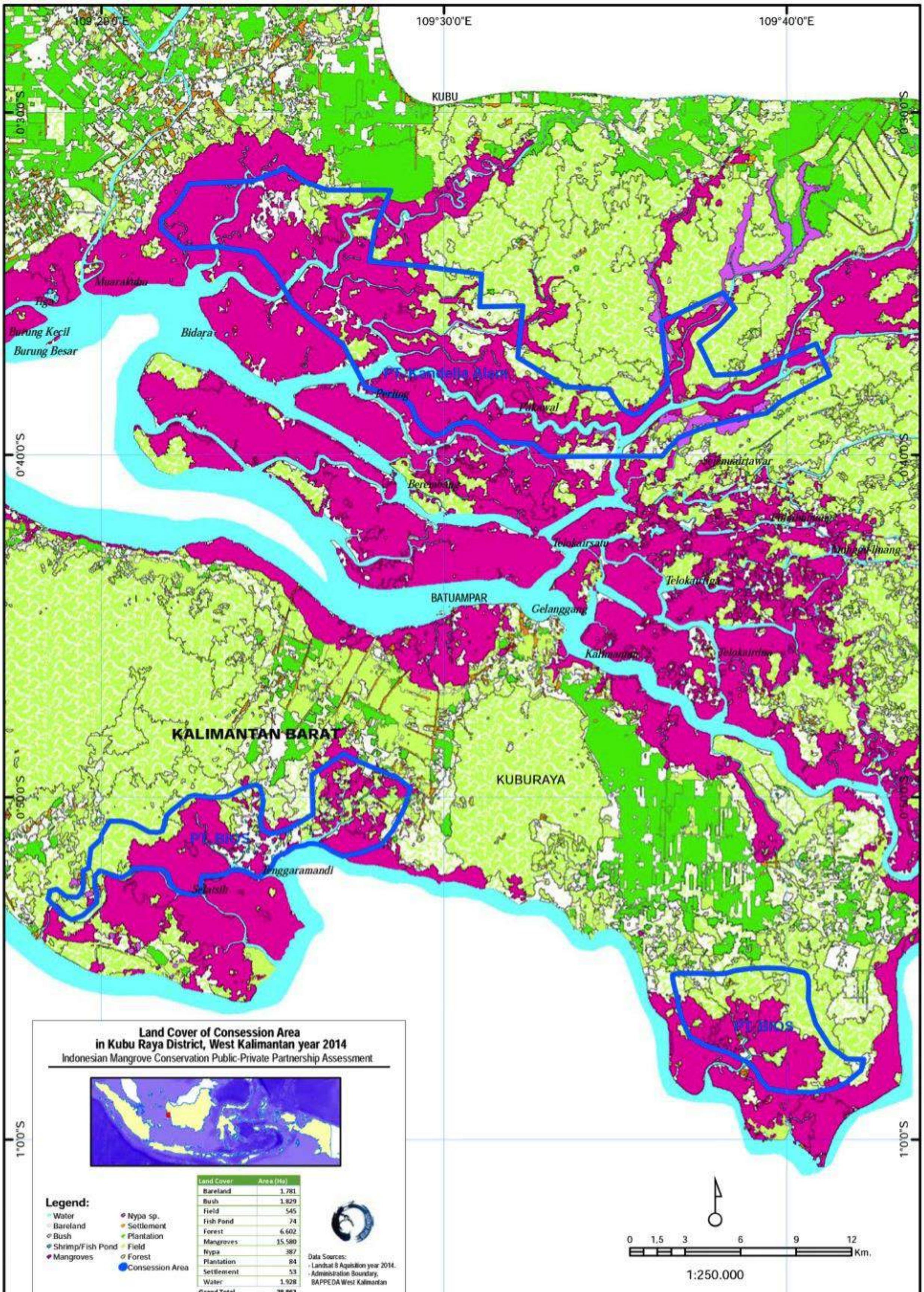
Indonesian Mangrove Conservation Public-Private Partnership Assessment




KUBU
KALIMANTAN BARAT
KUBURAYA
BATUAMPAR
Canopy Density of Concession Area in
Kubu Raya District, East Kalimantan year 2014
Indonesian Mangrove Conservation Public-Private Partnership Assessment
Legend:
Density Canopy
Low
Moderate
High
Concession Area
1:250.000


109°20'0"E
109°30'0"E
109°40'0"E
0°30'0"S
0°40'0"S
0°50'0"S
1°0'0"S
KUBU
Muarakubu
Tiga
Burung Kecil
Burung Besar
Bidara
PT. Kandelia Alam
Perling
Paksaai
Seruat
Telokairsatu
Pulaubintang
Mungguilinang
Telokairtiga
BATUAMPAR
Gelanggang
Kalimantan
Telokairdua
KALIMANTAN BARAT
KUBURAYA
PT. BIOS
Tenggaramandi
Selarsih
PT. BIOS
Land Cover of Consession Area in
Kubu Raya District, West Kalimantan year 2000
Indonesian Mangrove Conservation Public-Private Partnership Assessment
Legend:
Water
Bareland
Bush
Shrimp/Fish Pond
Mangroves
Nypa sp.
Settlement
Plantation
Field
Forest
Consession Area
Land Cover | Area (Ha)
Bareland | 604
Bush | 1.152
Field | 938
Fish Pond | 23
Forest | 4.111
Mangroves | 18.423
Nypa | 1.748
Plantation | 67
Settlement | 5
Water | 1.790
Grand Total | 28.862
Data Sources:
- Landsat 5 Aquisition year 2000.
- Administration Boundary, BAPPEDA West Kalimantan
0 1,25 2,5 5 7,5 10 Km.
1:250.000


Land Cover of Consession Area
in Kubu Raya District, West Kalimantan year 2007
Indonesian Mangrove Conservation Public-Private Partnership Assessment
Legend:
Water
Bareland
Bush
Shrimp/Fish Pond
Mangroves
Nypa sp.
Settlement
Plantation
Field
Forest
Consession Area
Land Cover
Area (Ha)
Bareland 2.641,50
Bush 1.485,11
Field 321,96
Forest 7.704,01
Mangroves 14.107,82
Nypa 767,82
Settlement 5,22
Water 1.828,34
Data Sources:
- Landsat 8 Aquisition year 2007.
- Administration Boundary. BAPPEDA West Kalimantan
1:250.000
0 1,25 2,5 5 7,5 10 Km.
109°20'0"E
109°30'0"E
109°40'0"E
0°30'0"S
0°40'0"S
0°50'0"S
1°0'0"S
KUBU
Bidara
Burung Kecil
Burung Besar
PT. Kandelia Alam
BATUAMPAR
Gelanggang
Kalimantan
KALIMANTAN BARAT
KUBURAYA
PT. BIOS
Tenggaramandi
Selatsih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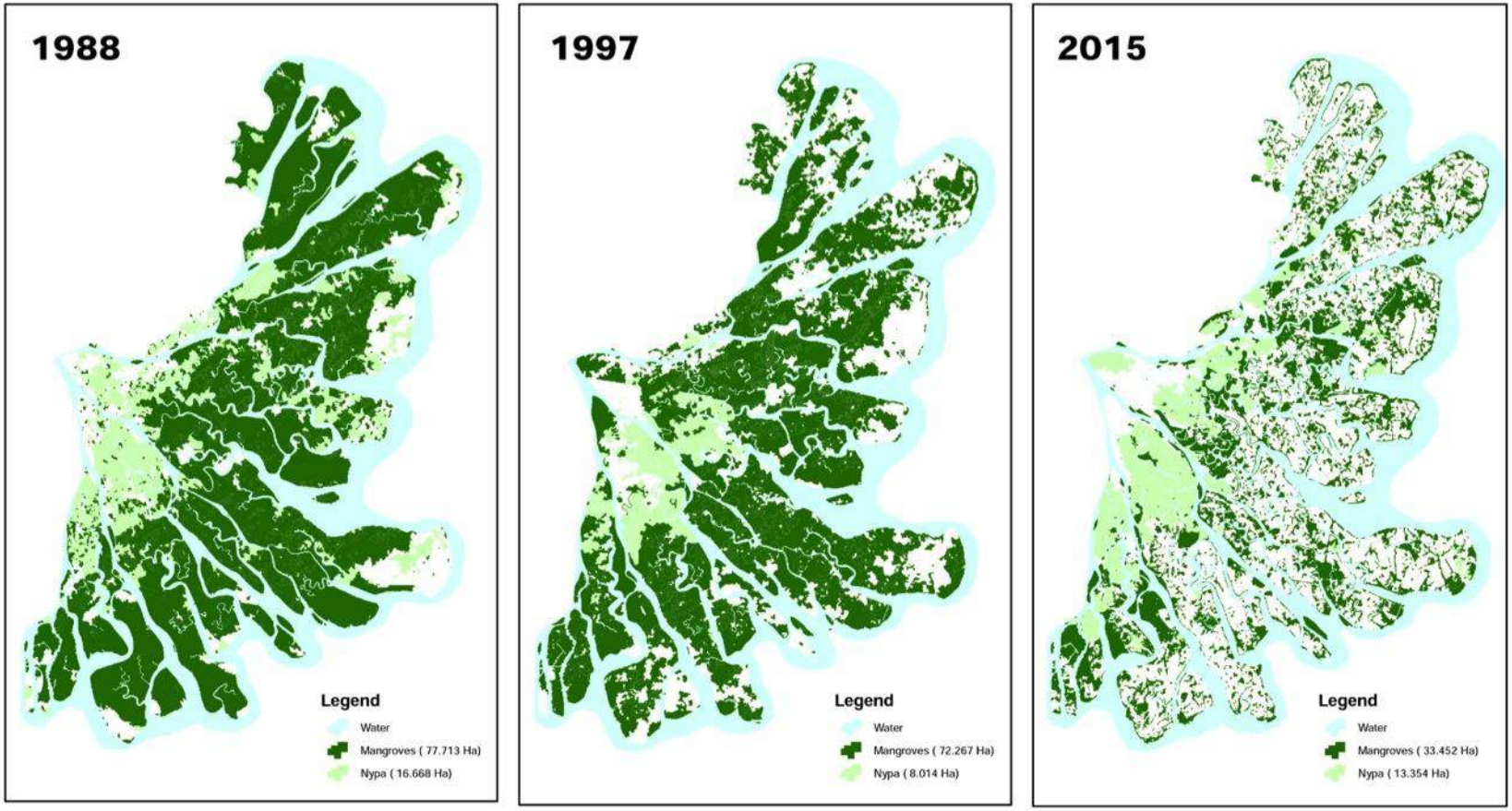
1°0'0"S
KUBU
Muarakubu
Burung Kecil
Burung Besar
Bidara
PT. Kandelia Alam
Periing
Pakawal
Sepandartawar
Teluk Nibung
Telokairsatu
Telokaringin
BATUAMPAR
Gelanggang
Kalimantan
Telokairdua
KALIMANTAN BARAT
KUBURAYA
PT. BIOS
Tanggaramandi
Selastih
Land Cover of Consession Area
in Kubu Raya District, West Kalimantan year 2014
Indonesian Mangrove Conservation Public-Private Partnership Assessment
Legend:
Water
Bareland
Bush
Shrimp/Fish Pond
Mangroves
Nypa sp.
Settlement
Plantation
Field
Forest
Consession Area
Land Cover | Area (Ha)
Bareland | 1.781
Bush | 1.829
Field | 545
Fish Pond | 74
Forest | 6.602
Mangroves | 15.580
Nypa | 387
Plantation | 84
Settlement | 53
Water | 1.928
Grand Total | 28.862
Data Sources:
- Landsat 8 Aquisition year 2014.
- Administration Boundary, BAPPEDA West Kalimantan
0 1.5 3 6 9 12 Km.
1:250.000

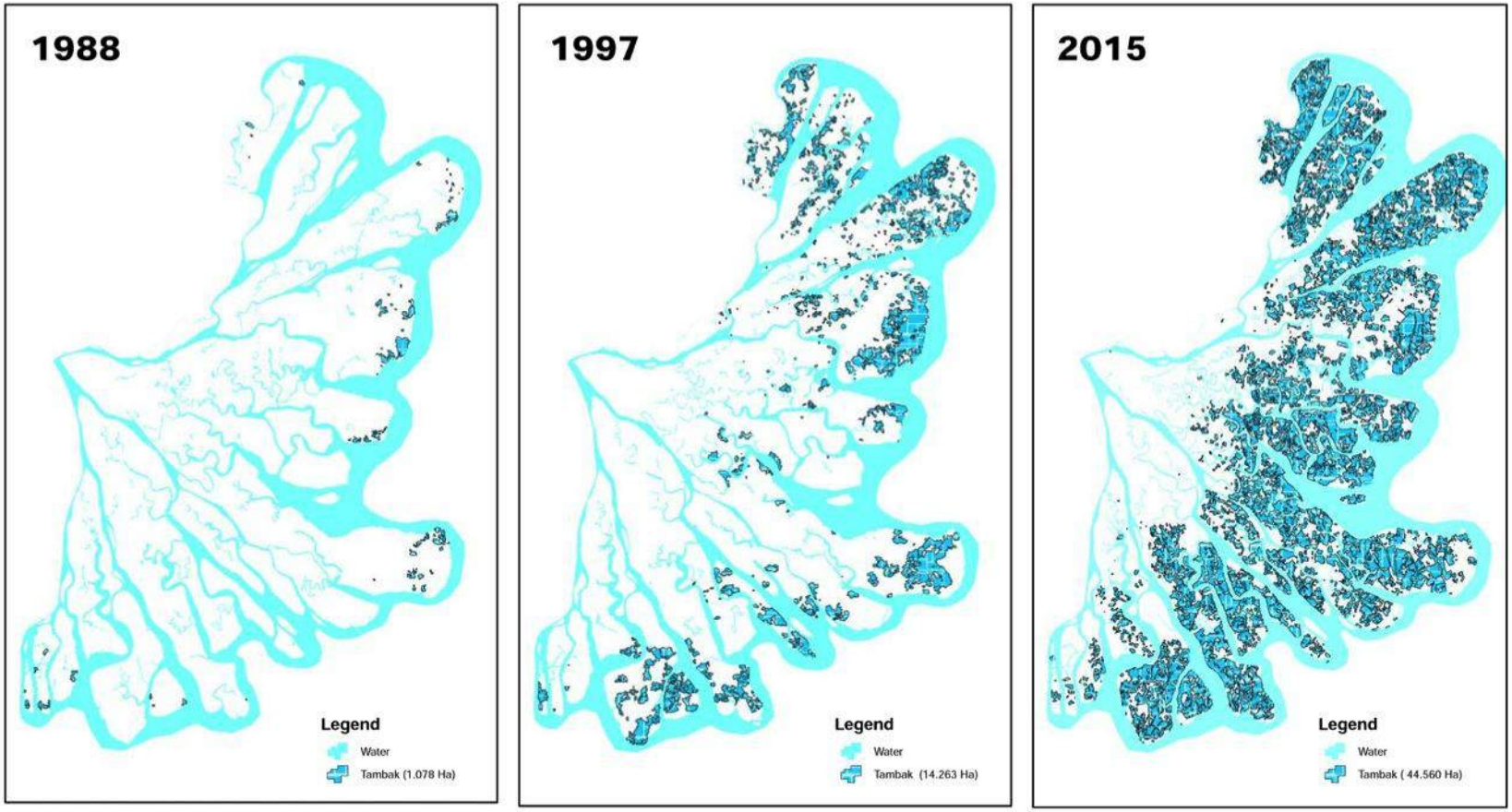
Change Cover of Mangroves in Mahakam Delta, East Kalimantan 1988 - 2015

Indonesian Mangrove Conservation Public-Private Partnership Assessment



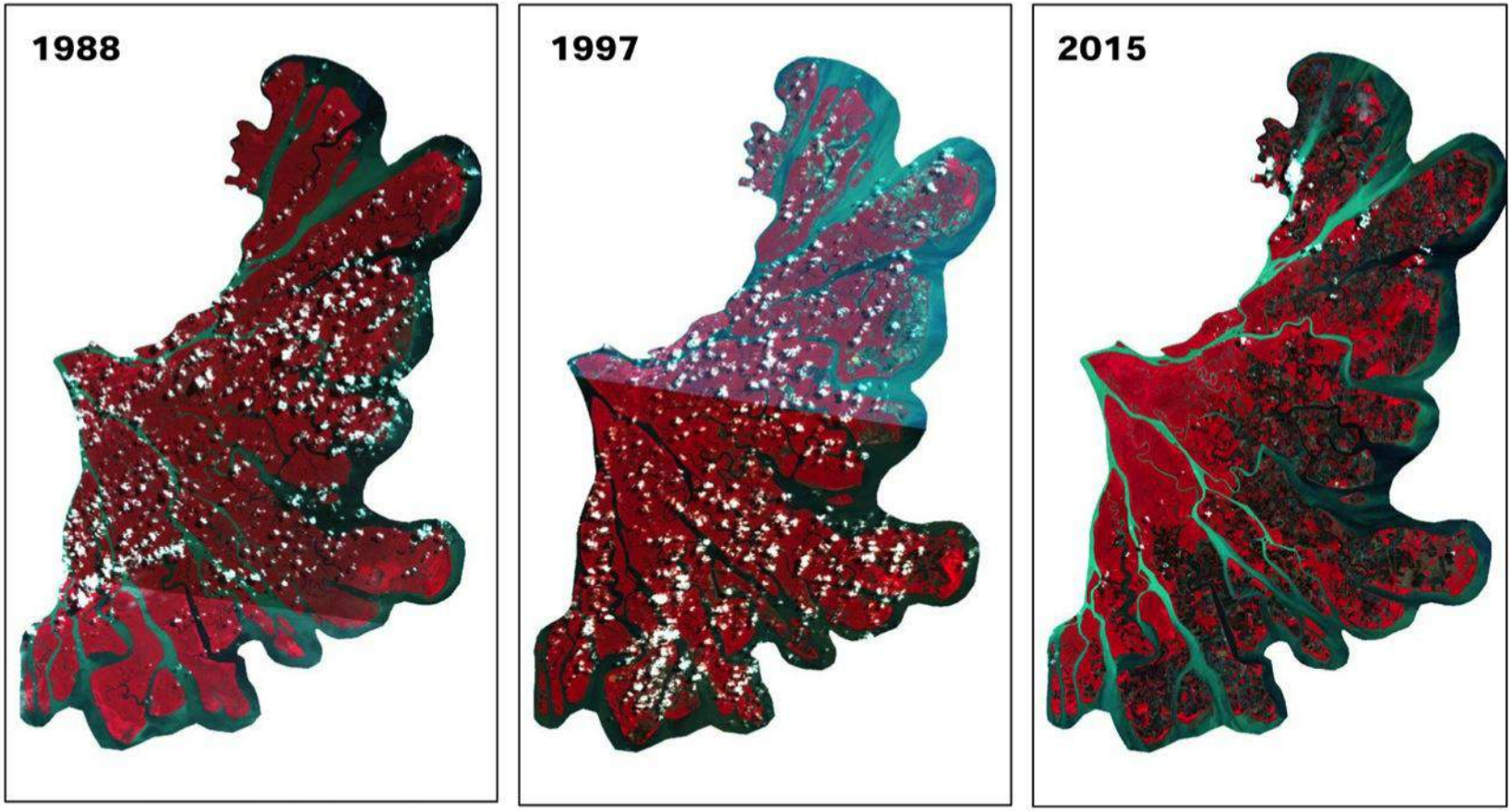
Change Cover of Tambak in Mahakam Delta, East Kalimantan 1988 - 2015

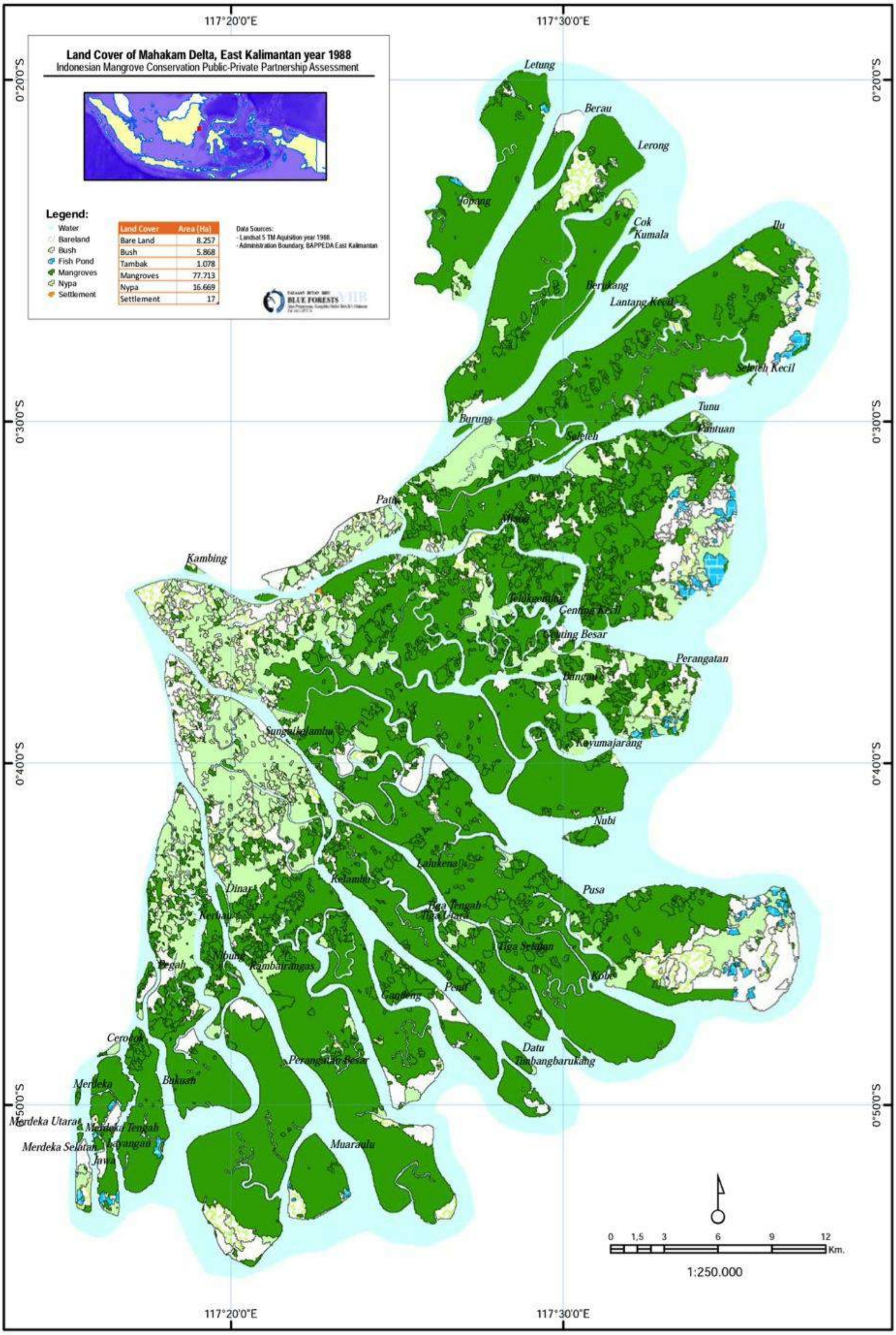
Indonesian Mangrove Conservation Public-Private Partnership Assessment



Satelite Imagery of Mahakam Delta, East Kalimantan 1988 - 2015

Indonesian Mangrove Conservation Public-Private Partnership Assessment




Land Cover of Mahakam Delta, East Kalimantan year 1988
Indonesian Mangrove Conservation Public-Private Partnership Assessment
Legend:
Water
Bareland
Bush
Fish Pond
Mangroves
Nypa
Settlement
Land Cover | Area (Ha)
Bare Land | 8.257
Bush | 5.868
Tambak | 1.078
Mangroves | 77.713
Nypa | 16.669
Settlement | 17
Data Sources:
- Landsat 5 TM Aquisition year 1988.
- Administration Boundary, BAPPEDA East Kalimantan
BLUE FORESTS
117°20'0"E
117°30'0"E
0°20'0"S
0°30'0"S
0°40'0"S
0°50'0"S
Letung
Berau
Lerong
Jopang
Cok Kumala
Ilu
Lantang Kecil
Seleteh Kecil
Burung
Tunu
Pantuan
Seleteh
Patin
Kambing
Perangatan
Kayumajarang
Nubi
Pusa
Dinar
Kelambu
Tiga Tengah
Tiga Utara
Tiga Selatan
Nibung
Rambairangas
Perangatan Besar
Datu
Bakuan
Merdeka
Merdeka Utara
Merdeka Tengah
Merdeka Selatan
Jawa
Muaraulu
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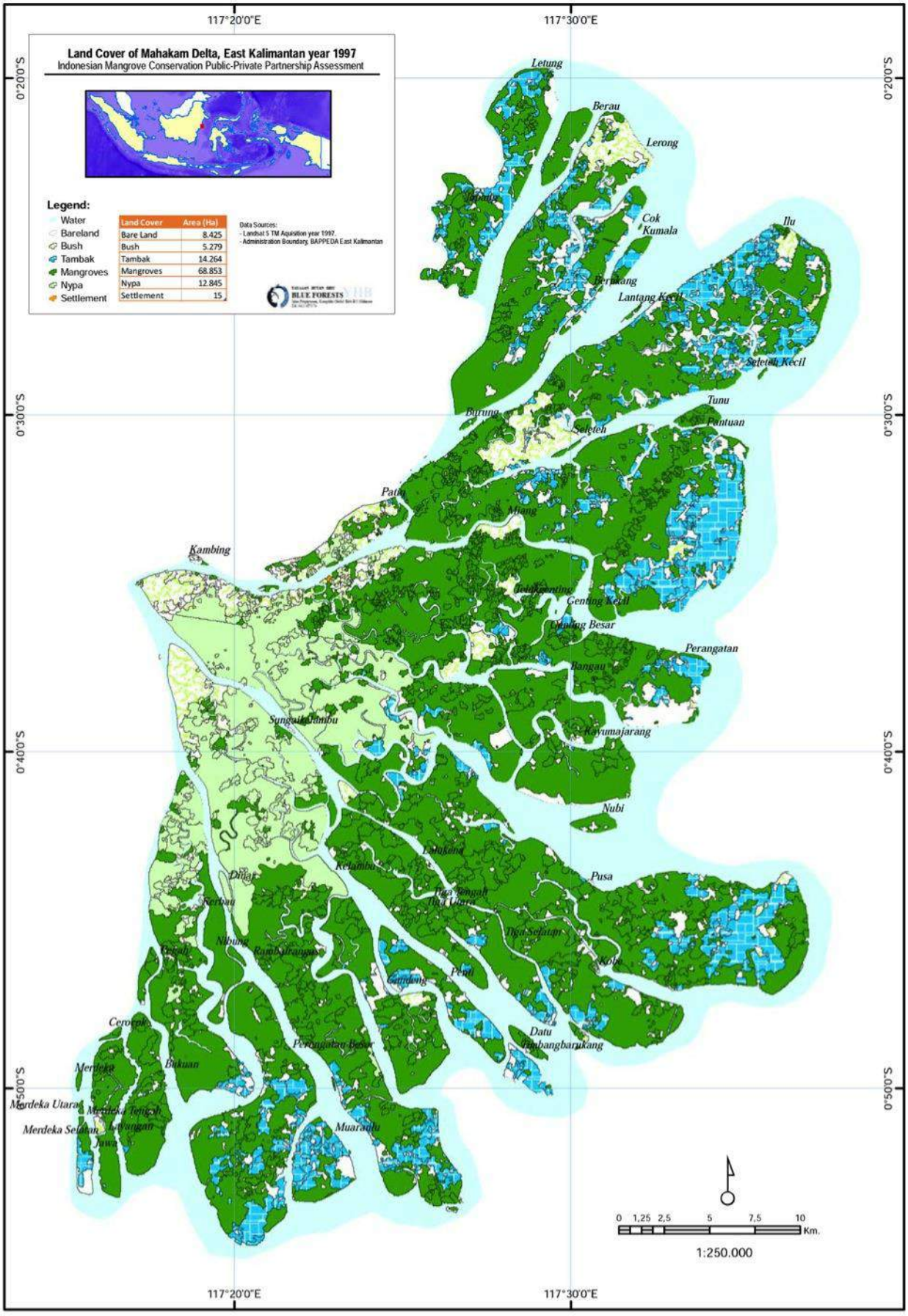
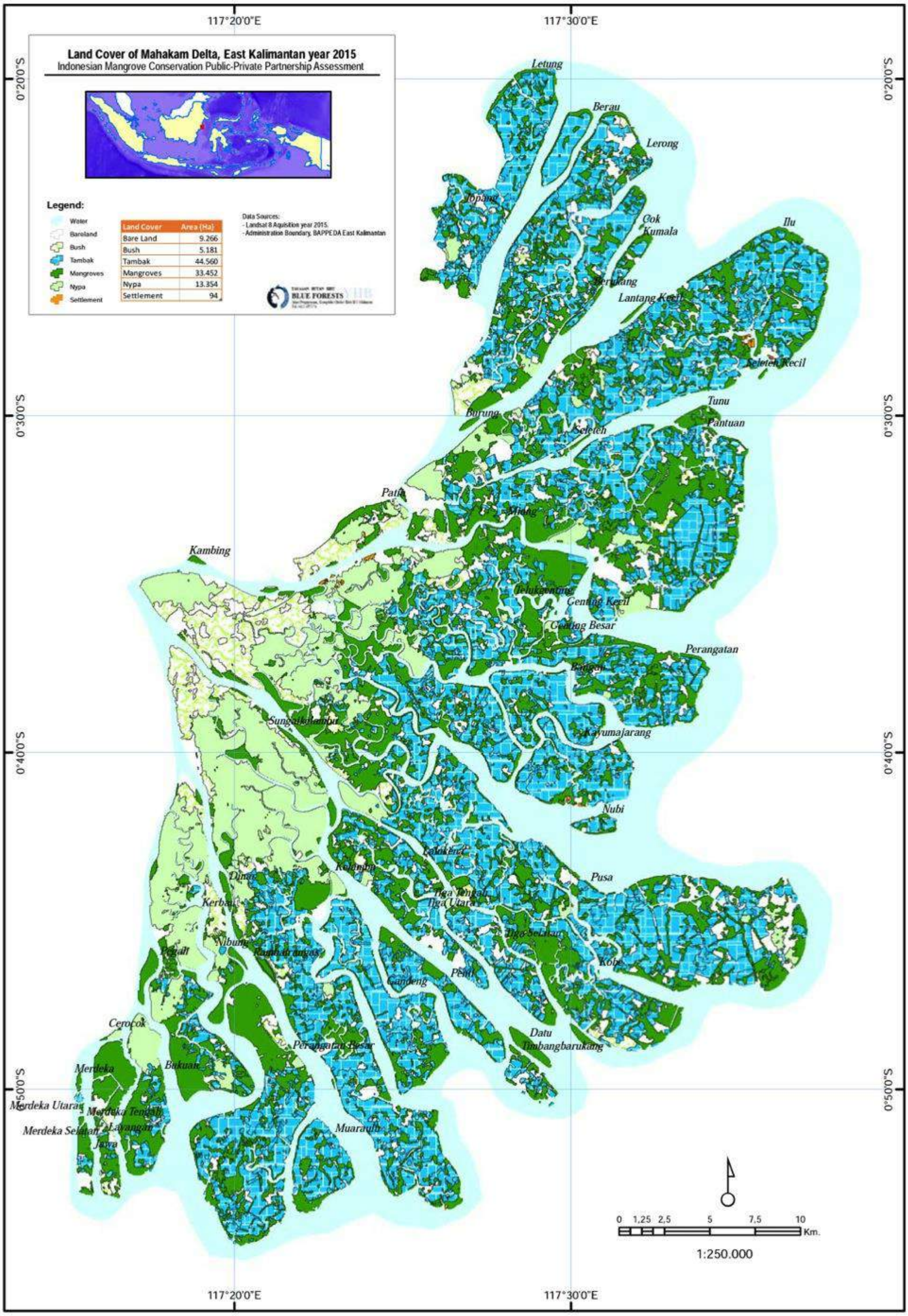

Land Cover of Mahakam Delta, East Kalimantan year 1997
Indonesian Mangrove Conservation Public-Private Partnership Assessment
Legend:
Water
Bareland
Bush
Tambak
Mangroves
Nypa
Settlement
Land Cover | Area (Ha)
Bare Land | 8.425
Bush | 5.279
Tambak | 14.264
Mangroves | 68.853
Nypa | 12.845
Settlement | 15
Data Sources:
- Landsat 5 TM Aquisition year 1997.
- Administration Boundary, BAPPEDA East Kalimantan
BLUE FORESTS
117°20'0"E
117°30'0"E
0°20'0"S
0°30'0"S
0°40'0"S
0°50'0"S
Letung
Berau
Lerong
Cok Kumala
Ilu
Lantang Kecil
Seleteh Kecil
Tunu
Pantuan
Buriung
Seleteh
Patin
Miang
Kambing
Genting Ketil
Genting Besar
Perangatan
Bangau
Kayumajarang
Nubi
Pusa
Tiga Tengah
Tiga Utara
Tiga Selatan
Penil
Datu
Perangatan Besar
Bukuan
Merdeka
Merdeka Utara
Merdeka Tengah
Merdeka Selatan
Muaradu
0 1,25 2,5 5 7,5 10 Km.
1:250.000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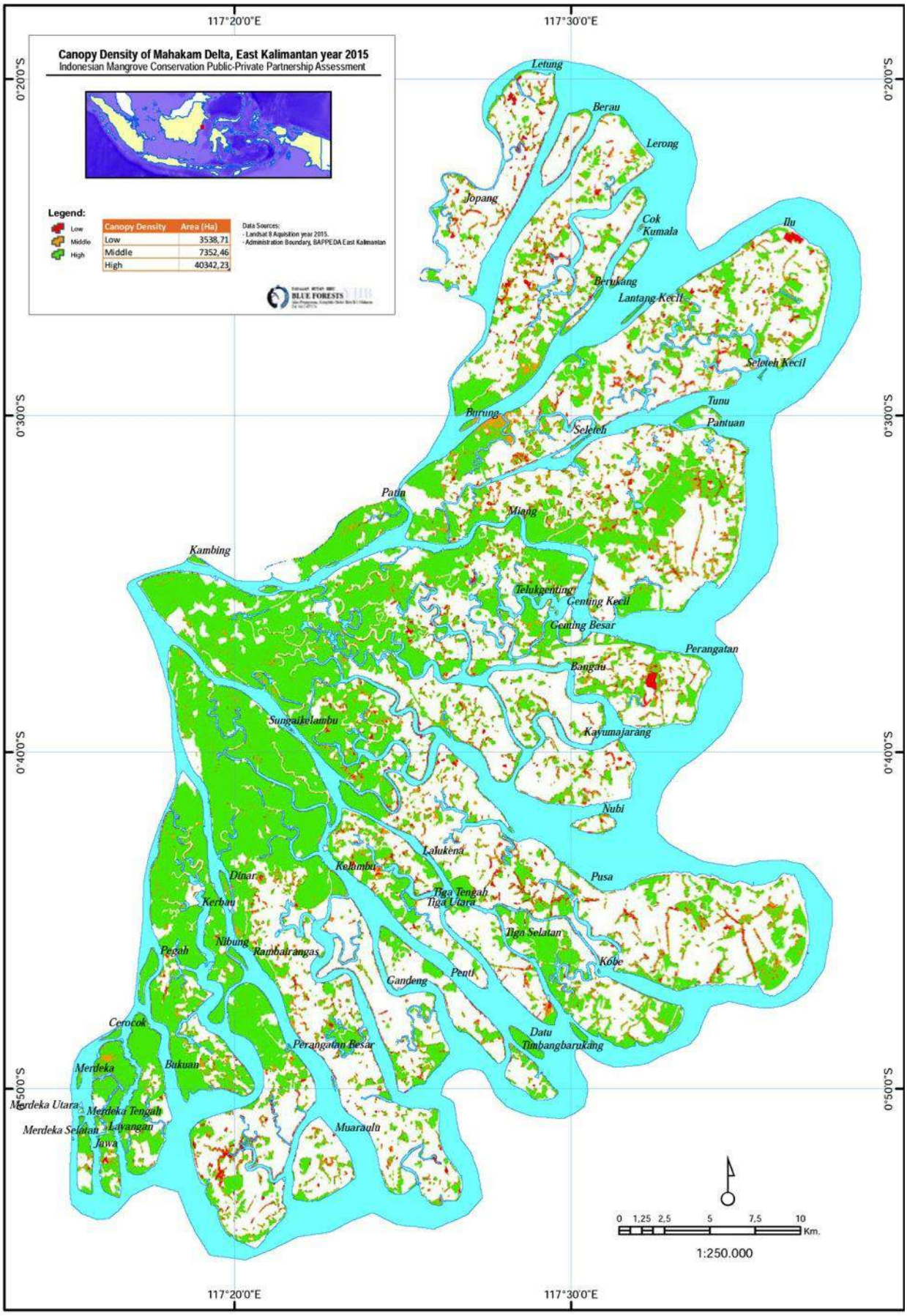
117°30'0"E
0°20'0"S
0°30'0"S
0°40'0"S
0°50'0"S
Land Cover of Mahakam Delta, East Kalimantan year 2015
Indonesian Mangrove Conservation Public-Private Partnership Assessment
Legend:
Water
Bareland
Bush
Tambak
Mangroves
Nypa
Settlement
Land Cover | Area (Ha)
Bare Land 9.266
Bush 5.181
Tambak 44.560
Mangroves 33.452
Nypa 13.354
Settlement 94
Data Sources:
- Landsat 8 Aquisition year 2015.
- Administration Boundary, BAPPEDA East Kalimantan
BLUE FORESTS
Letung
Berau
Lerong
Jopang
Cok Kumala
Ilu
Lantang Kecil
Seleteh Kecil
Tunu
Pantuan
Burung
Seleteh
Patin
Kambing
Telukaenting
Genting Kecil
Genting Besar
Perangatan
Sungaikalamon
Kayumajarang
Nubi
Pusa
Kelambu
Dima
Kerbau
Tiga Tengah
Tiga Utara
Tiga Selatan
Nibung
Pegali
Pendi
Gandeng
Kobe
Cerocok
Datu
Timbangbarukang
Perangatan Besar
Merdeka
Bukuan
Merdeka Utara
Merdeka Tengah
Merdeka Selatan
Layangan
Jawa
Muararuh
0 1,25 2,5 5 7,5 10 Km.
1:250.000


Canopy Density of Mahakam Delta, East Kalimantan year 2015
Indonesian Mangrove Conservation Public-Private Partnership Assessment
Legend:
Low
Middle
High
Canopy Density | Area (Ha)
Low | 3538,71
Middle | 7352,46
High | 40342,23
Data Sources:
- Landsat 8 Aquisition year 2015.
- Administration Boundary, BAPPEDA East Kalimantan
BLUE FORESTS
117°20'0"E
117°30'0"E
0°20'0"S
0°30'0"S
0°40'0"S
0°50'0"S
Letung
Berau
Lerong
Jopang
Cok Kumala
Ilu
Berukang
Lantang Kecil
Seleteh Kecil
Tunu
Pantuan
Burung
Seleteh
Patin
Miang
Kambing
Telukgenting
Genting Kecil
Genting Besar
Perangatan
Bangau
Sungaikelambu
Kayumajarang
Nubi
Lalukena
Kelambu
Dinar
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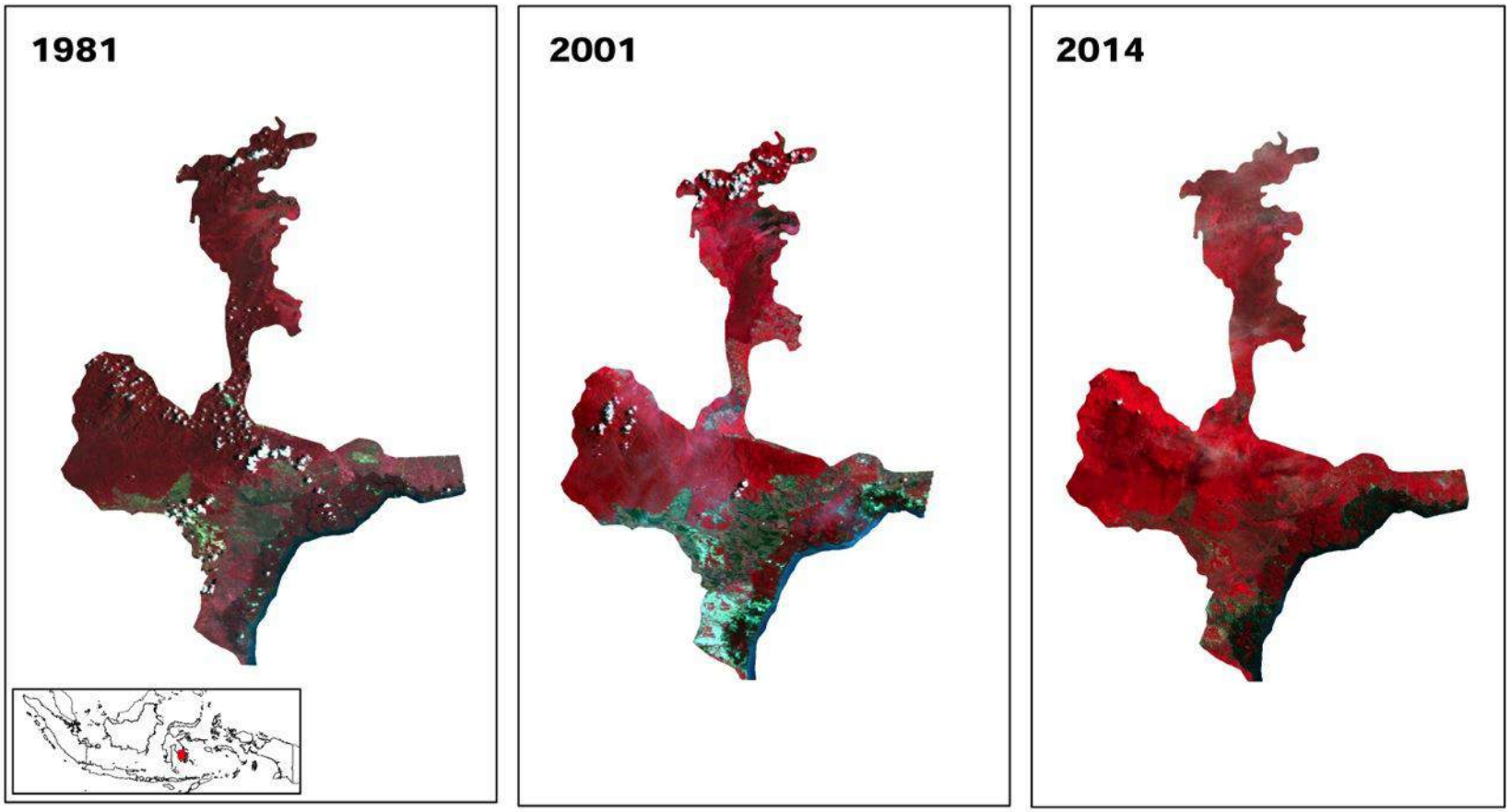
Tiga Tengah
Tiga Utara
Pusa
Tiga Selatan
Nibung
Pegah
Rambairangas
Kobe
Penti
Gandeng
Cerocok
Datu
Timbangbarukang
Perangatan Besar
Merdeka
Bukuan
Merdeka Utara
Merdeka Tengah
Merdeka Selatan
Lavangan
Jawa
Muaraulu
0 1,25 2,5 5 7,5 10
Km.
1:250.000

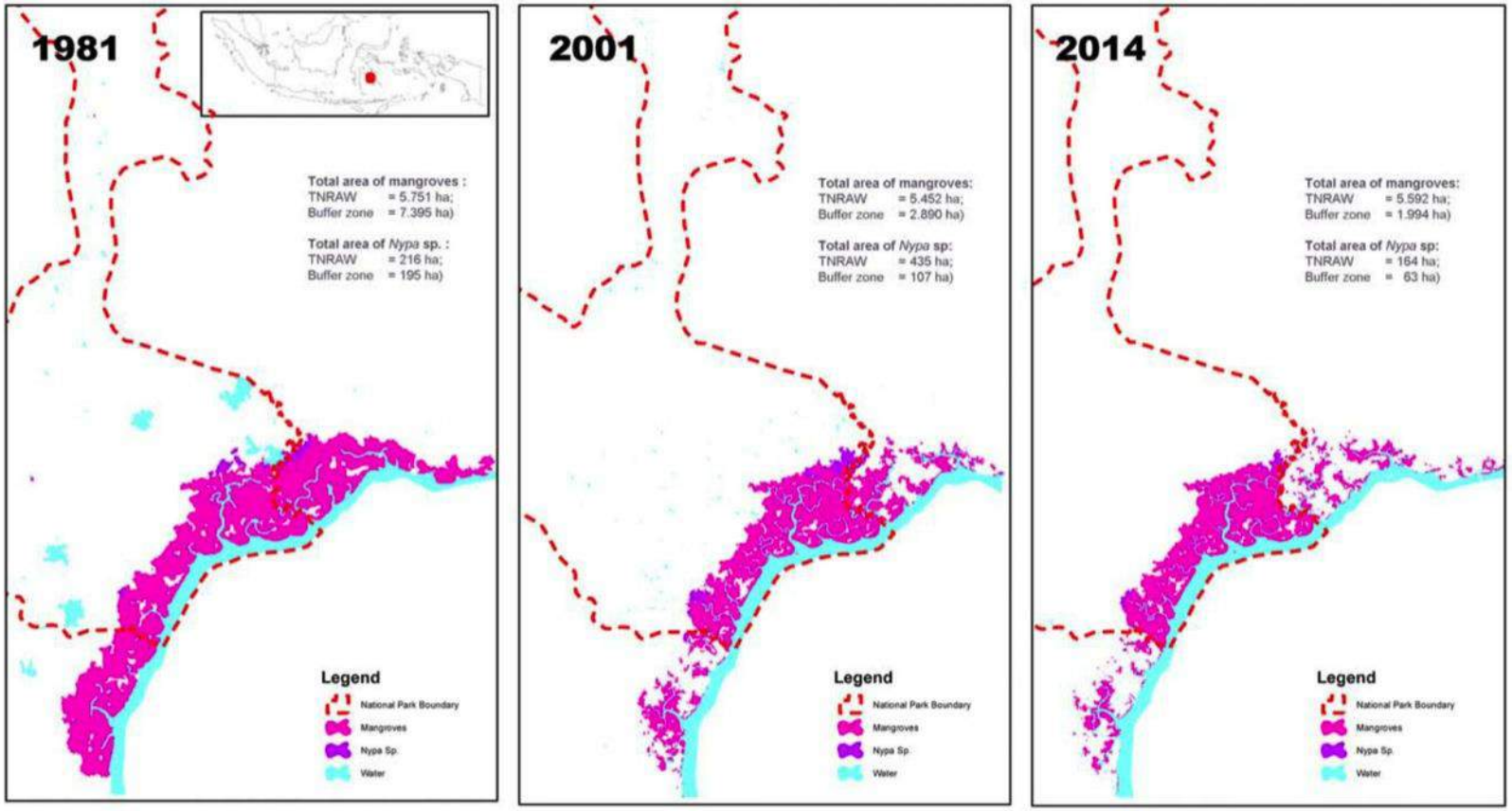
Satellite Imagery of Rawa Aopa Watumohai National Park, South East Sulawesi 1981 - 2014

Indonesian Mangrove Conservation Public-Private Partnership Assessment



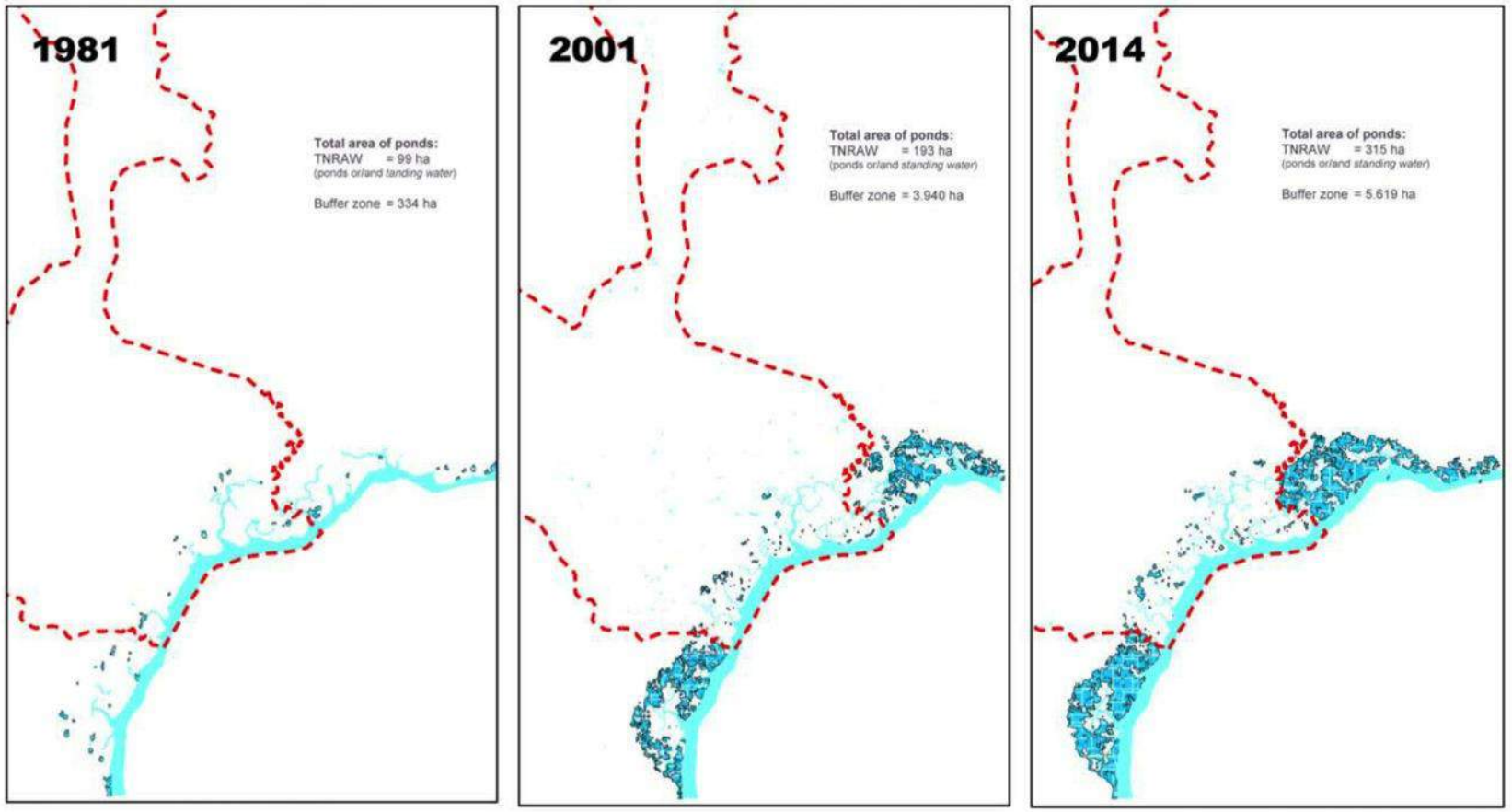
Change Cover of Mangroves in Rawa Aopa Watumohai National Park, South East Sulawesi 1981 - 2014

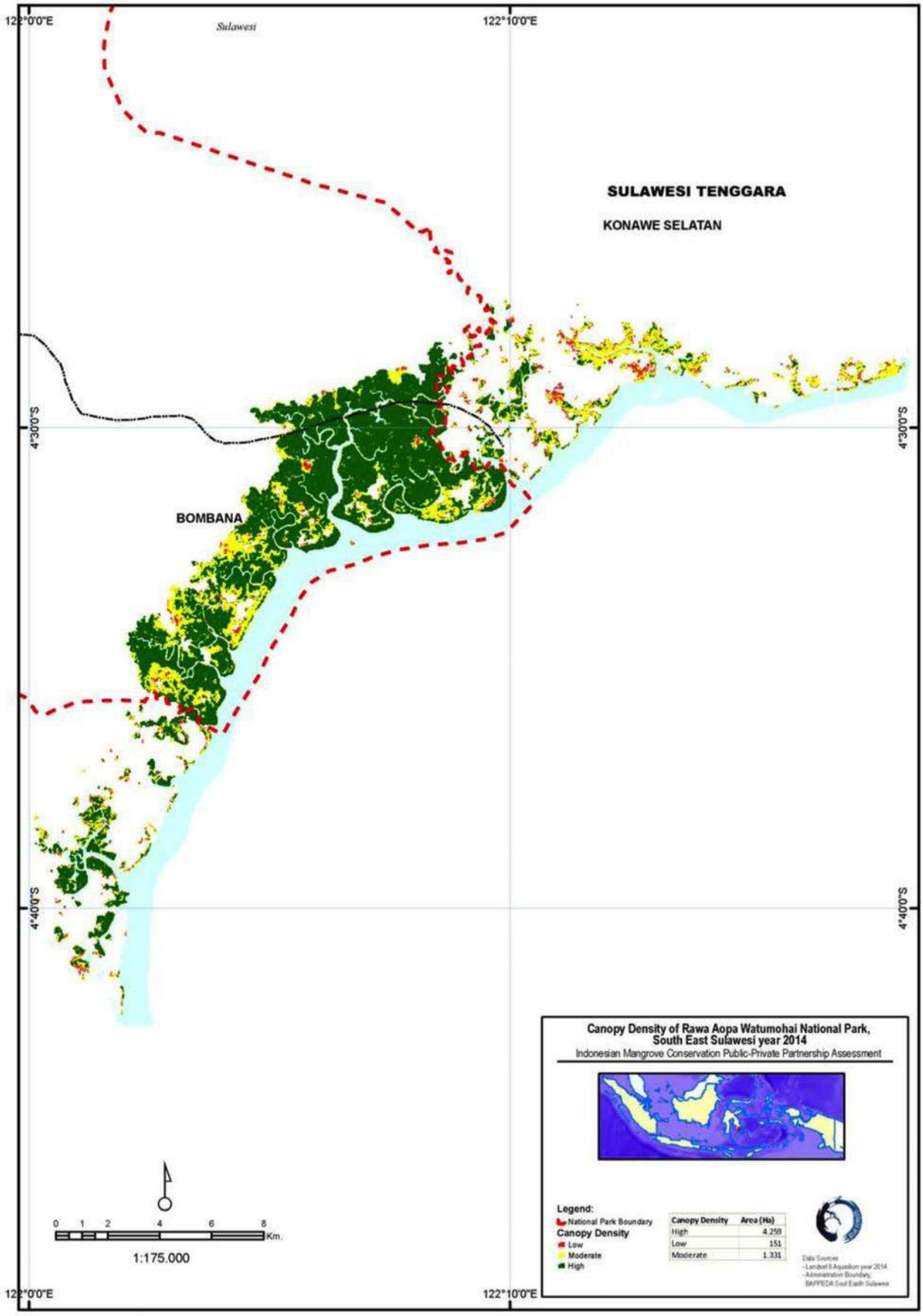
Indonesian Mangrove Conservation Public-Private Partnership Assessment

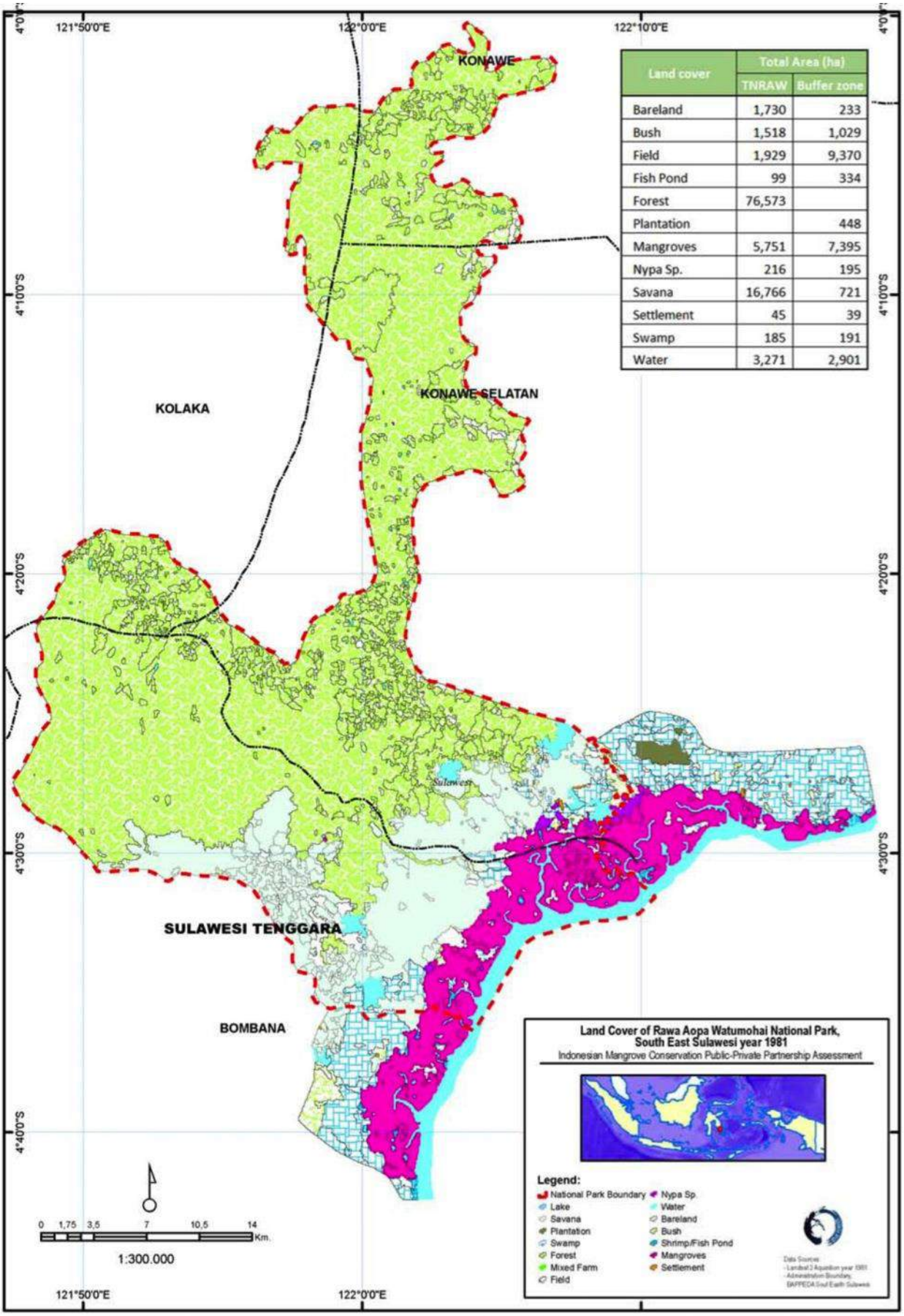


Change Cover of Shrimp/Fish Pond in Rawa Aopa Watumohai National Park, South East Sulawesi 1981 - 2014

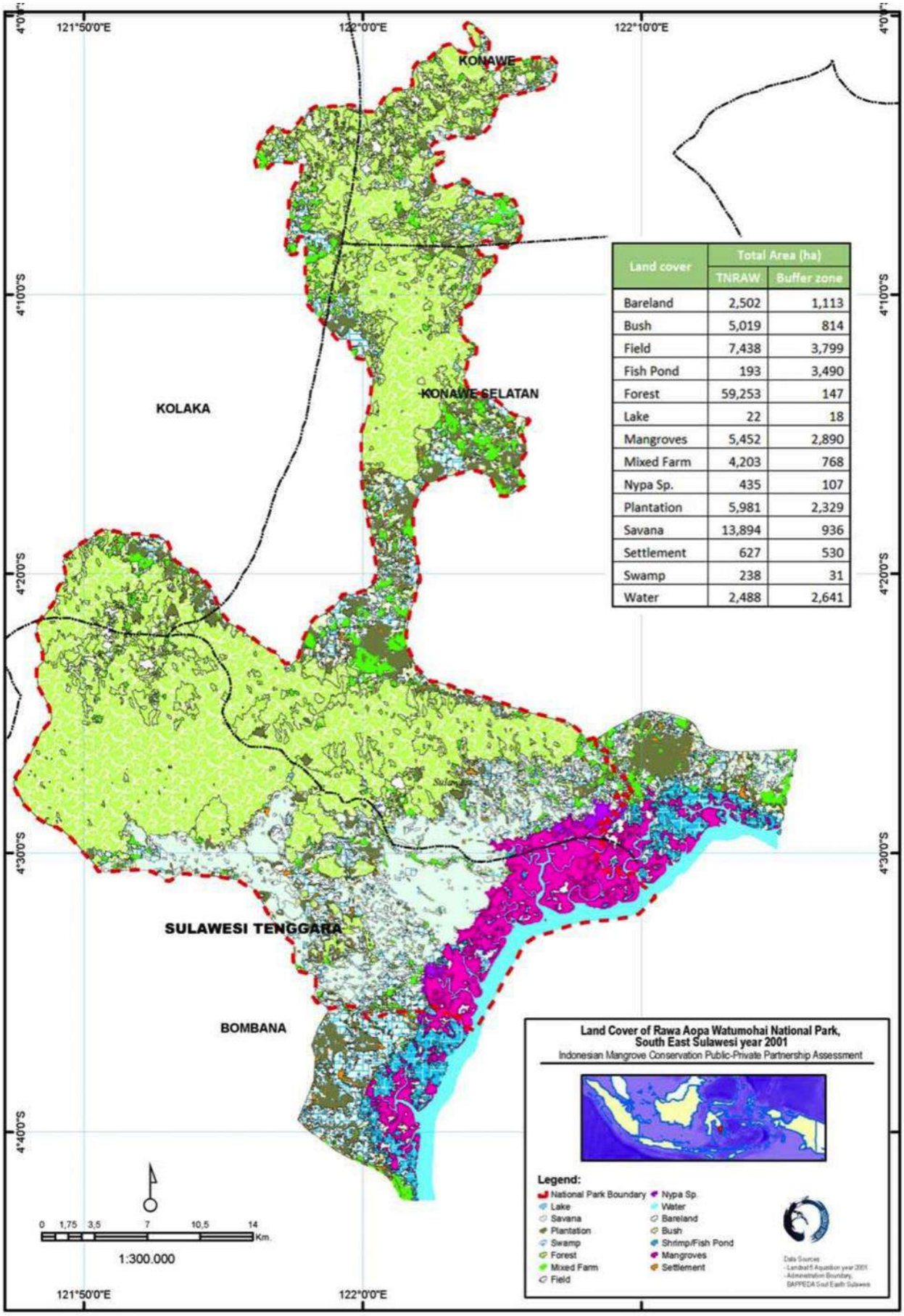
Indonesian Mangrove Conservation Public-Private Partnership Assessment

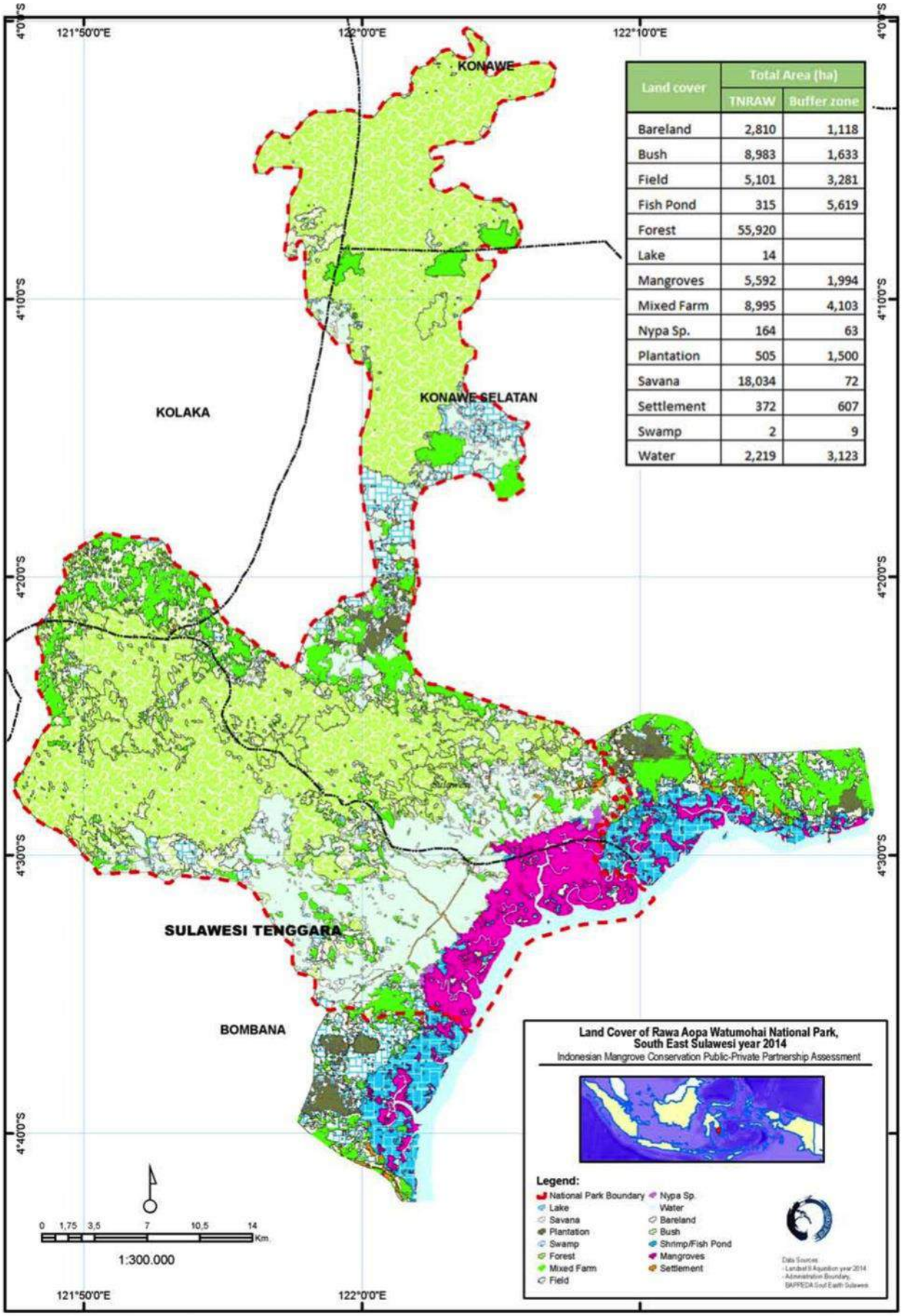



122°0'0"E
Sulawesi
122°10'0"E
SULAWESI TENGGARA
KONAWE SELATAN
4°30'0"S
BOMBANA
4°40'0"S
Canopy Density of Rawa Aopa Watumohai National Park, South East Sulawesi year 2014
Indonesian Mangrove Conservation Public-Private Partnership Assessment
Legend:
National Park Boundary
Canopy Density
Low
Moderate
High
Canopy Density | Area (Ha)
High | 4.259
Low | 151
Moderate | 1.331
0 1 2 4 6 8 Km.
1:175.000



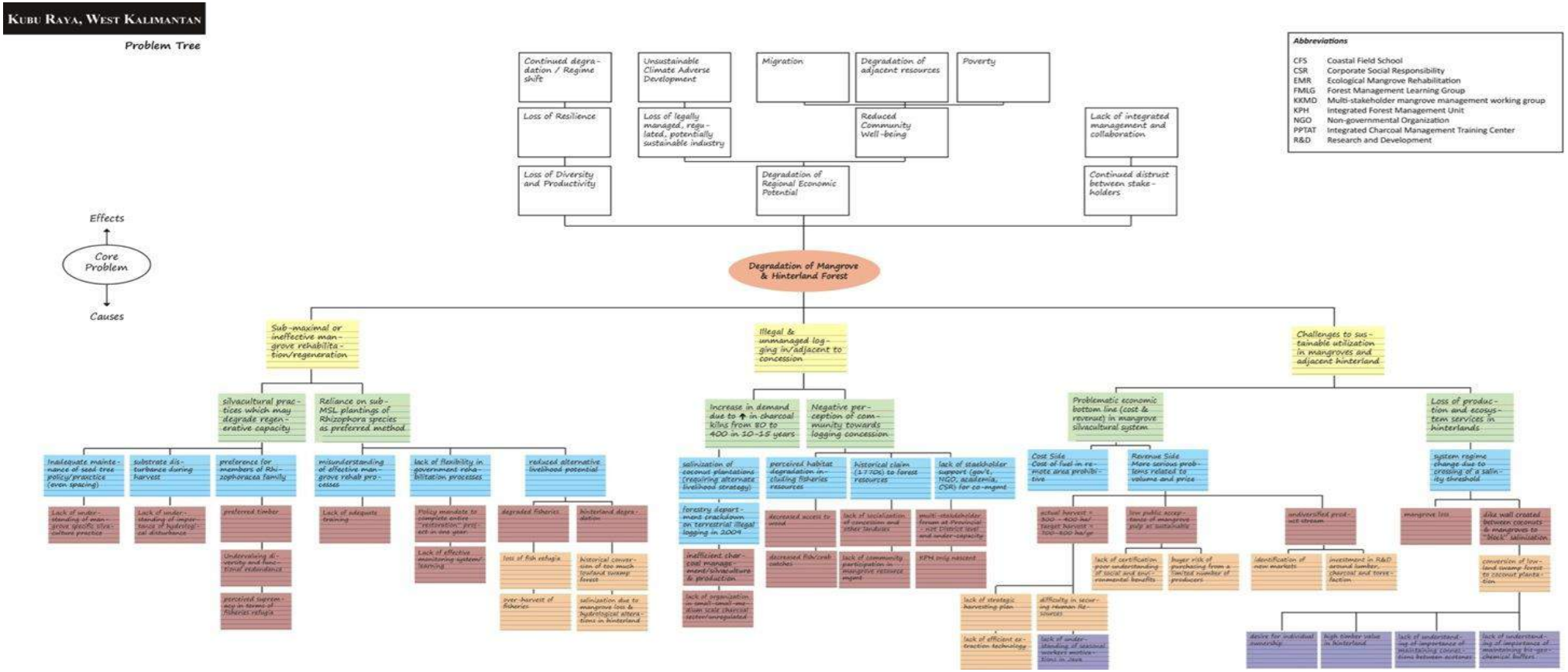
Land cover	Total Area (ha)	
	TNRAW	Buffer zone
Bareland	1,730	233
Bush	1,518	1,029
Field	1,929	9,370
Fish Pond	99	334
Forest	76,573	
Plantation		448
Mangroves	5,751	7,395
Nypa Sp.	216	195
Savana	16,766	721
Settlement	45	39
Swamp	185	191
Water	3,271	2,901

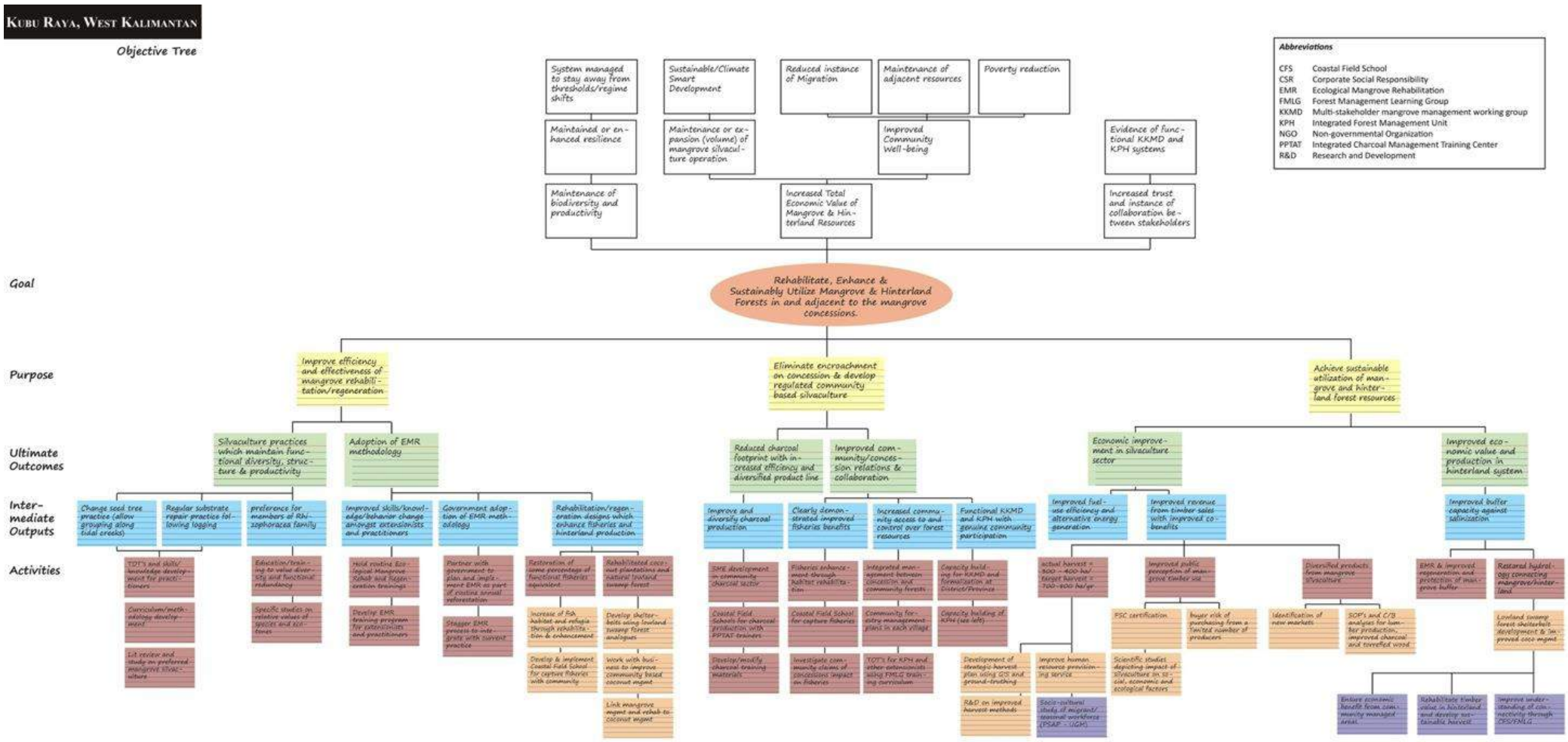

121°50'0"E
122°0'0"E
122°10'0"E
4°0'0"S
4°10'0"S
4°20'0"S
4°30'0"S
4°40'0"S
KONAWE
KONAWE SELATAN
KOLAKA
SULAWESI TENGGARA
BOMBANA
Land cover
Total Area (ha)
TNRAW
Buffer zone
Bareland 2,502 1,113
Bush 5,019 814
Field 7,438 3,799
Fish Pond 193 3,490
Forest 59,253 147
Lake 22 18
Mangroves 5,452 2,890
Mixed Farm 4,203 768
Nypa Sp. 435 107
Plantation 5,981 2,329
Savana 13,894 936
Settlement 627 530
Swamp 238 31
Water 2,488 2,641
0 1,75 3,5 7 10,5 14 Km.
1:300.000
Land Cover of Rawa Aopa Watumohai National Park, South East Sulawesi year 2001
Indonesian Mangrove Conservation Public-Private Partnership Assessment
Legend:
National Park Boundary
Lake
Savana
Plantation
Swamp
Forest
Mixed Farm
Field
Nypa Sp.
Water
Bareland
Bush
Shrimp/Fish Pond
Mangroves
Settlement



Land cover	Total Area (ha)	
	TNRAW	Buffer zone
Bareland	2,810	1,118
Bush	8,983	1,633
Field	5,101	3,281
Fish Pond	315	5,619
Forest	55,920	
Lake	14	
Mangroves	5,592	1,994
Mixed Farm	8,995	4,103
Nypa Sp.	164	63
Plantation	505	1,500
Savana	18,034	72
Settlement	372	607
Swamp	2	9
Water	2,219	3,123

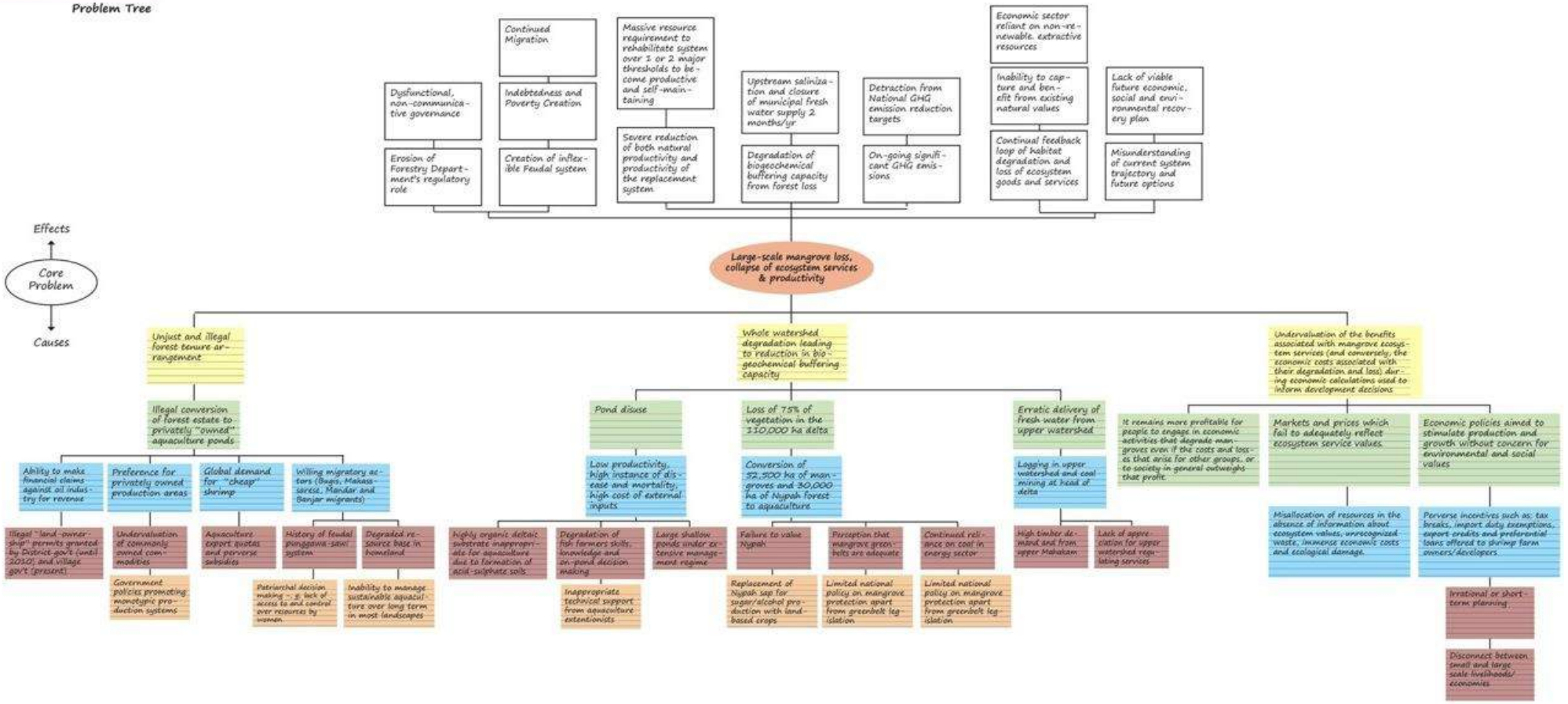
APPENDIX C: PROBLEM AND OBJECTIVE TREES (4 SITES)

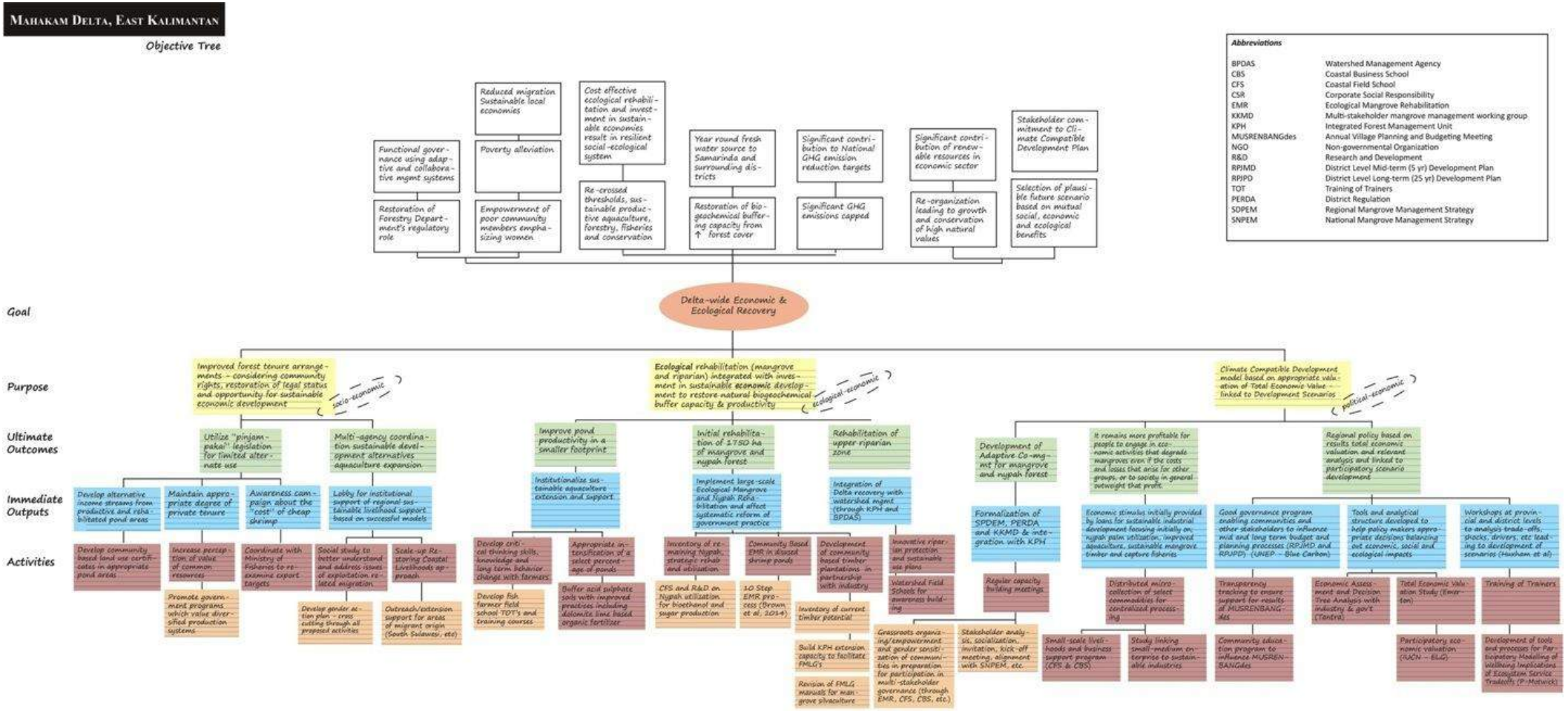



KUBU RAYA, WEST KALIMANTAN
Objective Tree
Abbreviations
CFS Coastal Field School
CSR Corporate Social Responsibility
EMR Ecological Mangrove Rehabilitation
FMLG Forest Management Learning Group
KKMD Multi-stakeholder mangrove management working group
KPH Integrated Forest Management Unit
NGO Non-governmental Organization
PPTAT Integrated Charcoal Management Training Center
R&D Research and Development
System managed to stay away from thresholds/regime shifts
Sustainable/Climate Smart Development
Reduced instance of Migration
Maintenance of adjacent resources
Poverty reduction
Maintained or enhanced resilience
Maintenance or expansion (volume) of mangrove silvaculture operation
Improved Community Well-being
Evidence of functional KKMD and KPH systems
Maintenance of biodiversity and productivity
Increased Total Economic Value of Mangrove & Hinterland Resources
Increased trust and instance of collaboration between stakeholders
Goal
Rehabilitate, Enhance & Sustainably Utilize Mangrove & Hinterland Forests in and adjacent to the mangrove concessions.
Purpose
Improve efficiency and effectiveness of mangrove rehabilitation/regeneration
Eliminate encroachment on concession & develop regulated community based silvaculture
Achieve sustainable utilization of mangrove and hinterland forest resources
Ultimate Outcomes
Silvaculture practices which maintain functional diversity, structure & productivity
Adoption of EMR methodology
Reduced charcoal footprint with increased efficiency and diversified product line
Improved community/concession relations & collaboration
Economic improvement in silvaculture sector
Improved eco-nomic value and production in hinterland system
Inter-mediate Outputs
Change seed tree practice (allow grouping along tidal creeks)
Regular substrate repair practice following logging
preference for members of Rhizophoracea family
Improved skills/knowledge/behavior change amongst extension/sts and practitioners
Government adoption of EMR methodology
Rehabilitation/regeneration designs which enhance fisheries and hinterland production
Improve and diversify charcoal production
Clearly demonstrated improved fisheries benefits
Increased community access to and control over forest resources
Functional KKMD and KPH with genuine community participation
Improved fuel-use efficiency and alternative energy generation
Improved revenue from timber sales with improved co-benefits
Improved buffer capacity against salinization
Activities
TOT's and skills/knowledge development for practitioners
Curriculum/methodology development
Lit review and study on preferred mangrove silviculture
Education/training to value diversity and functional redundancy
Specific studies on relative values of species and functions
Hold routine Ecological Mangrove Rehab and Regeneration trainings
Develop EMR training program for extensionists and practitioners
Partner with government to plan and implement EMR as part of routine annual reforestation
Stagger EMR process-to-integrate with current practice
Restoration of some percentages of functional fisheries equivalent
Increase of fish habitat and refugia through rehabilitation & enhancement
Develop & implement Coastal Field School for capture fisheries with community
Rehabilitated/excavated plantations and natural lowland swamp forest
Develop shelterbelts using lowland swamp forest analogues
Work with business to improve community based coconut mgmt
Link mangrove mgmt and rehab to coconut mgmt
SME development in community charcoal sector
Coastal Field Schools for charcoal production with PPTAT-trainers
Develop/modify charcoal training materials
Fisheries enhancement through habitat rehabilitation
Coastal Field School for capture fisheries
Investigate community claims of concessions impact on fisheries
Integrated management between concession and community forests
Community forestry management plans in each village
TOT's for KPH and other extensionists using FMLG training curriculum
Capacity building for KKMD and formalization at District/Province
Capacity building of KPH (see left)
Development of strategic harvest plan using GIS and ground-truthing
R&D on improved harvest methods
Actual harvest = 500 - 600 ha/ target harvest = 700-800 ha/yr
Improve human resource provisioning service
Socio-cultural study of migrant/seasonal workforce (PSAF - UGM)
Improved public perception of mangrove timber use
FSC certification
Scientific studies depicting impact of silvaculture in social, economic and ecological facetes
Buyer risk of purchasing from a limited number of producers
Diversified products from mangrove silvaculture
Identification of new markets
SOP's and C/B analyses for lumber production, improved charcoal and torrefied wood
EMR & improved regeneration and protection of mangrove buffer
Restored hydrology connecting mangrove/hinterland
Lowland swamp forest shelterbelt development & improved coco mgmt
Ensure economic benefit from community managed areas
Rehabilitate timber value in hinterland and develop sustainable harvest
Improve understanding of conn-ectivity through CBSP/FMLG

Mahakam Delta, East Kalimantan

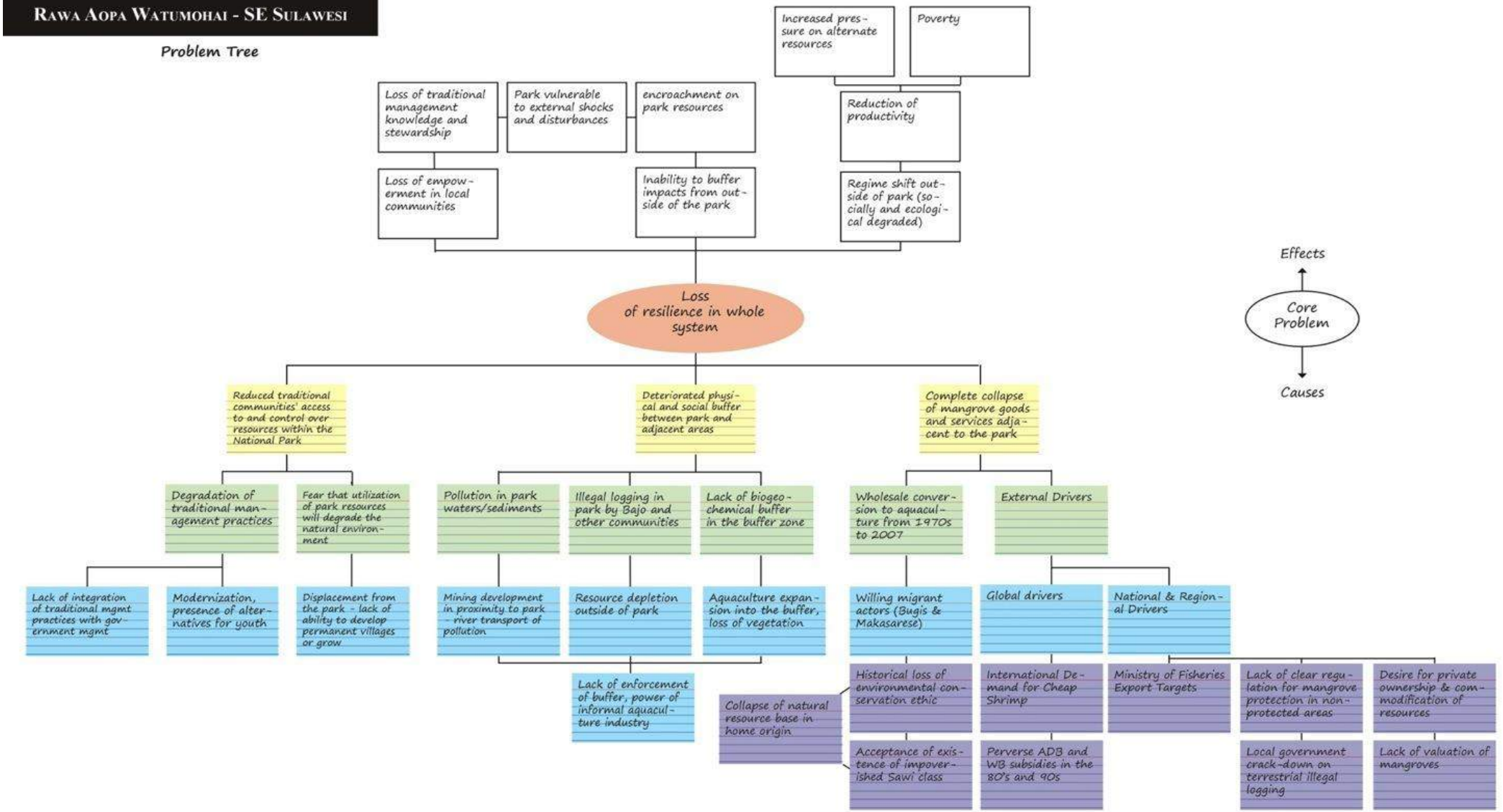
Problem Tree




Mahakam Delta, East Kalimantan
Objective Tree
Abbreviations
BPDAS Watershed Management Agency
CBS Coastal Business School
CFS Coastal Field School
CSR Corporate Social Responsibility
EMR Ecological Mangrove Rehabilitation
KKMD Multi-stakeholder mangrove management working group
KPH Integrated Forest Management Unit
MUSRENBANGdes Annual Village Planning and Budgeting Meeting
NGO Non-governmental Organization
R&D Research and Development
RPJMD District Level Mid-term (5 yr) Development Plan
RPJPD District Level Long-term (25 yr) Development Plan
TOT Training of Trainers
PERDA District Regulation
SDPEM Regional Mangrove Management Strategy
SNPEM National Mangrove Management Strategy
Goal
Purpose
Ultimate Outcomes
Immediate Outputs
Activities
Delta-wide Economic & Ecological Recovery
Functional governance using adaptive and collaborative mgmt systems
Restoration of Forestry Department's regulatory role
Reduced migration Sustainable local economies
Poverty alleviation
Empowerment of poor community members emphasizing women
Cost effective ecological rehabilitation and investment in sustainable economies result in resilient social-ecological system
Re-crossed thresholds, sustainable productive aquaculture, forestry, fisheries and conservation
Year round fresh water source to Samarinda and surrounding districts
Restoration of biogeochemical buffering capacity from ↑ forest cover
Significant contribution to National GHG emission reduction targets
Significant GHG emissions capped
Significant contribution of renewable resources in economic sector
Re-organization leading to growth and conservation of high natural values
Stakeholder commitment to Climate Compatible Development Plan
Selection of plausible future scenario based on mutual social, economic and ecological benefits
Improved forest tenure arrangements - considering community rights; restoration of legal status and opportunity for sustainable economic development
socio-economic
Ecological rehabilitation (mangrove and riparian) integrated with investment in sustainable economic development to restore natural biogeochemical buffer capacity & productivity
ecological-economic
Climate Compatible Development model based on appropriate valuation of Total Economic Value - linked to Development Scenarios
political-economic
Utilize "pinjam-pakai" legislation for limited alternate use
Multi-agency coordination sustainable development alternatives aquaculture expansion
Improve pond productivity in a smaller footprint
Initial rehabilitation of 1750 ha of mangrove and nypah forest
Rehabilitation of upper riparian zone
Development of Adaptive Co-mgmt for mangrove and nypah forest
It remains more profitable for people to engage in economic activities that degrade mangroves even if the costs and losses that arise for other groups, or to society in general outweight that profit
Regional policy based on results total economic valuation and relevant analysis and linked to participatory scenario development
Develop alternative income streams from productive and rehabilitated pond areas
Maintain appropriate degree of private tenure
Awareness campaign about the "cost" of cheap shrimp
Lobby for institutional support of regional-sustainable livelihood support based on successful models
Institutionalize sustainable aquaculture extension and support
Implement large-scale Ecological Mangrove and Nypah Rehabilitation and affect systematic reform of government practice
Integration of Delta recovery with watershed mgmt (through KPH and BPDAS)
Formalization of SPPDEM, PERDA and KKMD & integration with KPH
Economic stimulus initially provided by loans for sustainable industrial development focusing initially on nypah palm utilization, improved aquaculture, sustainable mangrove timber and capture fisheries
Good governance program enabling communities and other stakeholders to influence mid and long term budget and planning processes (RPJMD and RPJPD) (UNEP - Blue Carbon)
Tools and analytical structure developed to help policy makers appropriate decisions balancing out economic, social and ecological impacts
Workshops at provincial and district levels to analysis trade-offs, shocks, drivers, etc leading to development of scenarios (Huxham et al)
Develop community based land use certificates in appropriate pond areas
Increase perception of value of common resources
Promote government programs which value diversified production systems
Coordinate with Ministry of Fisheries to re-examine export targets
Social study to better understand and address issues of exploitation related migration
Develop gender action plan - cross cutting through all proposed activities
Scale-up Restoring Coastal Livelihoods approach
Outreach/extension support for areas of migrant origin (South Sulawesi, etc)
Develop critical thinking skills, knowledge and long term behavior change with farmers
Develop fish farmer field school TOT's and training courses
Appropriate intensification of a select percentage of ponds
Buffer acid sulphate soils with improved practices including dolomite lime based organic fertilizer
Inventory of remaining Nypah, strategic rehab and utilization
CFS and R&D on Nypah utilization for bioethanol and sugar production
Community Based EMR in closed shrimp ponds
10 Step EMR process (Brown et al, 2014)
Development of community based timber plantations in partnership with industry
Inventory of current timber potential
Build KPH extension capacity to facilitate FMLG's
Revision of FMLG manuals for mangrove silvaculture
Innovative riparian protection and sustainable use plans
Watershed Field Schools for awareness building
Grassroots organizing/empowerment and gender sensitization of communities in preparation for participation in multi-stakeholder governance (through EMR, CFS, CBS, etc.)
Regular capacity building meetings
Stakeholder analysis, socialization, invitation, kick-off meeting, alignment with SNPEM, etc.
Distributed micro-collection of select commodities for centralized processing
Small-scale livelihoods and business support program (CFS & CBS)
Study linking small-medium enterprise to sustainable industries
Transparency tracking to ensure support for results of MUSRENBANGdes
Community education program to influence MUSRENBANGdes
Economic Assessment and Decision Tree Analysis with industry & gov't (Tantra)
Total Economic Valuation Study (Emerton)
Participatory economic valuation (IUCN - BLG)
Training of Trainers
Development of tools and processes for Participatory Modelling of Wellbeing Implications of Ecosystem Service Tradeoffs (P-Matwick)

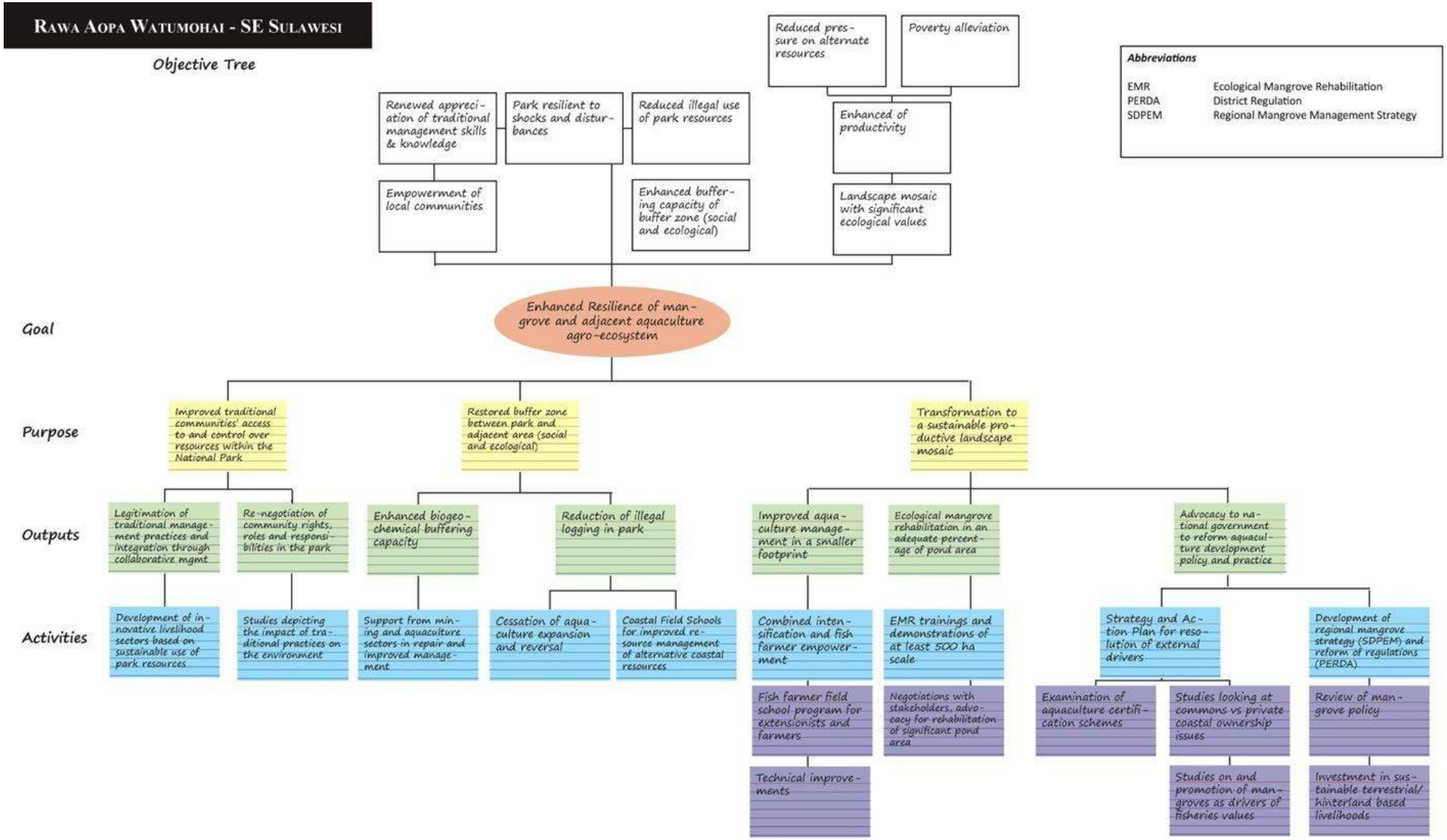
Rawa Aopa Watumohai - SE Sulawesi

Problem Tree



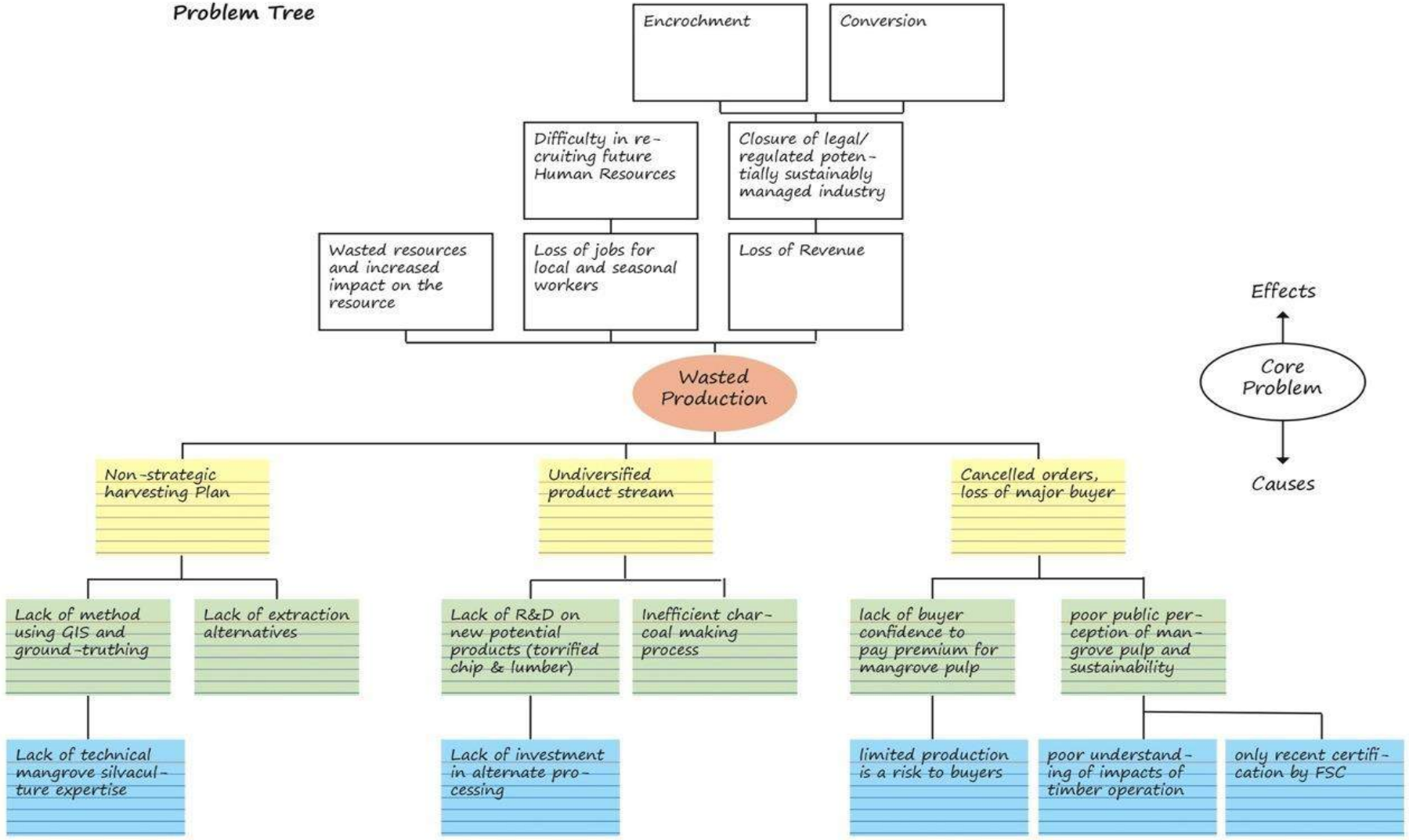
RAWA AOPA WATUMOHAI - SE SULAWESI

Objective Tree



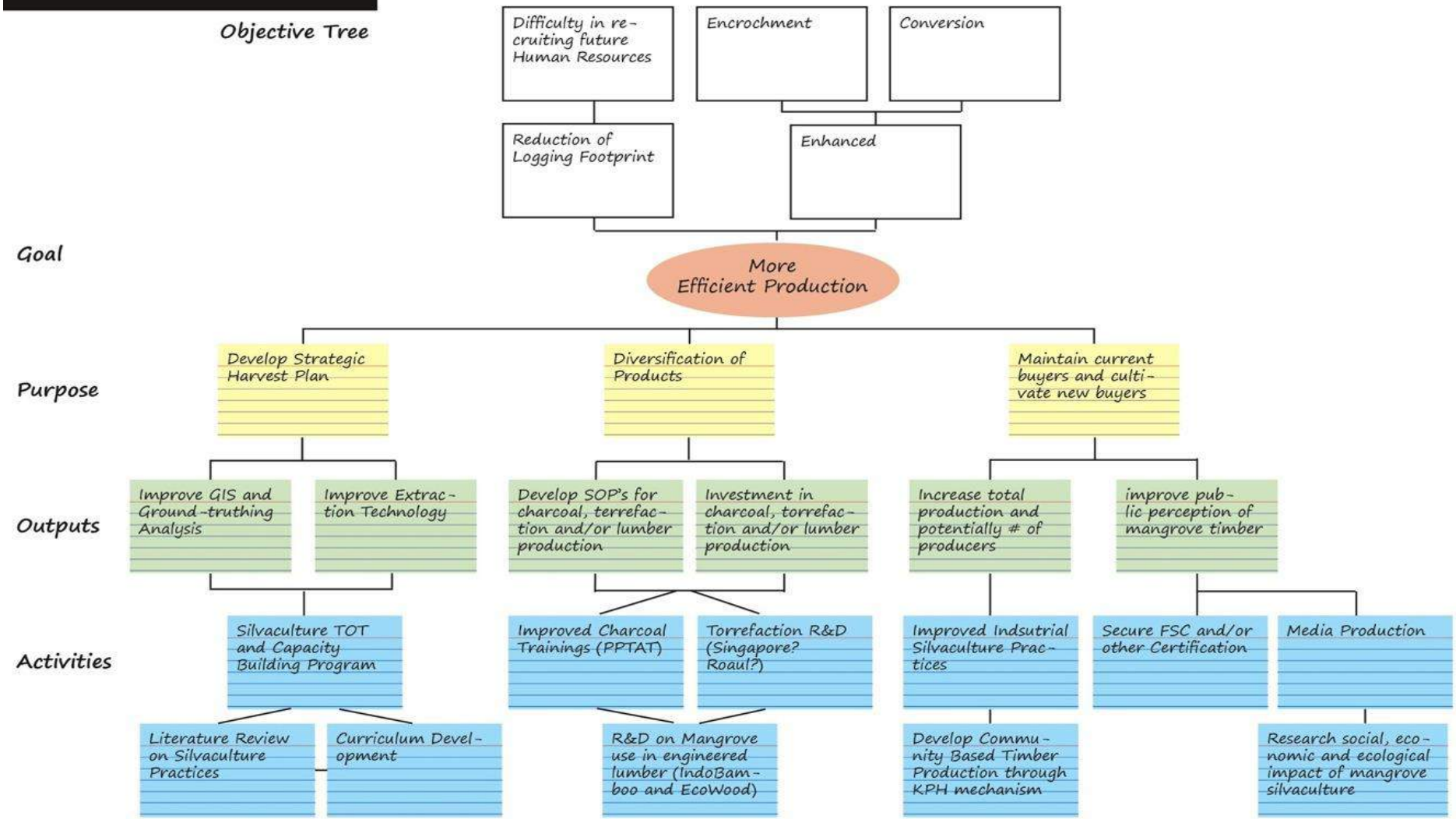
Bintuni Bay, West Papua

Problem Tree



Bintuni Bay, West Papua

Objective Tree



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Email: info@ifacs.or.id