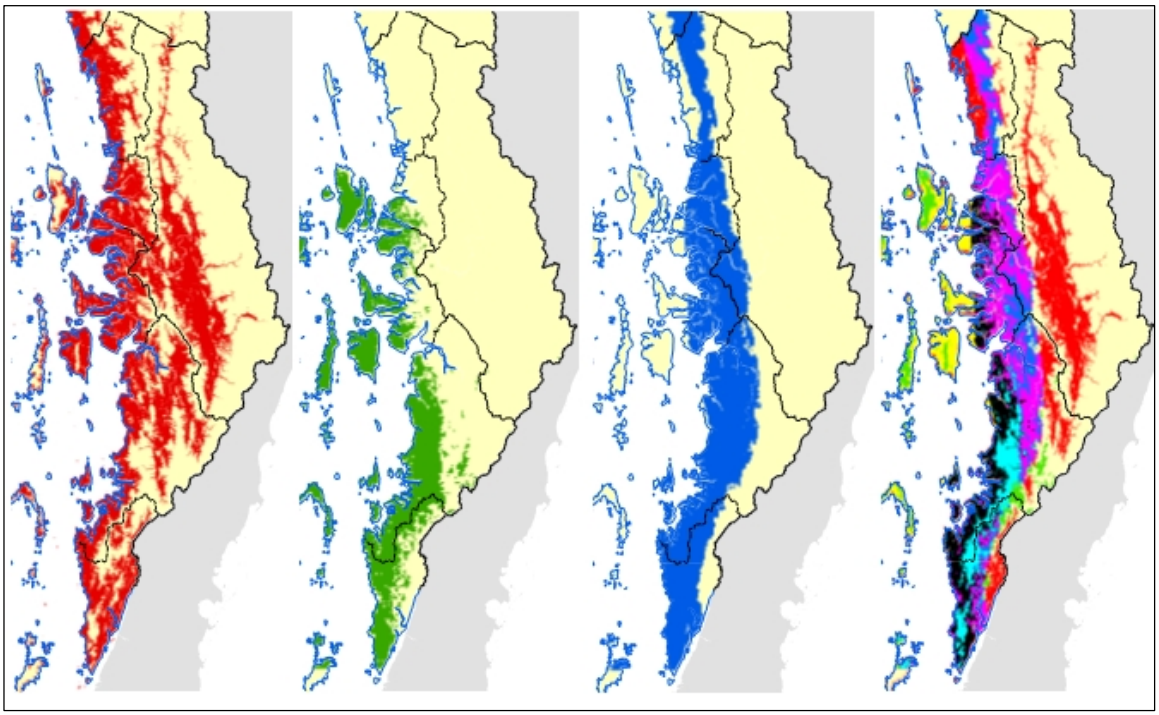
FAUNA & FLORA INTERNATIONAL

LAND SUITABILITY FOR OIL PALM IN SOUTHERN MYANMAR



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FONDATION SEGRÉ

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The program The Tanintharyi Conservation Programme is an initiative of Fauna & Flora International (FFI) Myanmar Programme, implemented in collaboration with the Myanmar Forest Department and a number of local, national and international collaborators and stakeholders. FFI Myanmar operates the programme under an MoU with the Forest Department specifically for marine and terrestrial conservation activities in Tanintharyi Region.

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Author details Earl C. Saxon and Stuart M. Sheppard prepared this Working Paper on behalf of FFI. Both are employees of FFI partner Forest Inform but were contracted on an individual basis.

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About Fauna & Flora International's approach to palm oil

Fauna & Flora International (FFI) protects threatened species and ecosystems worldwide, choosing solutions that are sustainable, based on sound science and take account of human needs. Operating in more than 40 countries worldwide – mainly in the developing world – FFI saves species from extinction and habitats from destruction, while improving the livelihoods of local people. Founded in 1903, FFI is the world's longest established international conservation body and a registered charity.

Since 2007 FFI has been an active member of the Roundtable on Sustainable Palm Oil, an international multi-stakeholder organisation and certification scheme whose members from along the palm oil supply chain are committed to transforming the market to make sustainable palm oil the norm. FFI has had projects in Indonesia, Malaysia and Liberia focused on identifying and managing high conservation values within production landscapes, supporting government and companies on a path to sustainable palm oil through better management, policy development and land use planning, and through facilitating dialogue.

In Myanmar, Tanintharyi Region is the focus of Myanmar's growing palm oil industry. The Region has 2.5 million hectares of largely intact unique Sundaic lowland forest with species, such as Gurney's Pitta *Pitta gurneyi*, found nowhere else in the world. FFI is motivated to work with the palm oil sector and government to ensure the sector expansion does not adversely impact these biodiversity rich areas and development is planned to take place in degraded areas with more potential for conversion to agriculture.

Introduction

The first commercial small-scale oil palm plantations were introduced to Myanmar in 1926 covering 120 ha. In the 1980's the European Economic Community and Swiss government implemented a palm oil project to stimulate growth in the sector. As of 2014 401,813 ha have been allocated and 134,539 ha planted. The government target is to plant 282,470 ha by 2030. The land is allocated to 44 companies, comprising 43 local companies and one Foreign Direct Investment. Three foreign companies have joint-ventures with local companies. Although much land is now planted, there appears to be significant scope to improve yields with better technical capacity and planting material. Down-stream, there are five mills owned by three companies with crude palm oil (CPO) processing capacity varying from 1.5 to 60 tonnes of fresh fruit bunch per hour (Zaw Win, 2014). Expansion of mills currently faces financing constraints.

The main driver for expansion is to meet domestic demand for edible oil; there are 60 million people in Myanmar consuming 400-500,000 metric tonnes of edible oil (palm oil, sesame and ground nut). Myanmar is importing palm oil; in 2012 this was 330,000 metric tonnes with a value of $376 million from Indonesia and Malaysia. Self sufficiency in edible palm oil is a national target, but local production is currently dwarfed by these imports.

Oil palm plantations in Myanmar are principally found within a narrow belt of coastal lowlands in Myeik and Kawthaung Districts (Figure 1). Donald et al. 2014 report that potential productivity in this area is low by international standards (Figure 2) due to climatic conditions.

As a contribution to assessing the long term commercial viability of Myanmar's oil palm industry, as well as its social and environmental impacts, we surveyed the agro-ecological conditions where it presently occurs and where it could be further developed. The Agritech Portal of Tamil Nadu Agricultural University states that,

> "Oil palm requires evenly distributed annual rainfall [of at least] 2000 mm without a defined dry season. In areas with a dry spell, deep soil with high water holding capacity and a shallow water table augmented with copious irrigation will satisfy the water requirement of the oil palm.
>
> "Temperature can be a limiting factor for oil palm production. Best oil palm yields are obtained in places where a maximum average temperature of 29^{o}-33^{o}C and minimum average temperature of 22^{o}-24^{o}C are available. Higher diurnal temperature variation causes floral abortion in regions with a dry season."
>
> http://agritech.tnau.ac.in/agriculture/oilseeds_oilpalm.html

Within Myanmar, annual rainfall, the presence of a distinct dry season (Figure 3) and elevation (an indicator of local variation in diurnal temperature range) already limit the area suitable for plantations. Sandy loam soils restrict the potential for irrigation and make the requirements for fertilizer high. Across the entire country, the duration and reliability of the wet season has decreased as climate variability has increased, and this trend is likely to continue.

Methods

A spatial database was compiled from diverse sources (Table 1). Geographic Information System (GIS) tools were used to identify the distribution of reported palm plantings in relation to each of the other factors.

Relative suitability for oil palm within Myanmar was determined by examining the distribution of cleared and planted land across the full range of locally occurring rainfall (Table 2), moisture stress (Table 3) and elevation values (Table 4). Steep slopes (gradient >16%) and mangrove forests were excluded within otherwise suitable areas.

The extent of oil palm planting in relation to land cover types, plantation permit areas and proximity to roads was calculated.

There is limited availability of data sets related to the distribution of threatened and endangered species. Therefore we have used the distribution of suitable habitat for the endemic bird, Gurney's Pitta, as an indicator for threatened and endangered

species, based on a spatial model of its habitat distribution in the lowlands (Donald *et al*., 2014), which was compared with the location of land suitable for oil palm.

Information on recent changes in the start and duration of the wet season was provided informally by U Tun Lwin, retired Director General of the Meteorology Department (Tun Lwin and Kyaw Lwin Oo, 2006). Casual interviews with local growers canvassed recent trends in the industry.

Results

The majority (66%) of planted land is closely associated with a single set of agro-ecological parameters (Figures 4 and 5). A further 25% occurs under more widespread conditions. Less than 10% occurs in a third zone. Based on this distribution, the three sets of agro-ecological parameters are considered to be most suitable, marginal and sub-marginal for oil palm in southern Myanmar. The regional extent of land with each relevant parameter is summarized in 4. The area of forest, scrub land, cleared and planted land within each suitability zone is displayed in Figure 6 and summarized in Table 5.

Weather observations already show significant reductions in the length of the wet season - losing up to 40 days since 1978 - and increased variability in its start and end dates (Tun Lwin and Kyaw Lwin Oo, 2006). Local reports suggest that some growers have already started to switch tree crops from oil palm to rubber, because the latter suits areas with a distinct dry season.

Gurney's Pitta habitat generally occurs in association with lower annual rainfall and higher seasonality (moisture stress in April) than occurs in areas most suitable for oil palm. Only 6% of modelled Pitta habitat is on forest land that is most suitable for palm. A further 31% is on forest land that is marginal or sub-marginal for oil palm. Our modelling suggests that 43% percent of the region's modelled Pitta habitat is on land entirely unsuitable for oil palm (Table 6).

While 84% of the reported planting area occurs on land with plantation permits, tenure on the remaining area is unclear. Though rarely enforced, cleared or cleared and planted land that does not comply with all legal requirements (valid permit, area planted and fees paid) should in theory revert to the government.

Infrastructure is also an important factor in determining the commercial viability of oil palm plantations. Road access is critical, as fresh fruit bunches need to reach a processing plant within two days or the quality of the oil deteriorates. In Myeik and Kawthaung Districts, there are presently two industrial-scale processing plants and three smaller capacity plants and 63% of reported planting occurs within 1km of a road (99% within 5km). The costs of a new processing plant and new road construction make it uneconomic to establish new plantations in marginally suitable land that is presently inaccessible.

Discussion

The most suitable areas for oil palm plantations consist of cleared land or severely degraded forests on wet coastal lowlands. The modelled habitat of Gurney's Pitta is

largely restricted to closed forests in drier inland valleys. Consequently, intensification of oil palm development on the most suitable land does not need to pose a threat to this Critically Endangered species, provided remaining lowland forest is not cleared.

The Roundtable on Sustainable Palm Oil (RSPO) has proposed standards for certification of palm oil supplies (http://www.rspo.org/file/PnC_RSPO_Rev1.pdf). Two critical environmental factors for the industry in Myanmar are that:

1. The status of rare, threatened or endangered species and other High Conservation Value habitats, if any, that exist in the plantation or that could be affected by plantation or mill management, shall be identified and operations managed to best ensure that they are maintained and/or enhanced (principle and criteria 5.2).
2. New plantings since November 2005 have not replaced primary forest or any area required to maintain or enhance one or more High Conservation Values (principle and criteria 7.3).

If High Conservation Value areas are cleared after 2005 then a company can follow the RSPO's compensation procedure to be eligible for RSPO certification. The impacts on Gurney's Pitta appear to be manageable, but there is currently insufficient data to do the same landscape-level assessment for other relevant species.

Agro-ecological conditions in areas already cleared and planted are marginal at best for oil palm compared with production areas in Malaysia and Indonesia (Donald et al. 2014). They are likely to deteriorate as the pace of climate change increases, but moving to areas with higher rainfall is not an adaptation option for oil palm growers, as the wetter coastal zone consists of mangrove forests that are vulnerable to both storm surges and rising sea levels. Since oil palm plantations remain productive for 25 years, projected climate change is a relevant factor in discounting the commercial viability of investment in this sector.

Land tenure and road access also limit the availability of suitable land. Consequently, expansion of the industry may concentrate on land adjacent to the most productive existing plantations where the potential for increased productivity is likely to be greatest (Figure 6).

References

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Tables and figures

Table 1. Data and sources[1]

Data	Source
Areas planted, as reported by growers (2010)	Tanintharyi regional office of the Settlement and Land Records Department (SLRD) scanned map
Elevation (mASL) and slope (%)	SRTM srtm.usgs.gov/
Forest cover and cleared land derived from Landsat imagery up to 2012	Hansen *et al.,* 2013, data courtesy of the author
Gurney's Pitta habitat (modelled)	Donald *et al.,* 2014 data courtesy of the author
Mangrove	USGS data.unep-wcmc.org/datasets/21
Oil palm plantation permit boundaries (2010)	Tanintharyi regional office of the Settlement and Land Records Department (SLRD) scanned map
Potential evapotranspiration, April (2000-2012)	PET www.ntsg.umt.edu/project/mod16
Rainfall, annual average (1950-2000)	Worldclim http://www.worldclim.org/
Roads and administrative boundaries	MIMU www.themimu.info/

Table 2. Annual Rainfall. Note that data on area cleared is current to 2012; data on area planted is current only to 2010.

Rainfall (mm/yr)	Myeik and Kawthaung Districts Land Area (ac)	Cleared and Planted Land (ac)	Percent of Total Cleared and Planted Land (%)
No data	270,488	9	0%
<2000	2,301,668	3,982	4%
2001-2400	1,220,579	8,264	9%
2401-2800	1,324,888	57,719	64%
2801-3200	810,302	20,384	23%
3201-3600	425,289	-	0%
3601-4000	209,099	-	0%
4001-4400	87,414	-	0%
4401-4800	6,329	-	0%
Total	6,656,054	90,358	100%

[1] Data utilized in this study are available from the authors or from FFI Myanmar on request.

Table 3. Seasonal Moisture Stress (ratio of precipitation to potential evapotranspiration P/PET for the month of April). Note that data on area cleared is current to 2012; data on area planted is current only to 2010.

April Moisture Deficit (P/PET)	Myeik and Kawthaung Districts Land Area (ac)	Cleared and Planted Land (ac)	Percent of Total Cleared and Planted Land (%)
<0.35	1,285,078	2,029	2%
0.36-0.40	814,586	1,067	1%
0.41-0.45	923,717	1,439	2%
0.46-0.50	794,375	7,943	9%
0.51-0.55	1,357,417	13,609	15%
0.56-0.60	1,307,563	62,423	69%
0.60-0.65	172,330	1,849	2%
0.66-0.70	988	-	0%
Total	6,656,054	90,359	100%

Table 4. Elevation. Note that data on area cleared is current to 2012; data on area planted is current only to 2010.

Elevation (mASL)	Myeik and Kawthaung Districts Land Area (ac)	Cleared and Planted Land (ac)	Percent of Total Cleared and Planted Land (%)
<50	1,973,013	49,480	55%
51-100	1,001,096	31,929	35%
101-150	674,593	5,431	6%
151-200	534,416	2,246	2%
201-250	455,863	756	1%
251-300	393,008	247	0%
301-350	341,521	125	0%
351-400	301,568	65	0%
>400	980,977	79	0%
Total	6,656,054	90,358	100%

Table 5a. Agro-ecological conditions and extent of land cover type within each suitability zone. Note that data on area cleared is current to 2012; data on area planted is current only to 2010.

Class	Optimal rainfall (2401-3200 mm/yr)	Min moisture stress (P/PET April ≥0.6)	Max elevation (≤100mASL)	Forest (ac)	Scrub (ac)	Cleared not Planted (ac)	Cleared and Planted (ac)
1	yes	yes	yes	142,358	82,643	86,894	53,972
2	n/a	no	yes	513,129	442,165	349,225	19,970
3	yes	yes	no	48,307	3,477	2,681	1,301

Table 5b. Agro-ecological conditions and percentage of land cover type within each suitability class. Note that data on area cleared is current to 2012; data on area planted is current only to 2010.

Class	Optimal rainfall (2401-3200 mm/yr)	Min moisture stress (P/PET April ≥0.6)	Max elevation (≤100m ASL)	Forest (%)	Scrub (%)	Cleared not Planted (%)	Cleared and Planted (%)
1	yes	yes	yes	39%	23%	24%	15%
2	n/a	no	yes	39%	33%	26%	2%
3	yes	yes	no	87%	6%	5%	2%

Table 6a. Extent of modelled Gurney's Pitta habitat within each oil palm suitability class and cover type (acres). Note that data on area cleared is current to 2012; data on area planted is current only to 2010.

Suitability Class	Forest (ac)	Scrub (ac)	Cleared not Planted (ac)	Cleared and Planted (ac)
1	47,929	8,310	7,907	10,511
2	244,726	96,027	39,648	2,900
3	14,568	1,169	424	122

Table 6b. Extent of modelled Gurney's Pitta habitat within each oil palm suitability class and cover type (percentage). Note that data on area cleared is current to 2012; data on area planted is current only to 2010.

Suitability Class	Forest (%)	Scrub (%)	Cleared not Planted (%)	Cleared and Planted (%)
1	34%	10%	9%	19%
2	48%	22%	11%	15%
3	30%	34%	16%	9%

Table 6c. Extent of total regional modelled Gurney's Pitta habitat within each oil palm suitability class and cover type (percentage). Note that data on area cleared is current to 2012; data on area planted is current only to 2010.

Suitability Class	Forest (%)	Scrub (%)	Cleared not Planted (%)	Cleared and Planted (%)
1	6%	1%	1%	1%
2	29%	11%	5%	0%
3	2%	0%	0%	0%

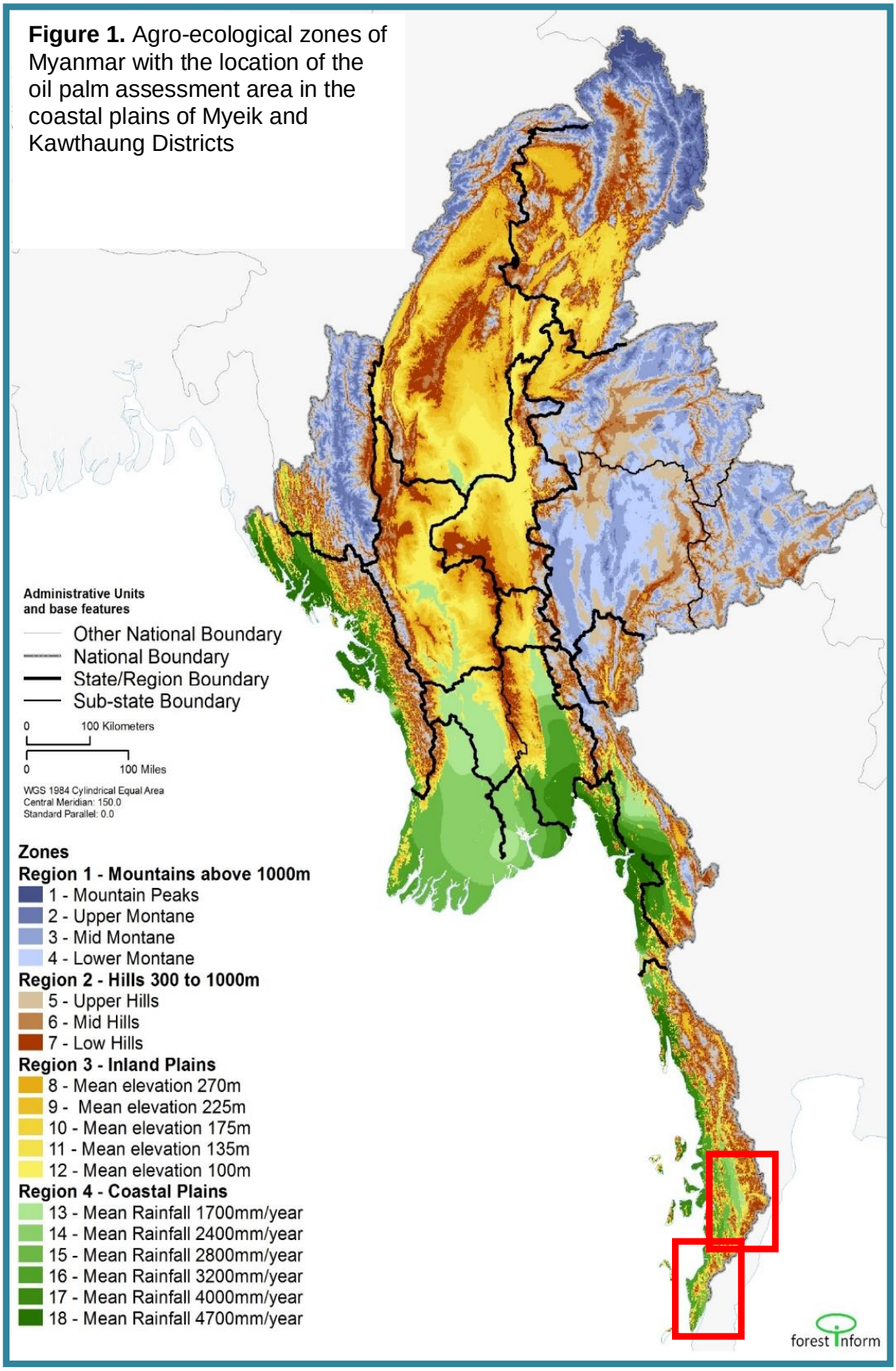


Figure 1. Agro-ecological zones of Myanmar with the location of the oil palm assessment area in the coastal plains of Myeik and Kawthaung Districts

Figure 2. Agro-climatically attainable yield for rain fed (i.e. non-irrigated) oil palm production in SE Asia in tonnes per hectare estimated by Global Agro-ecological Zones (GAEZ) v3.0 (IIASA/FAO, 2012). Yields range from zero (green) to over 8

tonnes per hectare (red). The modelled range of Gurney's Pitta in Myanmar is indicated in black. [Figure and caption extracted from Donald et al. 2014 Fig S1]

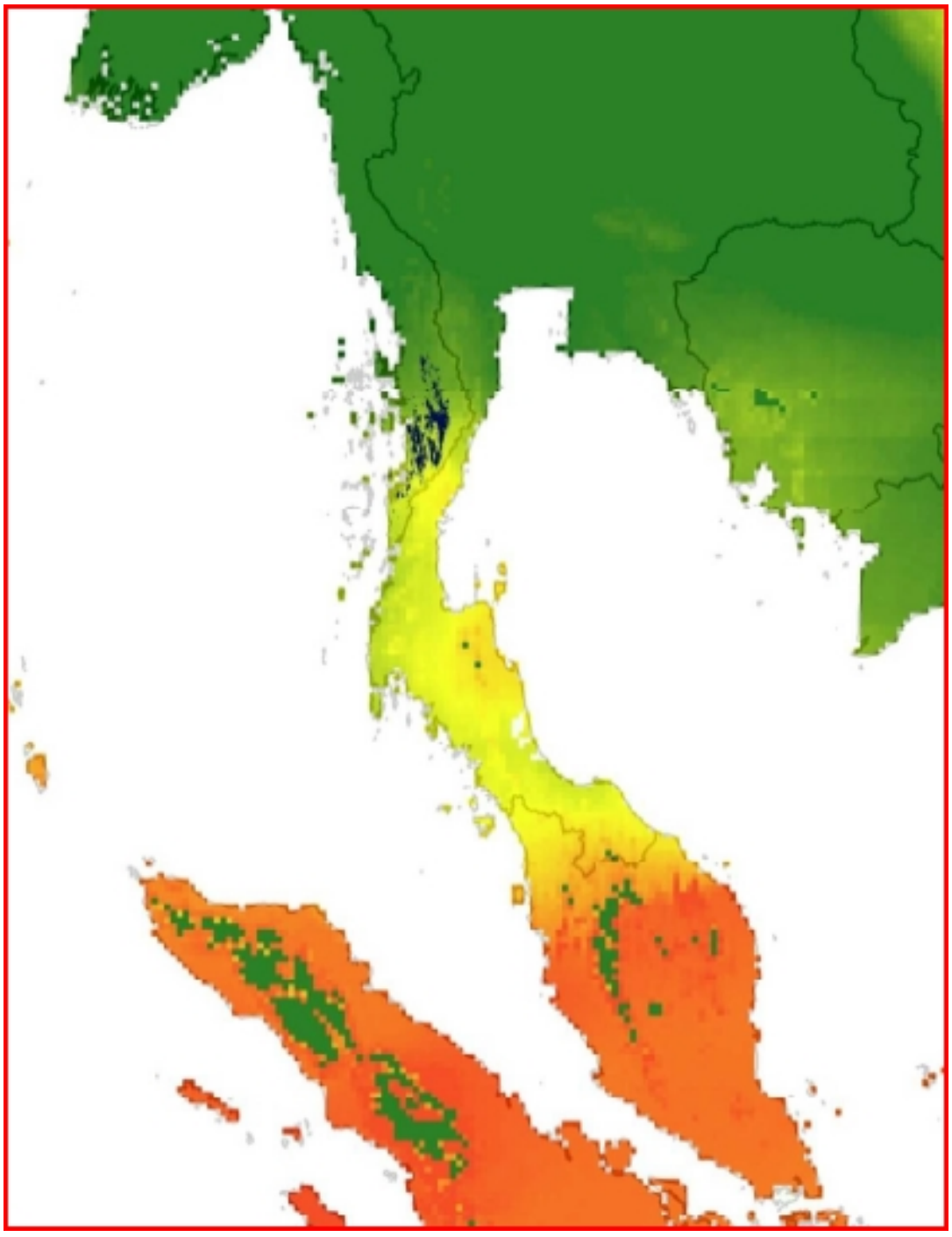


Figure 3. Seasonality in Tanintharyi Region measured as percent of days each month with recorded rainfall. The northernmost recording station (Dawei) has the most rain days in the wet season; the southernmost recording station (Kawthaung) has the most rain days in the dry season and the shortest dry season. Data from http://weatherhobo.com/myanmar

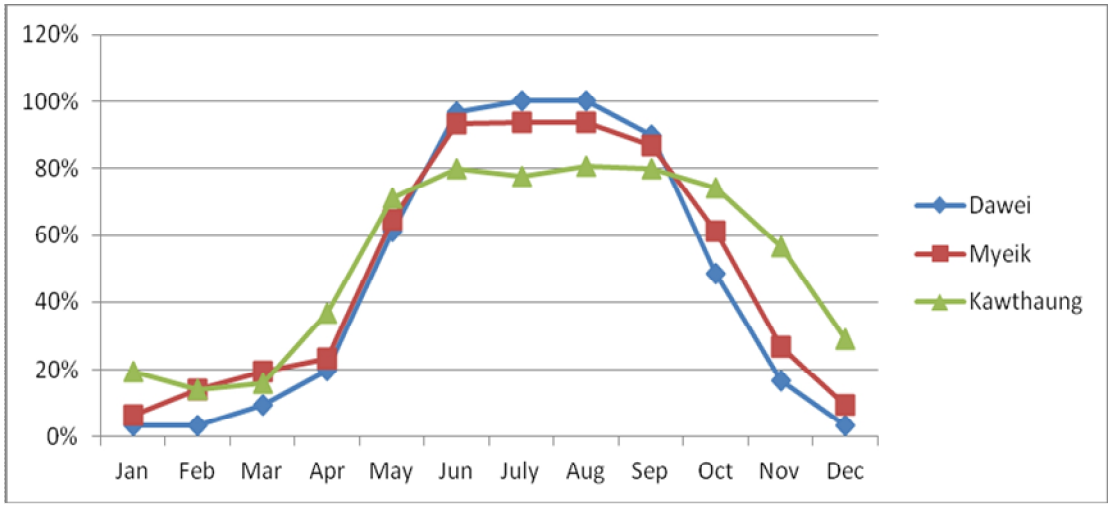
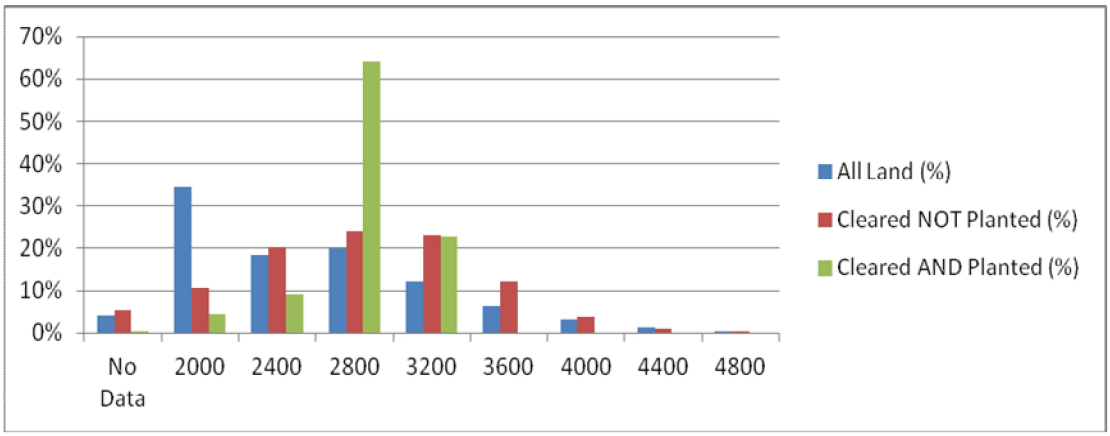
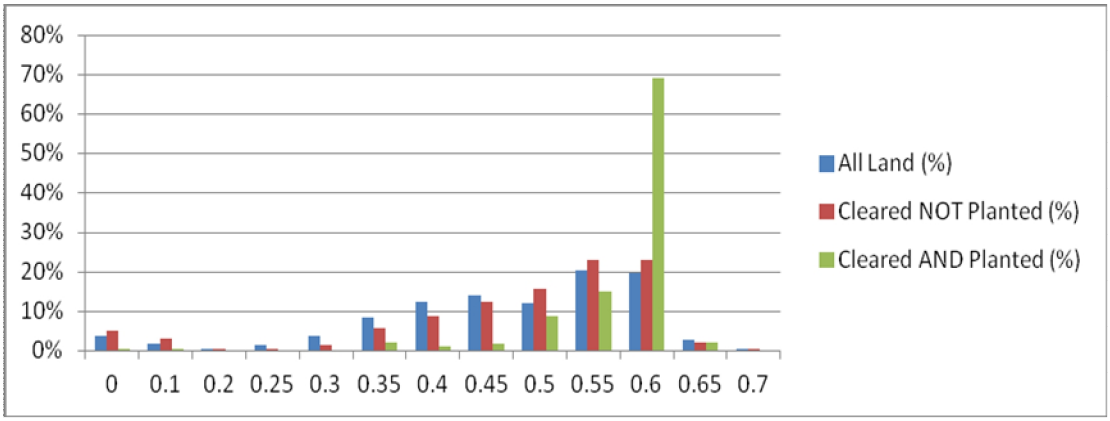


Figure 4. Distribution of cleared and planted land in Myeik and Kawthaung Districts, Myanmar, across three agro-ecological parameters. Oil palm planting is very narrowly concentrated in the mid-range of regional annual rainfall, least seasonal moisture stress (highest ratio of precipitation to potential evapotranspiration during the month of April), and at the lowest elevation.

Annual Rainfall (mm)



Moisture Stress in April (P/PET)



Elevation (m ASL)

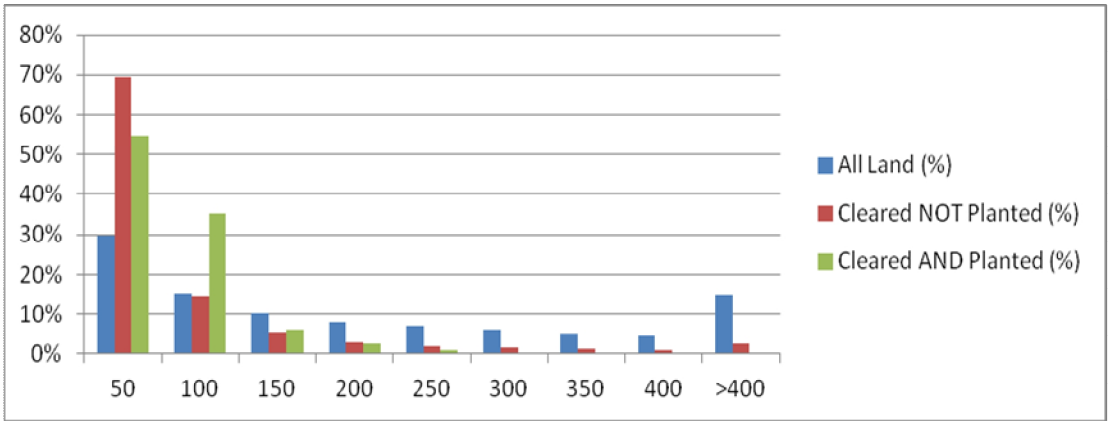


Figure 5. Distribution of the agro-ecological conditions most suitable for oil palm in Myeik and Kawthaung Districts, Myanmar: (left to right) low elevation; low moisture deficit; optimal rainfall; and all factors combined. Areas where all the most suitable conditions co-occur appear black.

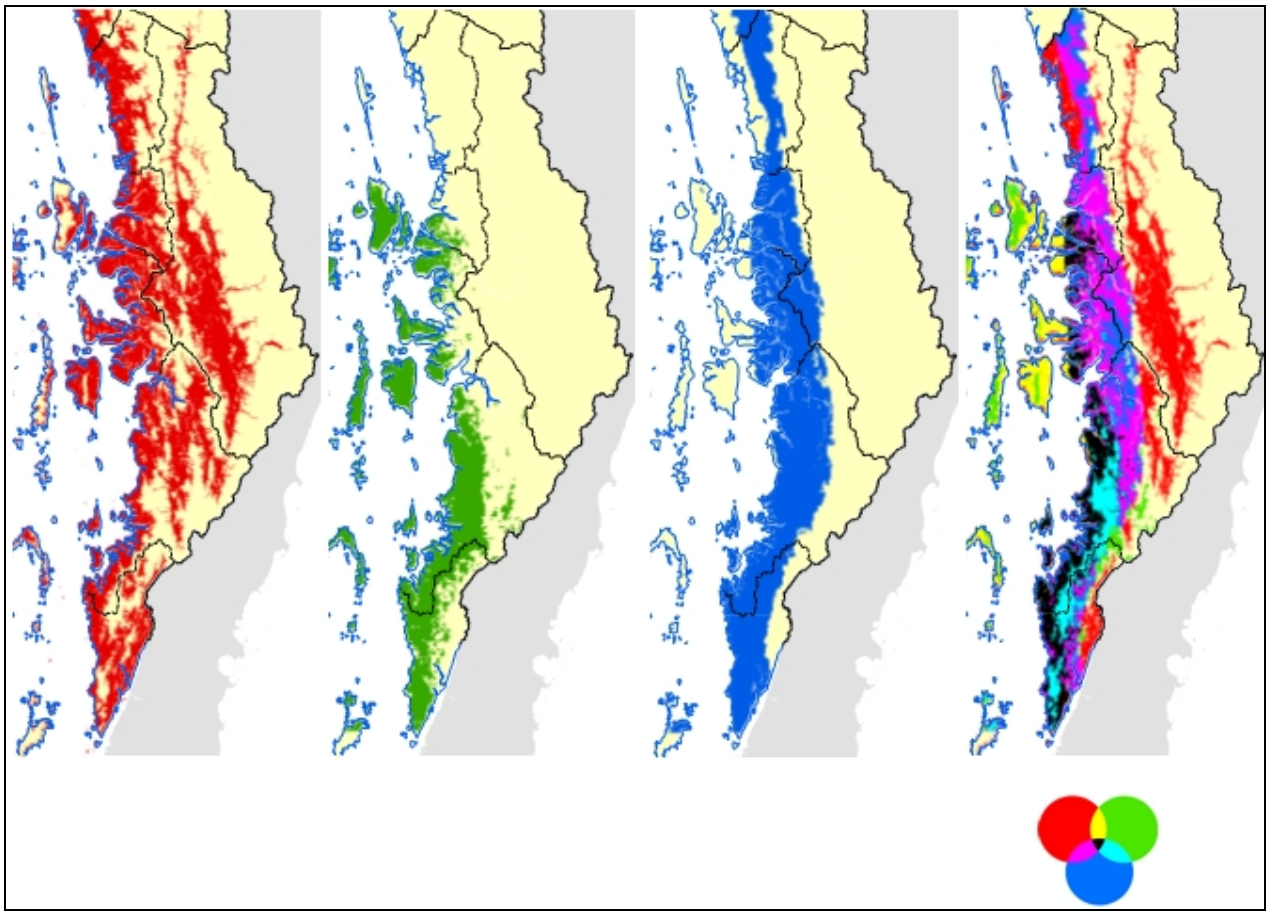
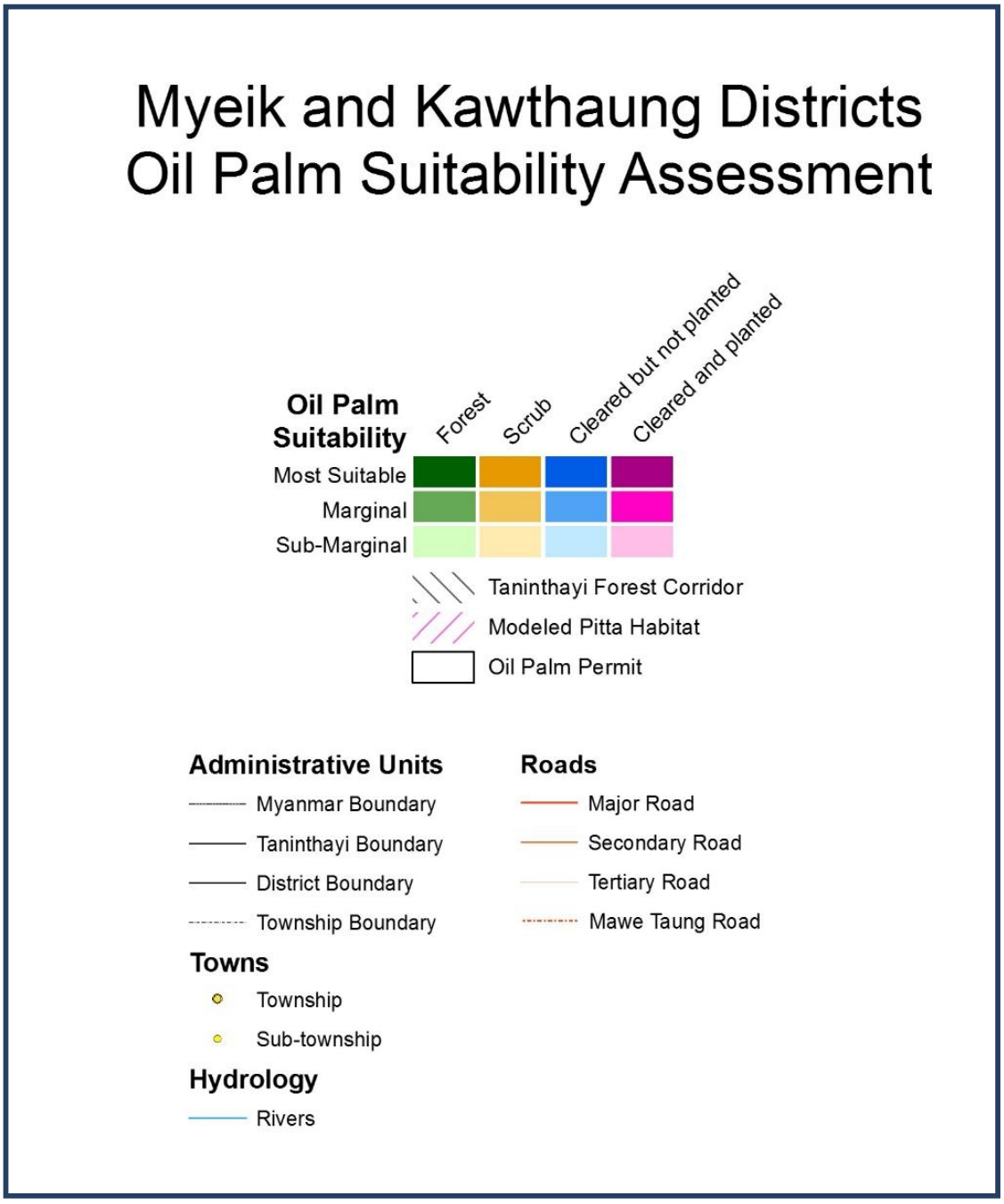
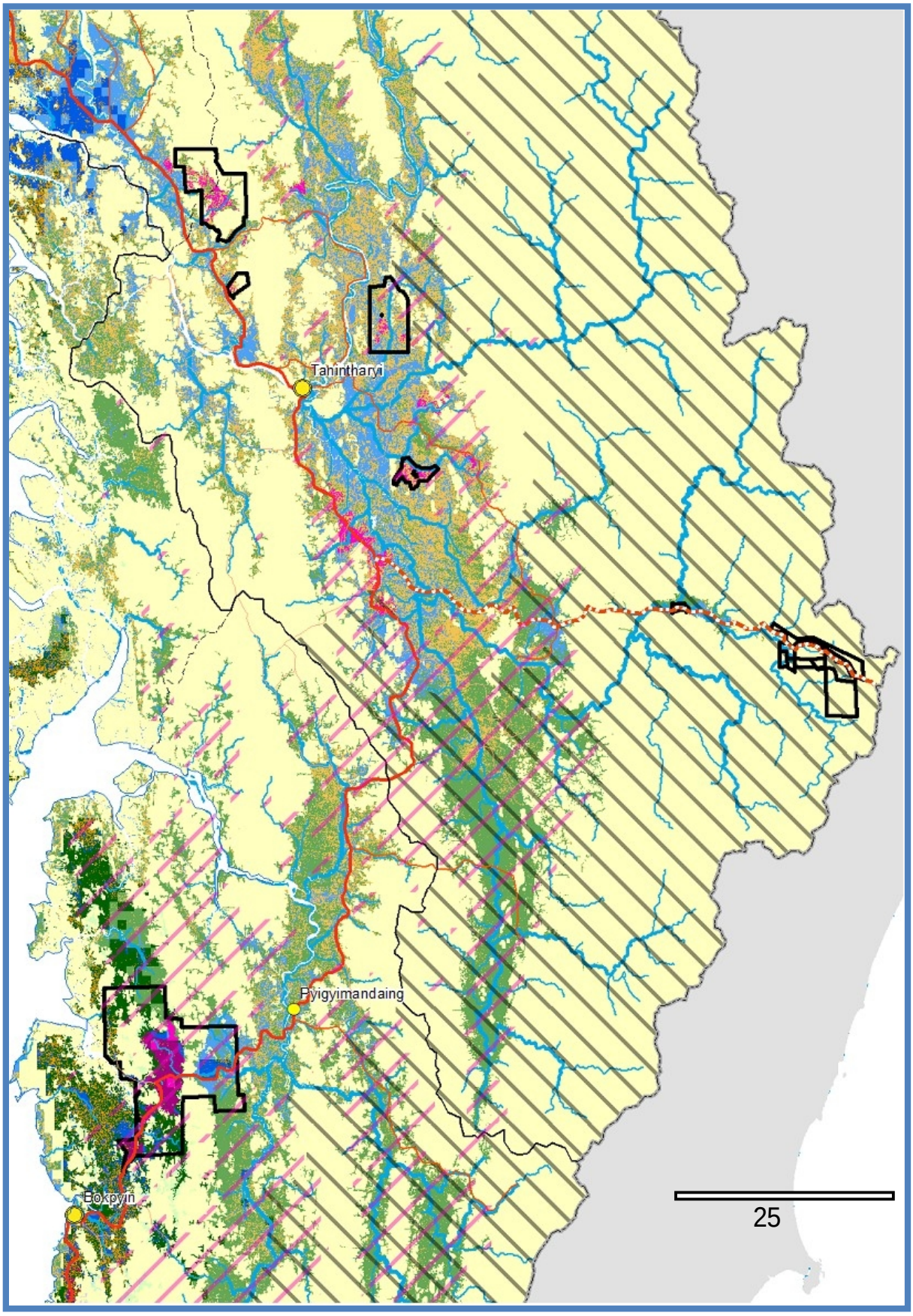


Figure 6. Oil palm suitability, land cover, plantation permits, conservation priority area and modelled habitat for Gurney's Pitta. Note that data on area cleared is current to 2012; data on area planted is current only to 2010. (Legend and 2 map sheets; refer to Figure 1 for the location of each sheet)

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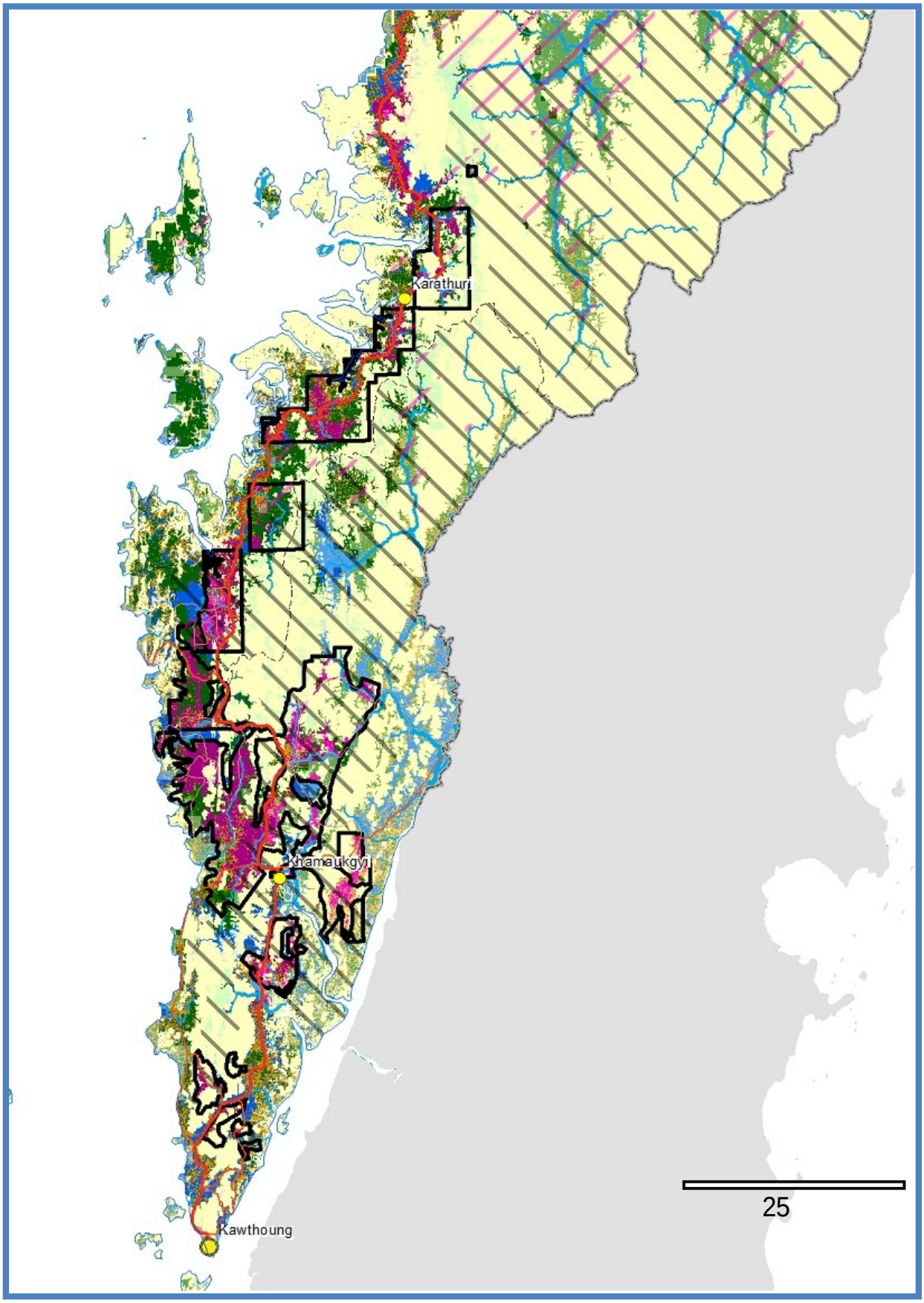
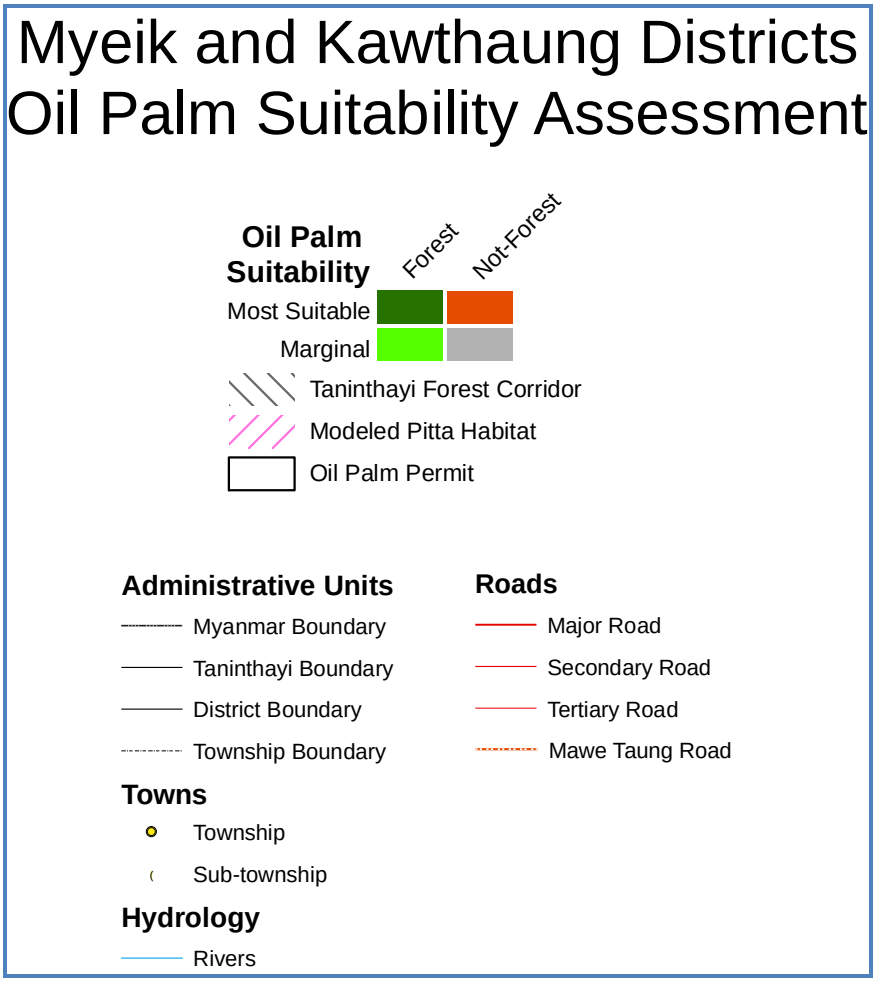
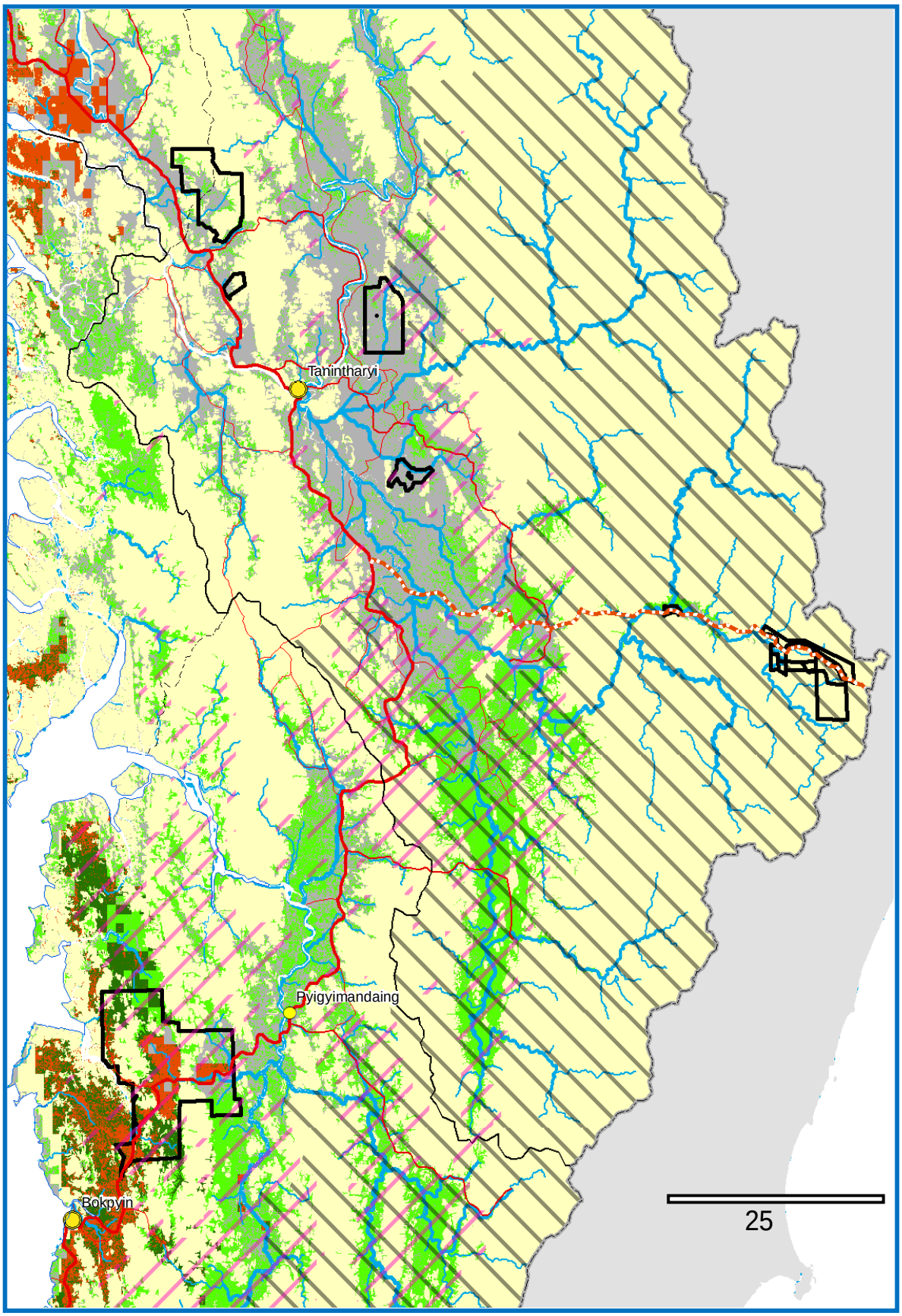


Figure 7. Areas with forest (tree cover >85%, Hansen 2013) and without forest (scrub, cleared or planted) within the most suitable zone for oil palm in Myeik and

Kawthaung Districts, Myanmar). Non-forest areas within the most suitable zone offer the greatest potential for increasing oil palm production by expansion of areas planted and improved agricultural practices. (Legend and 2 map sheets; refer to Figure 1 for the location of each sheet)

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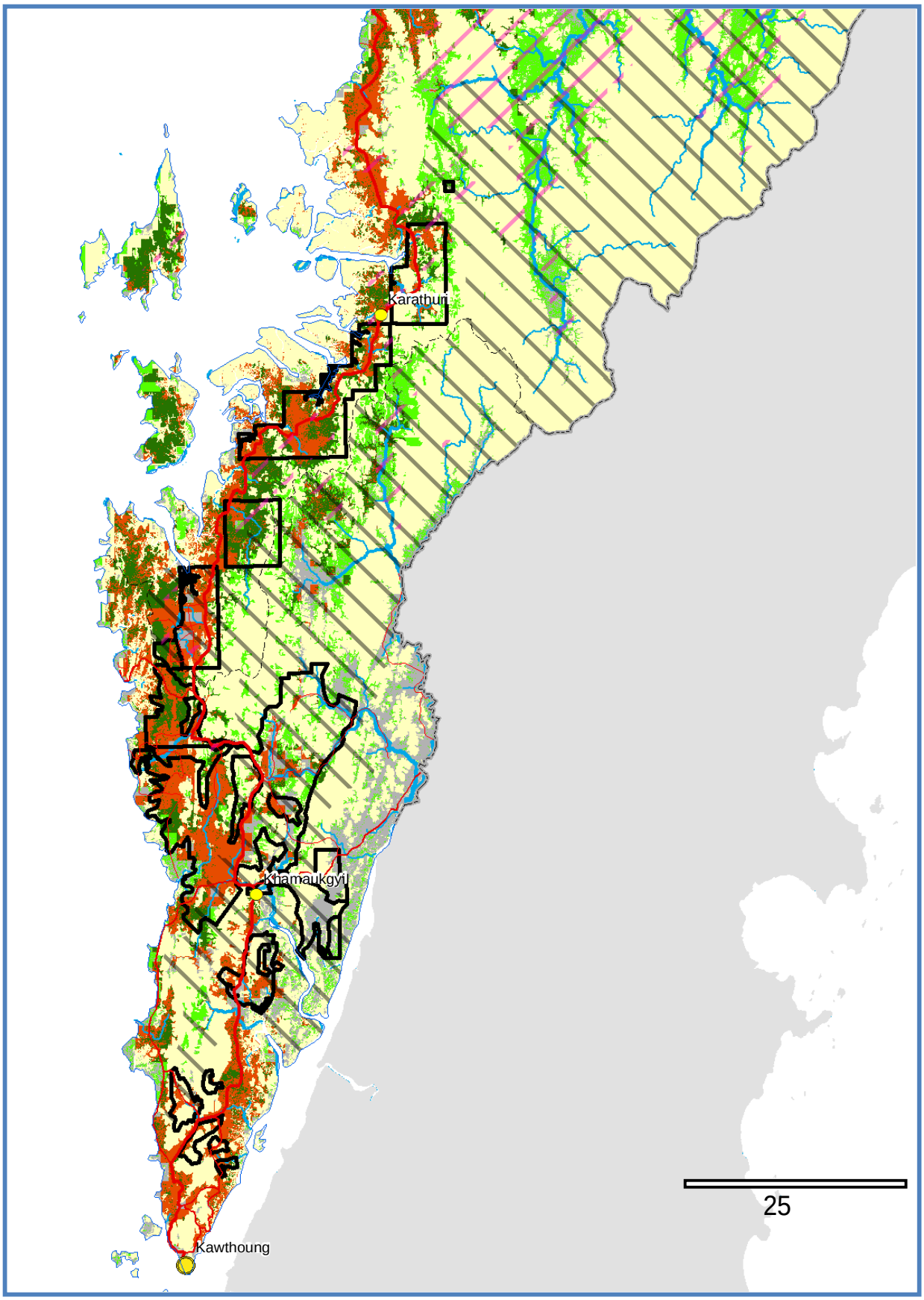
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