Table 2.3 Forest Area and Deforestation, 1985-1997 (GFW Estimate)

Table 2.2 presented in the body of this report utilizes data from the original RePPProT survey for forest cover in 1985 and from the World Bank study for forest cover in 1997. Table 2.3 presents GFW's deforestation estimates utilizing the modified RePPProT dataset developed by UNEP-WCMC and our own analysis of the GOI/World Bank dataset. Our analysis of the UNEP-WCMC dataset finds a somewhat lower estimate of total forest cover in 1985 than that of RePPProT. *(See Comment under Forest Cover in 1985, above*).

Holmes reports a total of 12,786,970 ha as "no data" areas. The largest "no data" area was in Irian Jaya, owing to the heavy cloud cover in that mountainous area. In a limited number of other provinces, listed in Annex Table 4, Holmes estimated the percentage of "no data" areas that were likely to be forested.

In total, Holmes estimated that of 5.3 million ha of "no data" areas, 2.8 million ha (53 percent) should be classified as forest. The area of assumed forest represents 9 percent of the adjusted forest area for the provinces presented in his report.

Our analysis of the GOI/World Bank dataset differs from that of Holmes in that we make no assumptions about possible forest cover in areas obscured by cloud, otherwise classified as "no data" or not classified at all ("unknown"). We categorize all these areas as "no data"; the total forest area is therefore lower (but not necessarily more accurate) than that produced by Holmes for the

Annex Table 4 Measured and Estimated Forest Area in Selected Provinces

Province	Measured Forest (Ha)	"No Data" Area (Ha)	"No Data" Area Assumed to be Forest (Ha)	Adjusted Forest Area (Ha)	"No Data" Area Assumed to be Forest (%)
Central Kalimantan	8,543,384	1,883,359	1,356,616	9,900,000	72
East Kalimantan	13,361,195	716,512	538,805	13,900,000	75
North Sulawesi	1,106,031	635,586	193,969	1,300,000	31
Central Sulawesi	2,892,697	1,152,402	507,303	3,400,000	44
South Sulawesi	2,114,703	534,416	185,297	2,300,000	35
Southeast Sulawesi	1,975,726	329,540	24,274	2,000,000	7
TOTAL	**29,993,736**	**5,251,815**	**2,806,264**	**32,800,000**	**53%**

Source: D. Holmes, "Deforestation in Indonesia: A Review of the Situation in 1999." (Jakarta, Indonesia: World Bank, 2000), Table 1.

three major islands of Sumatra, Kalimantan, and Sulawesi. As mentioned above, Holmes did not complete estimates of forest cover for Java, Bali, or Nusa Tenggara. Our estimates of forest cover in these islands are based only on areas positively identified as forest. After eliminating from consideration all "no data" areas in both the WCMC and GOI/World Bank datasets, we found that deforestation between 1985 and 1997 totaled 21.6 million ha, an area equivalent to 18 percent of forest cover at the beginning of the 12-year period. In addition, we overlaid the World Bank dataset with spatial data on industrial timber and estate crop plantation area from the NFI, 1996. By doing so, we identified 6.6 million ha that may have been wrongly classified as natural forest in the World Bank study. These areas are identified in the relevant maps as areas "reported as plantations: status unknown." However, in the absence of ground truthing, we chose not to remove them from our estimate of natural forest cover.

Table 2.6 Natural Forest, Potentially Degraded Forest, and Deforested Area, Mid-1990s

Source: GOI-FAO, 1996.

Methodology: Using the vegetation cover files of the National Forest Inventory, the following initial forest cover classes were defined: mountain forest, highland forest, lowland forest, mangrove forest, and swamp forest. These classes were aggregated to one category of natural forest. This grid was overlaid successively with the concession grid, industrial timber plantation and estate crop plantation grids, and spatial data on transmigration sites. Natural forest area that coincided with area under logging concession was defined as degraded (*but see the caveat in the text preceding Table 2.6*). Natural forest area that coincided with a plantation or a transmigration site was defined as deforested, on the assumption that natural forest so converted is unlikely to revert to natural forest cover. Where natural forest area coincided with more than one other land use category, the hierarchy chosen was transmigration site > estate crop > timber plantation > logging concession. Thus if a transmigration site coincided with a logging concession, the area was defined as deforested. The rationale for this ordering is that logging concessions can precede the other forms of forest conversion but cannot follow them.

Maps: Data Sources and Methodology

Map 1 Natural Forest Cover Change in Indonesia, 1985-1997

Sources: UNEP-WCMC, 1996, and GOI/World Bank, 2000.

Methodology: The two forest cover grids were overlaid to highlight forest areas lost since 1985. "No data" areas are identified. In addition, some areas classified as "forest" in the World Bank dataset are classified in the NFI dataset as industrial timber plantations or estate crop plantations. We identify these areas as "Reported as plantations: status unknown." Given the lack of ground truthing in the World Bank dataset, the areas are probably plantations.

Map 2 Natural Forest Cover Change in Kalimantan, 1985 –1997

Sources: UNEP-WCMC, 1996, and GOI/World Bank, 2000.

Methodology: As Map 1 above.

Map 3 Loss of Lowland, Submontane and Montane Forest, 1985-1997

Sources: UNEP-WCMC, 1996, and GOI/World Bank, 1999.

Methodology: The deforestation grid was overlaid with a digital elevation model (DEM) to classify deforested areas by elevation. Lowland forests were considered to be below 300m. Submontane forests were classified as being between 300m and 1,000m. Montane forests were categorized as being above 1,000m. The majority of deforestation has occurred in lowland forests.

Map 4 Extent and Distribution of Low Access and Accessed Forest, 1997

Sources: Forest cover from GOI/World Bank, 2000; plantation and concession data from GOI/FAO, 1996; river data from Digital Chart of the World; road data (including major logging roads) from sources in the Indonesian Ministry of Transportation; settlements and transmigration sites from the Ministry of Transmigration, provided by FWI.

Definitions: Low access forests are those believed to be relatively undisturbed by human activity. They are defined as forest areas that are more than 1 km distant from roads, logging concessions, industrial timber plantations, estate crop plantations, or other forest developments. In the case of Kalimantan, forest areas that are more than 0.5 km distant from navigable rivers with no more than one mapped settlement per 30 km were also considered to be low access forests.

Methodology: The GOI/World Bank forest cover dataset was used to map the extent and distribution of low access forests; "no data" areas in this dataset were filled using the National Forest Inventory forest cover dataset (1996). Roads were buffered 1 km on either side and converted to a grid. By overlaying settlement and river data layers, river segments with no more than one mapped settlement per 30 km were selected. Selected rivers were buffered 15 km upstream and downstream of each settlement and 0.5 km on either side. The resulting coverage was converted to a grid. Rivers within swamps and hill forest were considered unaccessed and were excluded from this analysis. The river, road, and forest cover grids were merged. Any forest grid cells outside road and/or river linear features were extracted and overlaid with plantations and estate crops. Forest areas that overlapped with plantations and estate crops were eliminated. The resulting forest lands were classified as low access forest. All excluded forest areas were classified as accessed forest. Low access forests were further characterized based on whether they are located in logging concessions. The low access forest grid was overlaid with the concessions grid. Forest areas were then delineated as either within or outside concession areas. Forest area falling within concessions may be regarded as "contact zones," where the probability of access and disturbance is higher. Note that in the absence of data on the status of concessions (active, inactive, or expired) as well as information on the condition of protected areas, this analysis of the status of Indonesia's potentially intact forest is incomplete.

Map 5 Fragmentation of Low Access and Potentially Low Access Forest

Sources: As for Map 4.

Methodology: Low access forest areas were grouped into contiguous tracts of forest and reclassified based on the following size categories:

200 km^2-500 km^2

501 km^2-10,000 km^2

Over 10,000 km^2

Map 6 Protection Status of Low Access and Potentially Low Access Forest

Sources: Forest cover as for Map 4. Protected area data from UNEP-WCMC: subset of V 4.0 UNEP-WCMC Protected Areas Global GIS dataset. March 2000.

Methodology: The low access forest grid was overlaid with the protected area data. The resulting grid was further overlaid with the concession area grid from the NFI to classify the protected areas further according to whether they are located within or outside logging concessions.

Map 7 Extent and Distribution of Protected Areas, Kalimantan

Sources: Forest Cover as for Map 4. Protected area data from UNEP-WCMC: subset of V 4.0 UNEP-WCMC Protected Areas Global GIS dataset. March 2000.

Methodology: No additional analysis was performed for this map.

Map 8 Extent and Distribution of Logging Concessions

Source: GOI-FAO, 1996.

Methodology: No additional analysis was performed for this map.

Comment: The data in this map are outdated. More recent nonspatial data were made available from the Ministry of Forestry, with attribute data, including location, size, and ownership of concession. Unfortunately, it was not possible to georeference these data, and the information in the NFI remains the most recent spatial data that we were able to access.

Map 9 Limited Survey of Reported Cases of Illegal Logging

Sources: Based on reports of illegal logging published between 1997 and 1998 in the following Indonesian newspapers: *Suara Pembaruan; Kompas; Media Indonesia; Bisnis Indonesia; Rakyat Merdeka; Radar Bogor, Koran Tempo; Business News; The Jakarta Post; Serambi Indonesia; Cendrawasih Post; Kaltim Post; Kontan; Republika; Suara Karya; Harian Terbit; Harian Ekonomi; Forum Keadilan; Kalteng Post; Kendari Post; Merdeka; Pakuan; Pelita Bangsa; Pikiran Rakyat; Riau Pos; Samarinda Pos; Sinar Tani; Sinar Pagi; Terbit; Warta Kota; Banjarmasin Pos; Berita Keadilan; DR; Tempo*. Data were also collected via investigative reports from members of the Forest Watch Indonesia network.

Map 10 Extent and Distribution of Estate Crops in Sumatra

Source: GOI-FAO, 1996

Methodology: No additional analysis was performed for this map.

Map 11 Plantations in Former Logging Concessions, Sumatra and Kalimantan

Source: GOI-FAO, 1996.

Methodology: The logging concession, estate crop plantation, and industrial timber plantation grids were overlaid to identify areas classified as both a logging concession and a plantation. The most likely explanation for such overlaps is that plantations have been established in former concession areas. Such overlaps are not uncommon in the NFI because the survey was developed in part on the basis of land use (land tenure) documents. Not infrequently, applications for a logging concession and for a license to convert forest to a plantation will compete for the same area of forest. Equally, some companies hold licenses to operate forest land as a logging concession and, subsequently, convert their own concession to a plantation.

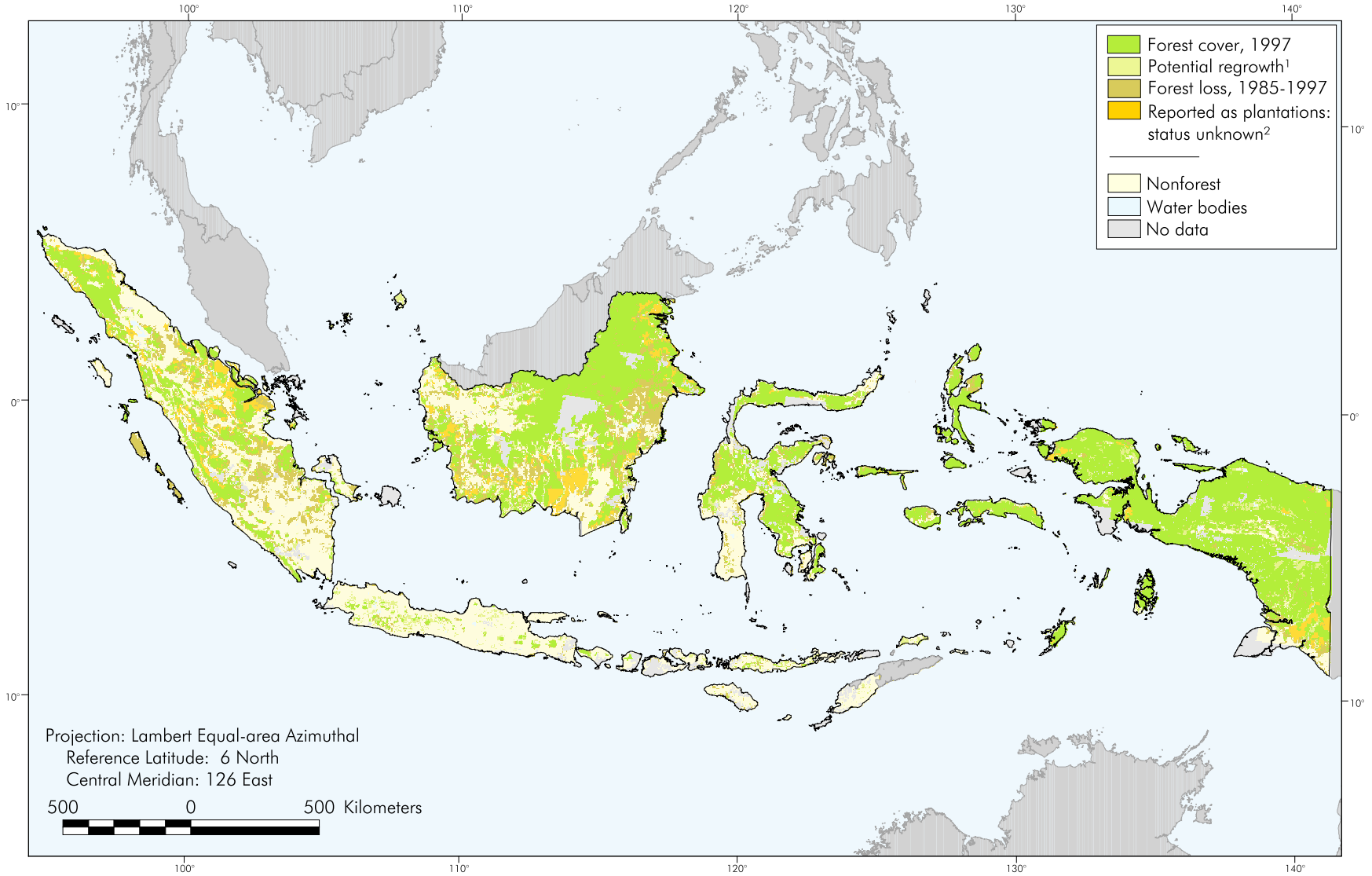
Map 12 Forest Uses and Areas Burned in 1997-1998: East Kalimantan

Source: A.A. Hoffmann, A. Hinrichs, and F. Siegert. 1999. *Fire Damage in East Kalimantan in 1997/1998 Related to Land Use and Vegetation: Satellite Radar Inventory Results and Proposals for Further Actions*. IFFM-SFMP Report 1a. ISBN 979-606-044-2.

Map 13 Limited Survey of Reported Conflicts Over Forest Resources

Source: Government of Indonesia, Ministry of Forestry information, 1997-1999; reports of forest-related conflict published between 1997 and 1998 in the Indonesian newspapers listed for Map 9.

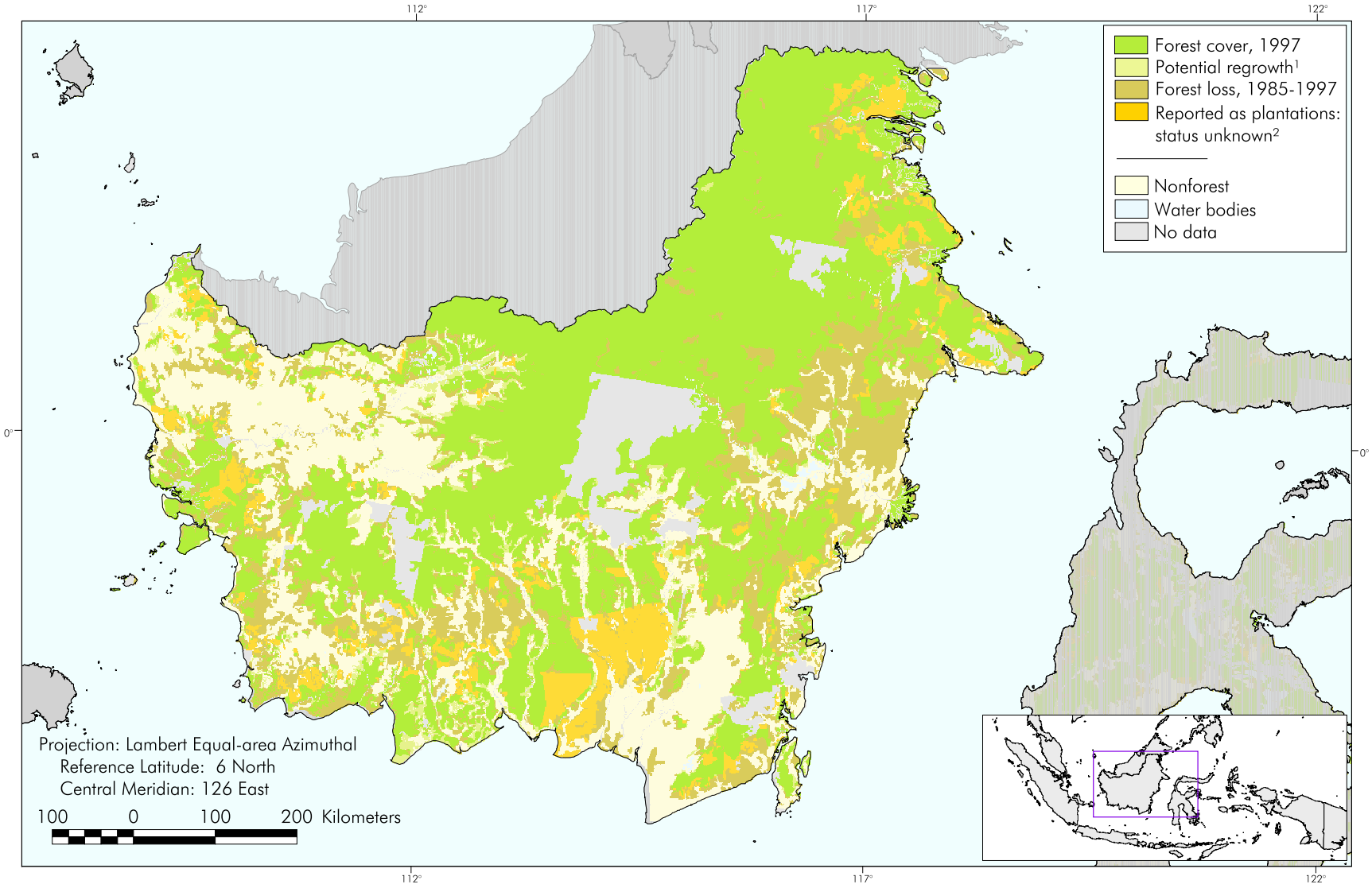
MAP 1 Natural Forest Cover Change in Indonesia, 1985-1997



Sources:
Forest cover for 1997: GOI/World Bank, 2000. Forest cover for 1985: UNEP-WCMC, 2000 based on RePPProT data. Estate crops and plantations: GOI/FAO, 1996. Boundaries: ESRI Digital Chart of the World (DCW), 1993 and FWI, 2001.

Notes:
[1] Potential regrowth areas are classified as forest in GOI/World Bank 2000 but not in UNEP-WCMC, 1996. In some cases, it appears that these areas are an artifact of the overlay process.
[2] These are areas identified as forest in GOI/World Bank, 2000 and as estate crops or plantations in GOI/FAO, 1996.

MAP 2 Natural Forest Cover Change in Kalimantan, 1985-1997



Sources:
Forest cover for 1997: GOI/World Bank, 2000. Forest cover for 1985: UNEP-WCMC, 2000 based on RePPProT data. Estate crops and plantations: GOI/FAO, 1996. Boundaries: ESRI Digital Chart of the World (DCW), 1993 and FWI, 2001.

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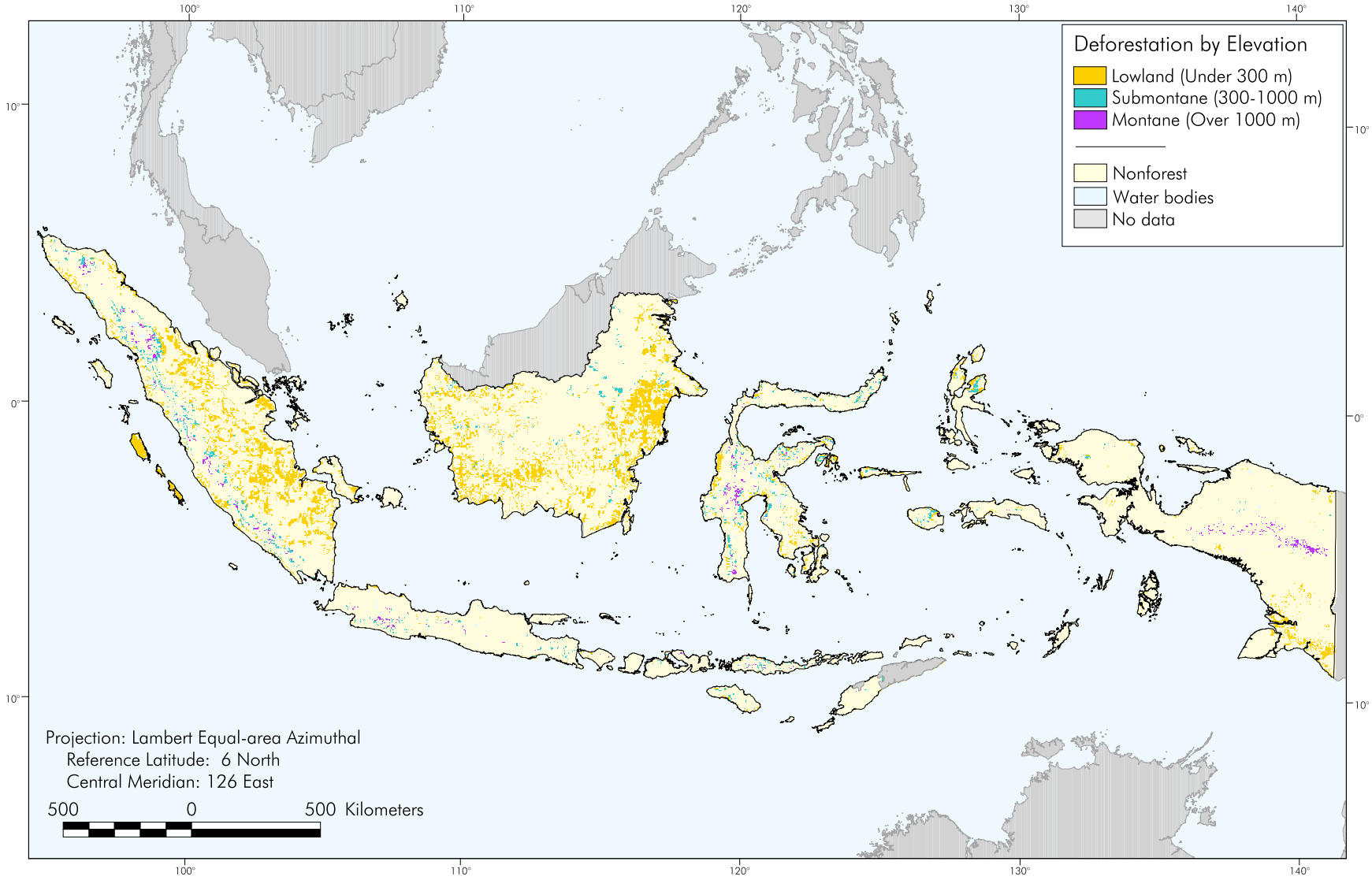
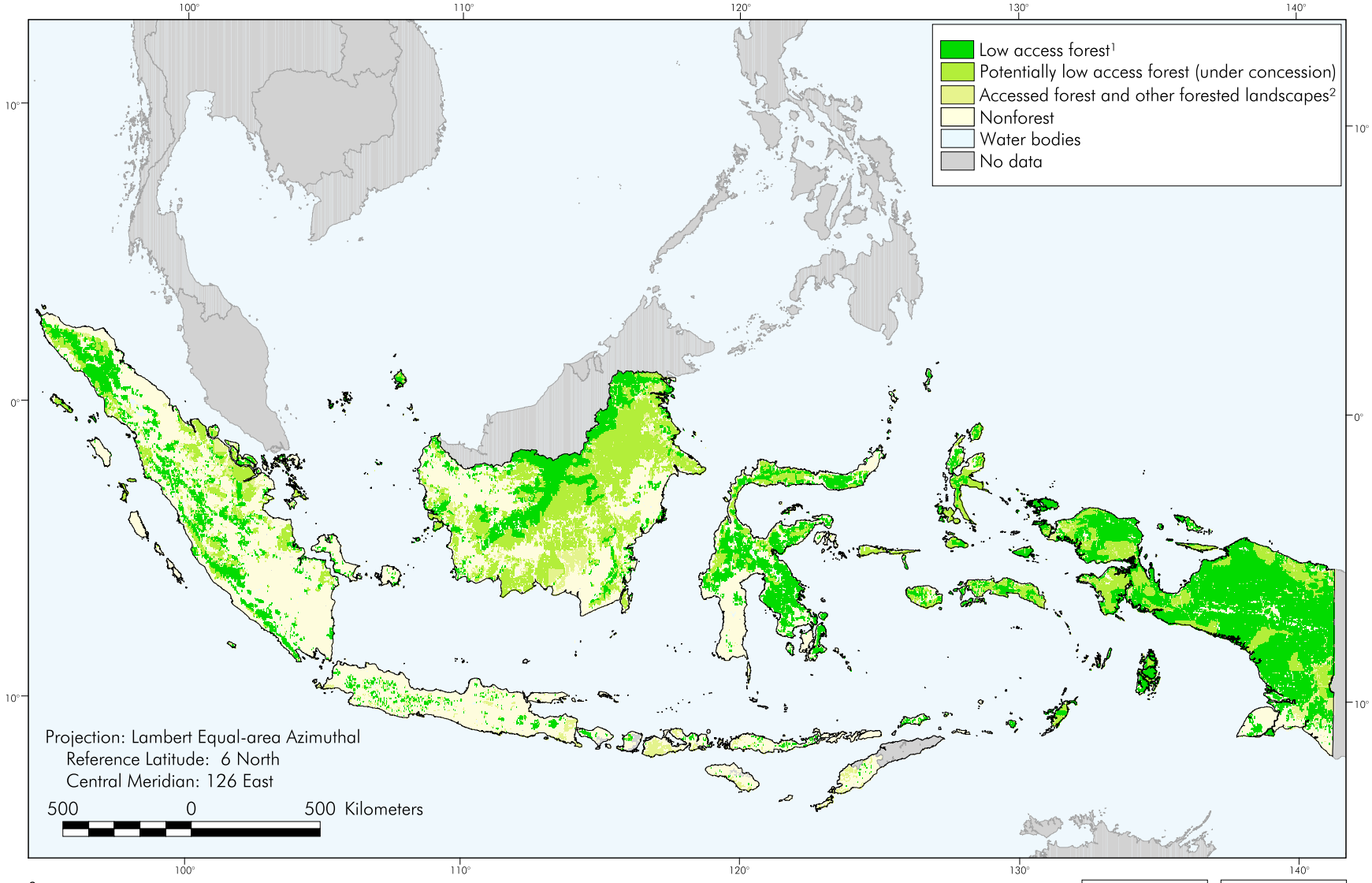
MAP 3 Loss of Lowland, Submontane, and Montane Forest, 1985-1997



Sources:
Forest cover for 1997: GOI/World Bank, 2000. Forest cover for 1985: UNEP-WCMC, 1996 based on RePPProT data.
Elevation: USGS, 2000. Boundaries: ESRI Digital Chart of the World, 1993 and FWI, 2001.

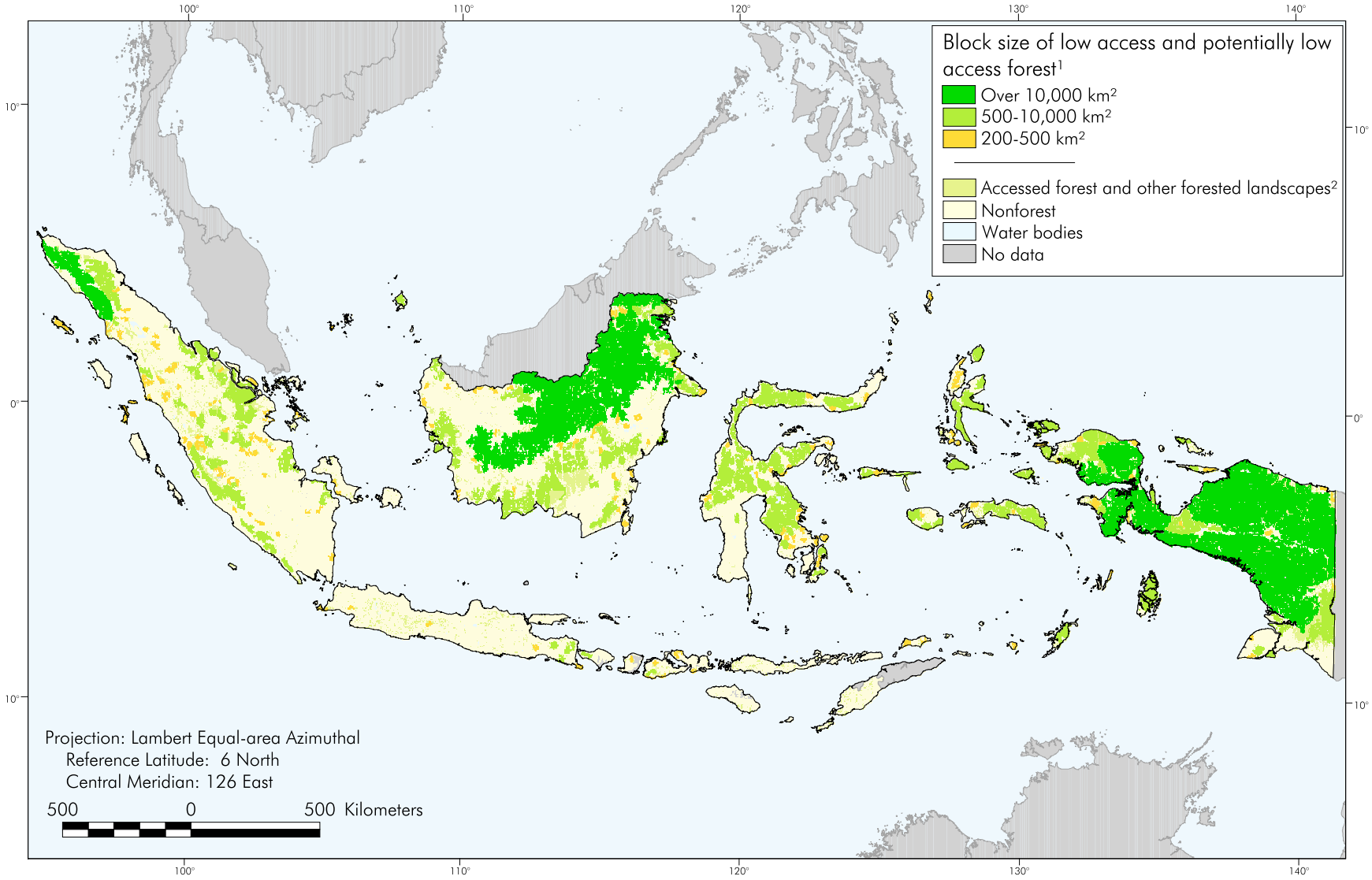
MAP 4 Extent and Distribution of Low Access and Accessed Forest, 1997



Sources:
Base forest cover: GOI/World Bank, 2000, modified with GOI/FAO, 1996. Forest concessions: GOI/FAO, 1996.
Boundaries: ESRI Digital Chart of the World, 1993 and FWI, 2001.

Notes:
[1] Low access forests are presumed natural forests; however, the dataset does not identify forests that have been degraded by fires or other human activities.
[2] Includes areas of forest reported as plantations (see Map 1) and accessed forests within 1km of roads or navigable waterways.

MAP 5 Fragmentation of Low Access and Potentially Low Access Forest



Sources:
Base forest cover: GOI/World Bank, 2000 modified with GOI/FAO, 1996. Forest concessions: GOI/FAO, 1996.
Boundaries: ESRI Digital Chart of the World, 1993 and FWI, 2001.

Notes:
[1] Low access forests are presumed natural forests; however, the dataset does not identify forests that have been degraded by fires or other human activities.
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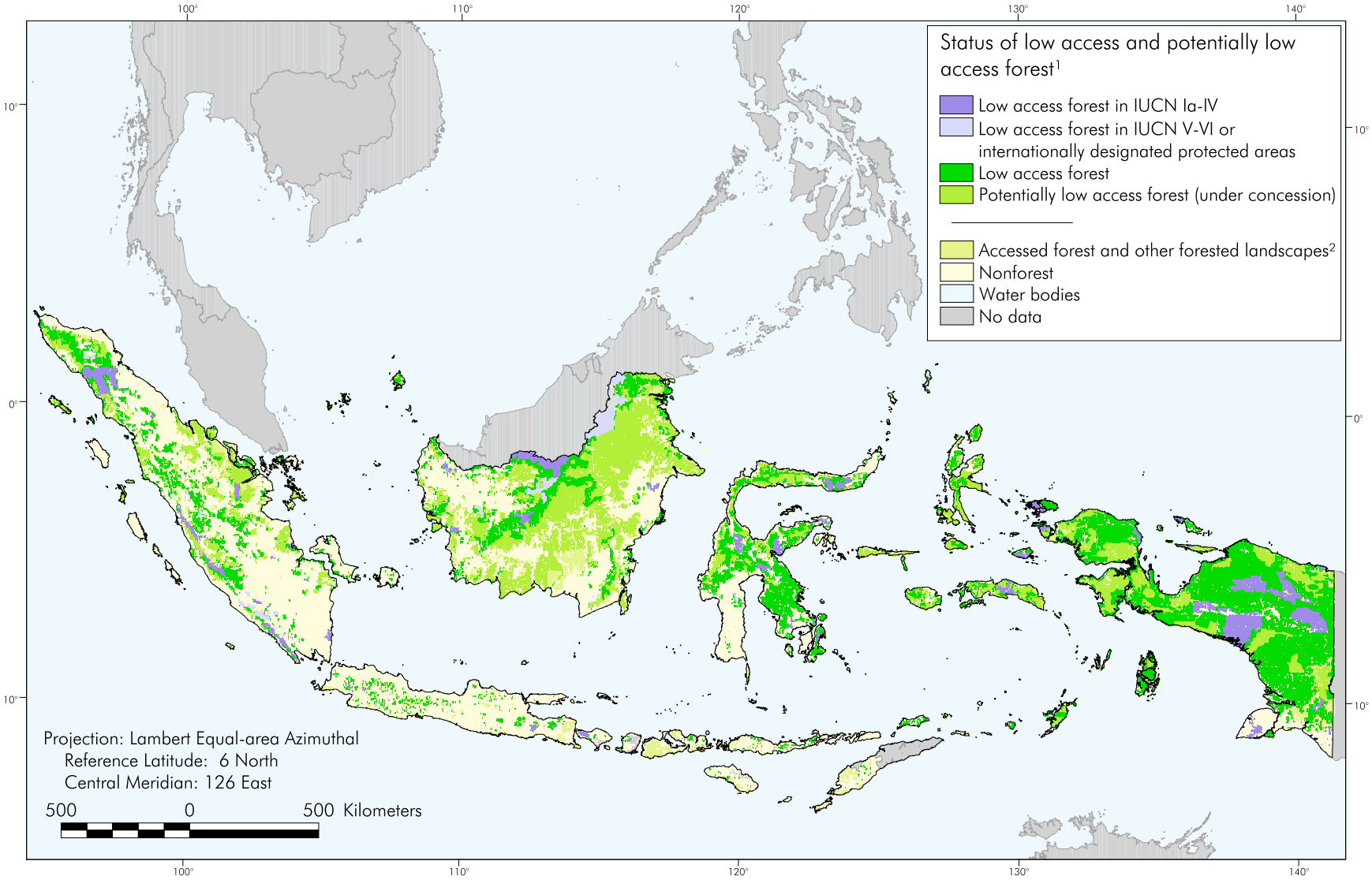
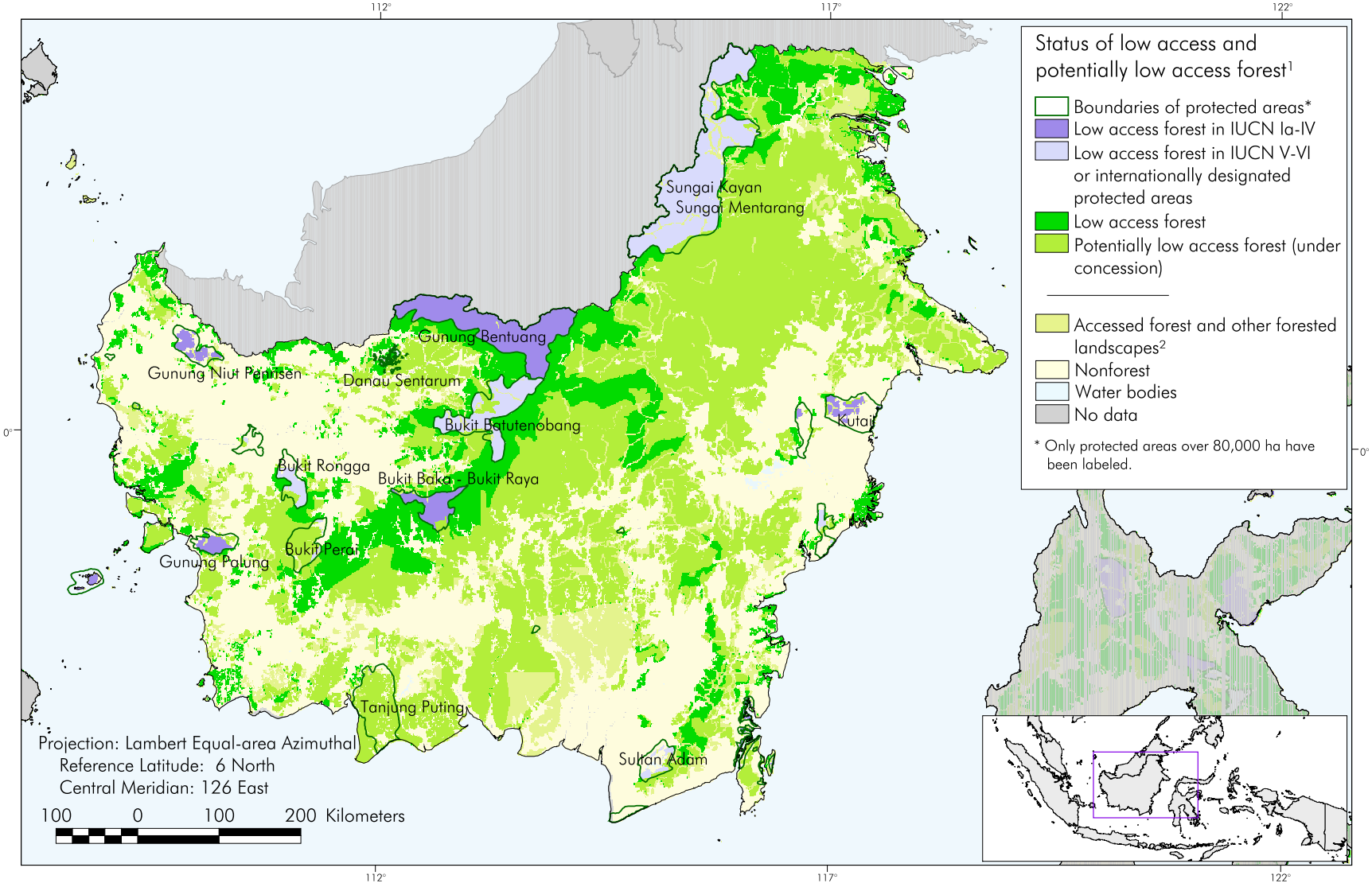
MAP 6 Protection Status of Low Access and Potentially Low Access Forest



Sources:
Base forest cover: GOI/World Bank, 2000 modified with GOI/FAO, 1996. Protected area boundaries: UNEP-WCMC, 2000. Forest concessions: GOI/FAO, 1996. Boundaries: ESRI Digital Chart of the World, 1993 and FWI, 2001.

Notes:
[1] Low access forests are presumed natural forests; however, the dataset does not identify forests that have been degraded by fires or other human activities.
[2] Includes areas of forest reported as plantations (see Map 1) and accessed forests within 1km of roads or navigable waterways.

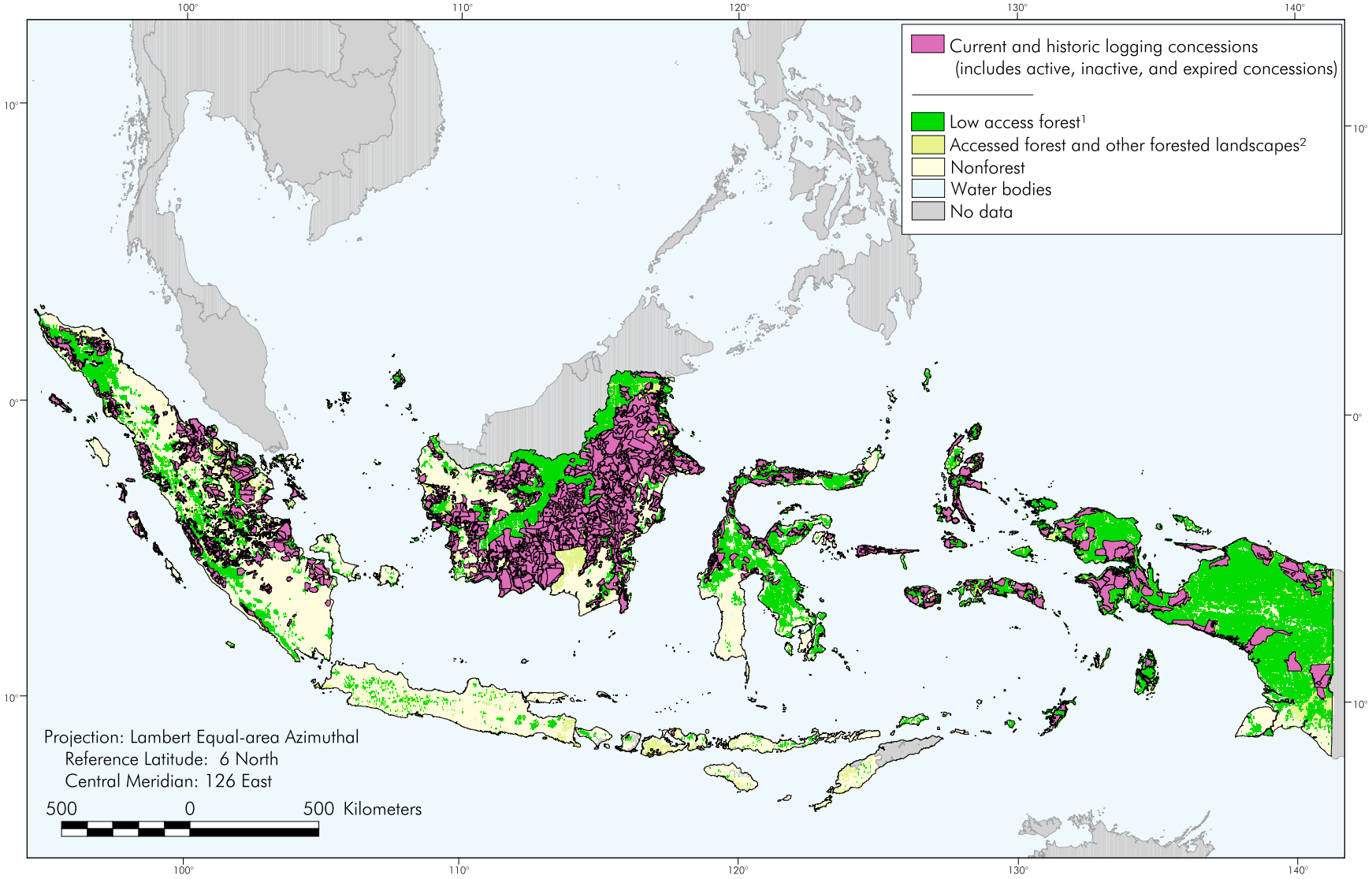
MAP 7 Extent and Distribution of Protected Areas, Kalimantan



Sources:
Base forest cover: GOI/World Bank, 2000 modified with GOI/FAO, 1996. Protected area boundaries: UNEP-WCMC, 2000. Forest concessions: GOI/FAO, 1996. Boundaries: ESRI Digital Chart of the World, 1993 and FWI, 2001.

Notes:
[1] Low access forests are presumed natural forests; however, the dataset does not identify forests that have been degraded by fires or other human activities.
[2] Includes areas of forest reported as plantations (see Map 1) and accessed forests within 1km of roads or navigable waterways.

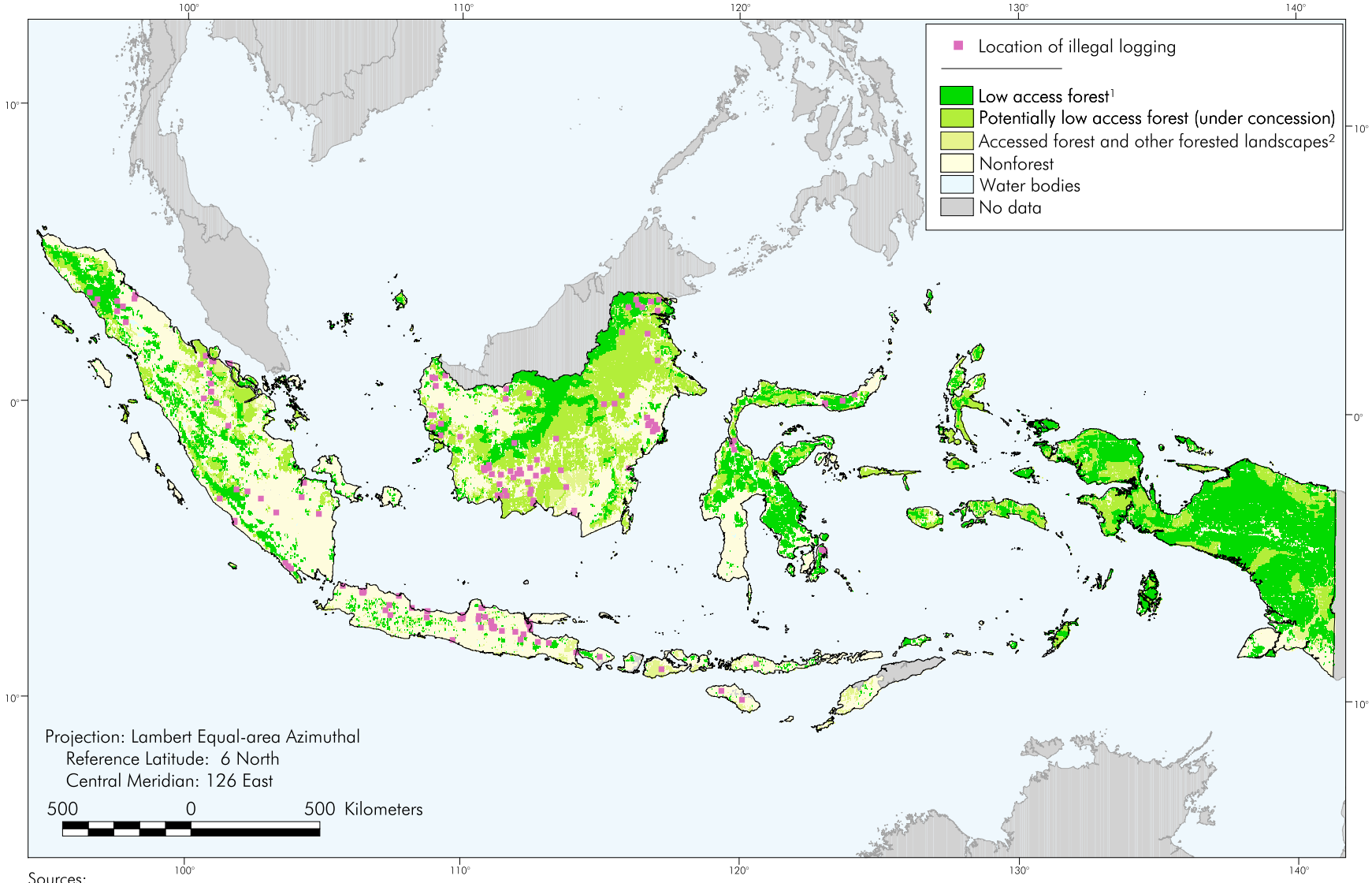
MAP 8 Extent and Distribution of Logging Concessions



Sources:
Base forest cover: GOI/World Bank, 2000 modified with GOI/FAO, 1996. Forest concessions: GOI/FAO, 1996.
Boundaries: ESRI Digital Chart of the World, 1993 and FWI, 2001.

Notes:
[1] Low access forests are presumed natural forests; however, the dataset does not identify forests that have been degraded by fires or other human activities.
[2] Includes areas of forest reported as plantations (see Map 1) and accessed forests within 1km of roads or navigable waterways.

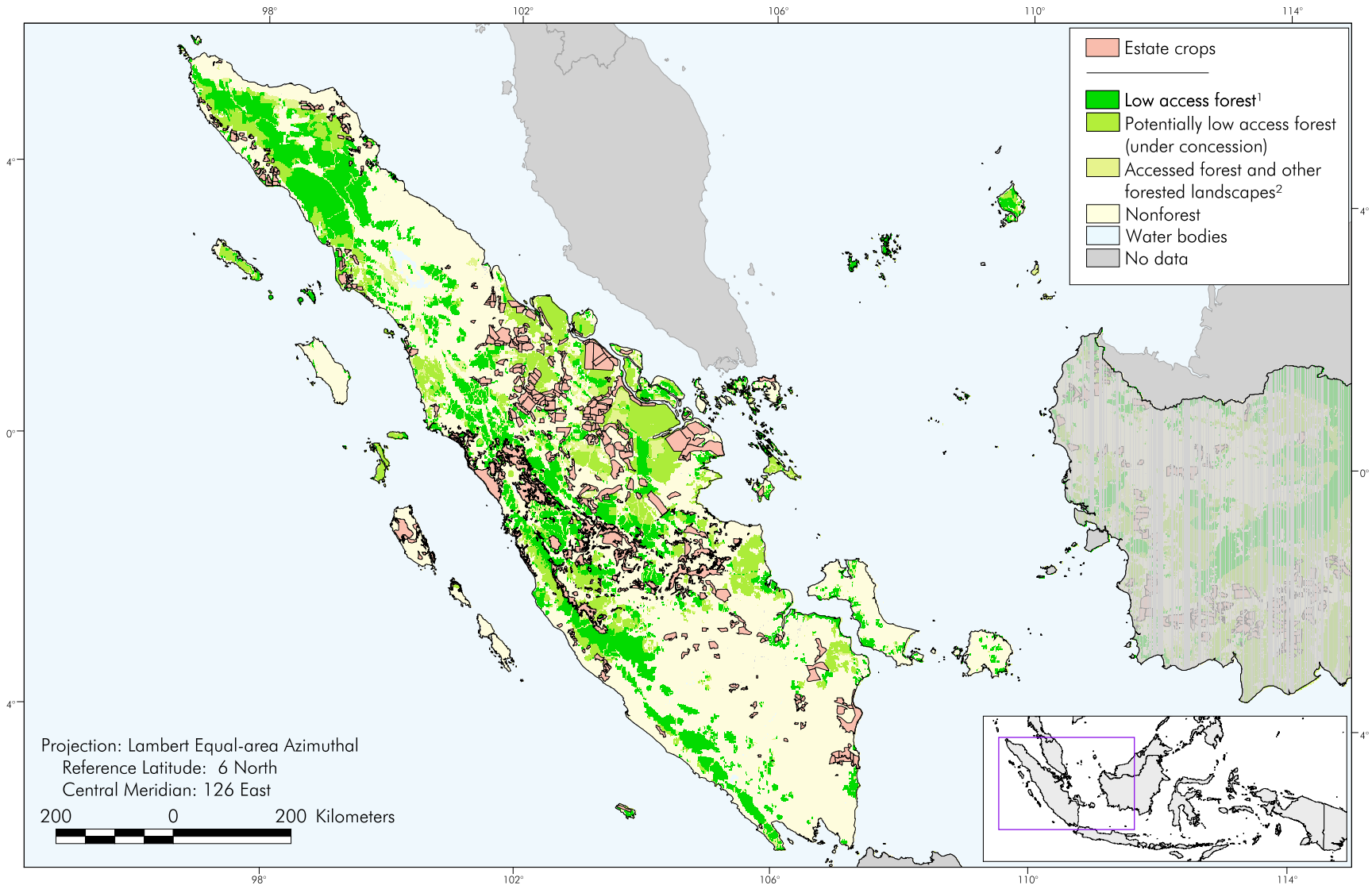
MAP 9 Limited Data Survey of Reported Cases of Illegal Logging, 1997-1998



Sources:
Base forest cover: GOI/World Bank, 2000 modified with GOI/FAO, 1996. Forest concessions: GOI/FAO, 1996. Illegal logging: FWI compilation of information from Indonesian newspapers between 1997 and 1998. Boundaries: ESRI Digital Chart of the World, 1993 and FWI, 2001.

Notes:
[1] Low access forests are presumed natural forests; however, the dataset does not identify forests that have been degraded by fires or other human activities.
[2] Includes areas of forest reported as plantations (see Map 1) and accessed forests within 1km of roads or navigable waterways.

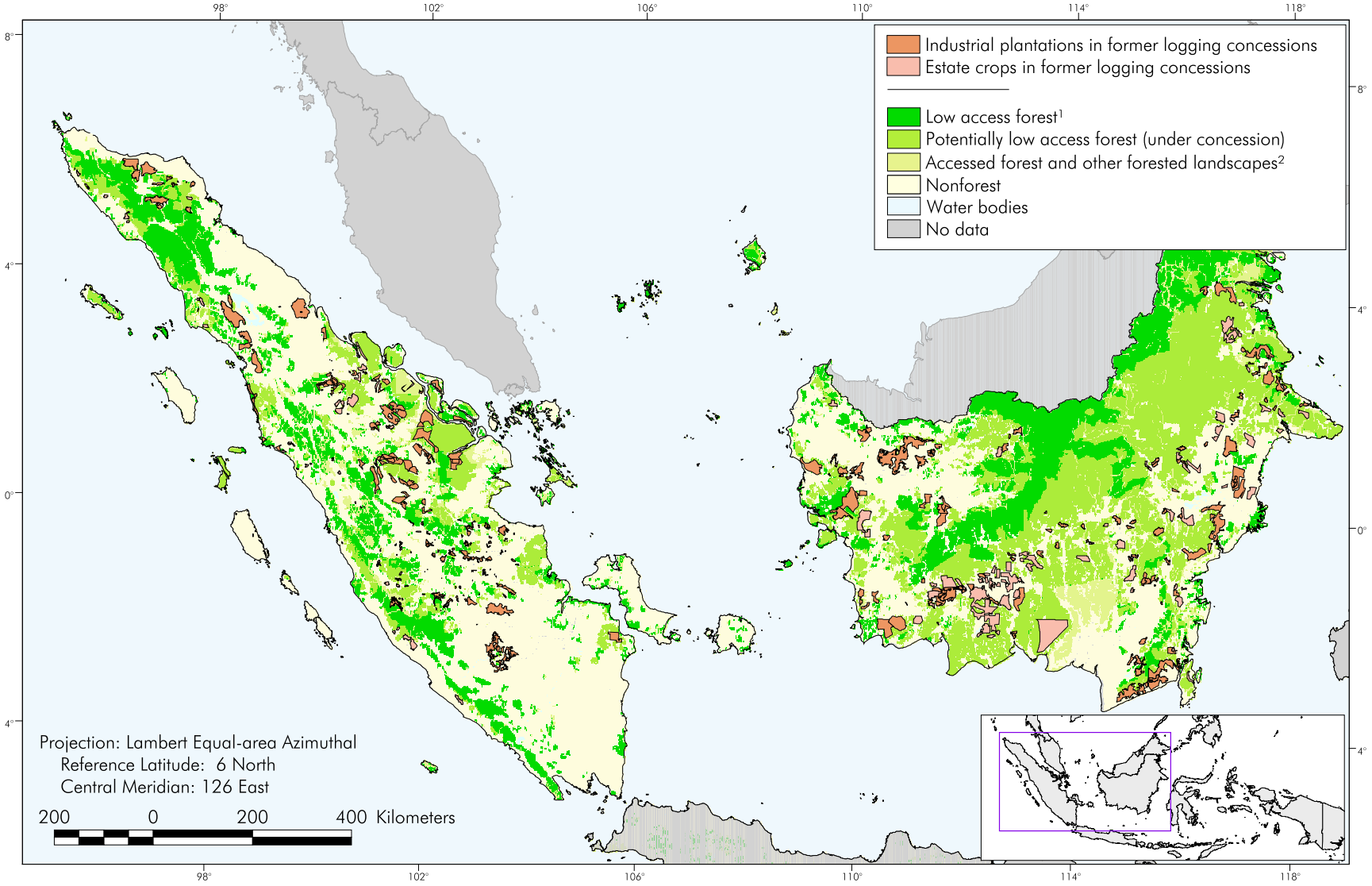
MAP 10 Extent and Distribution of Estate Crops in Sumatra



Sources:
Base forest cover: GOI/World Bank, 2000 modified with GOI/FAO, 1996. Forest concessions: GOI/FAO, 1996.
Estate crops: GOI/FAO, 1996. Boundaries: ESRI Digital Chart of the World, 1993 and FWI, 2001.

Notes:
[1] Low access forests are presumed natural forests; however, the dataset does not identify forests that have been degraded by fires or other human activities.
[2] Includes areas of forest reported as plantations (see Map 1) and accessed forests within 1km of roads or navigable waterways.

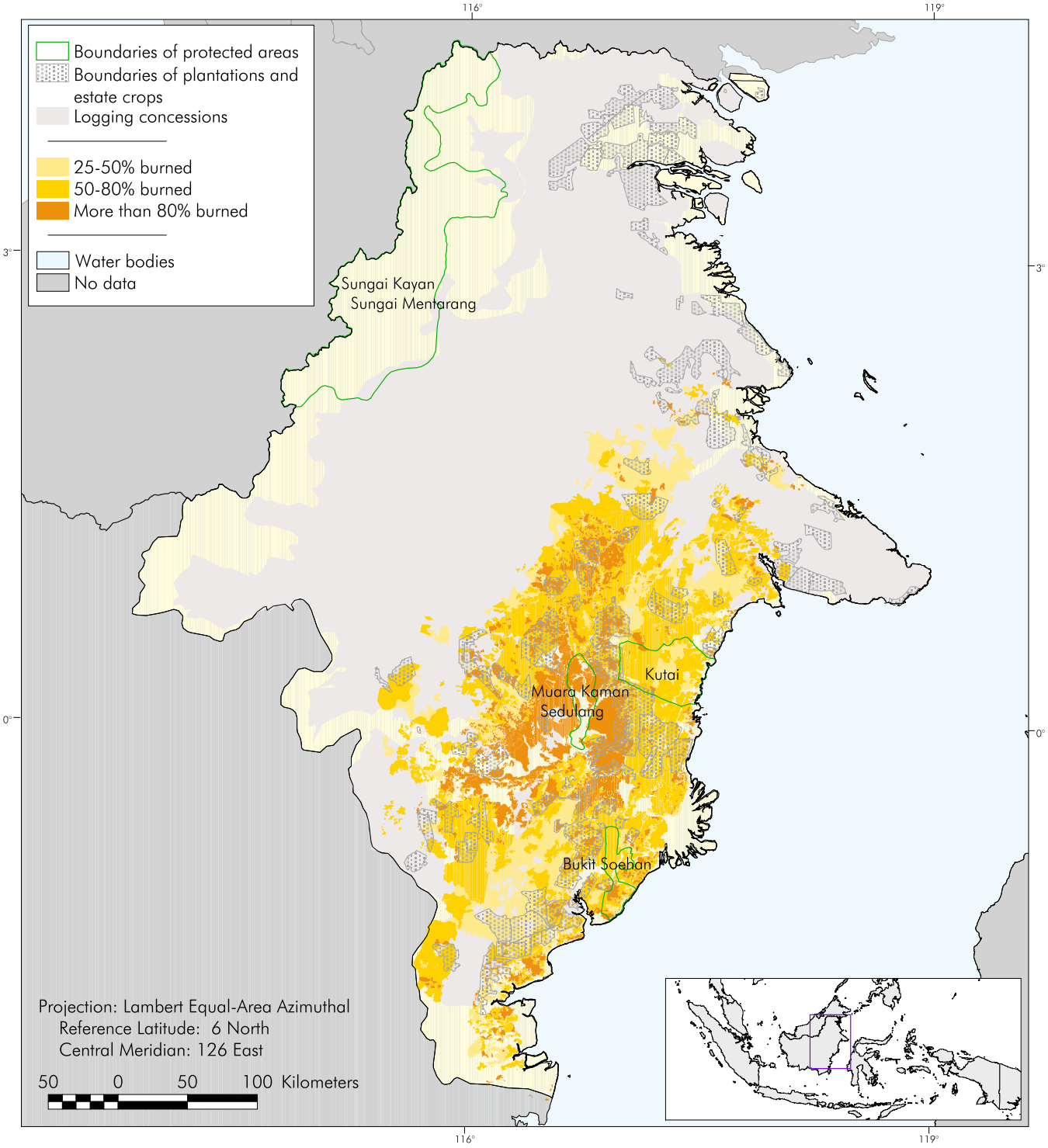
MAP 11 Plantations in Former Logging Concessions, Sumatra and Kalimantan



Sources:
Base forest cover: GOI/World Bank, 2000 modified with GOI/FAO, 1996. Forest concessions: GOI/FAO, 1996.
Estate crops: GOI/FAO, 1996. Boundaries: ESRI Digital Chart of the World, 1993 and FWI, 2001.

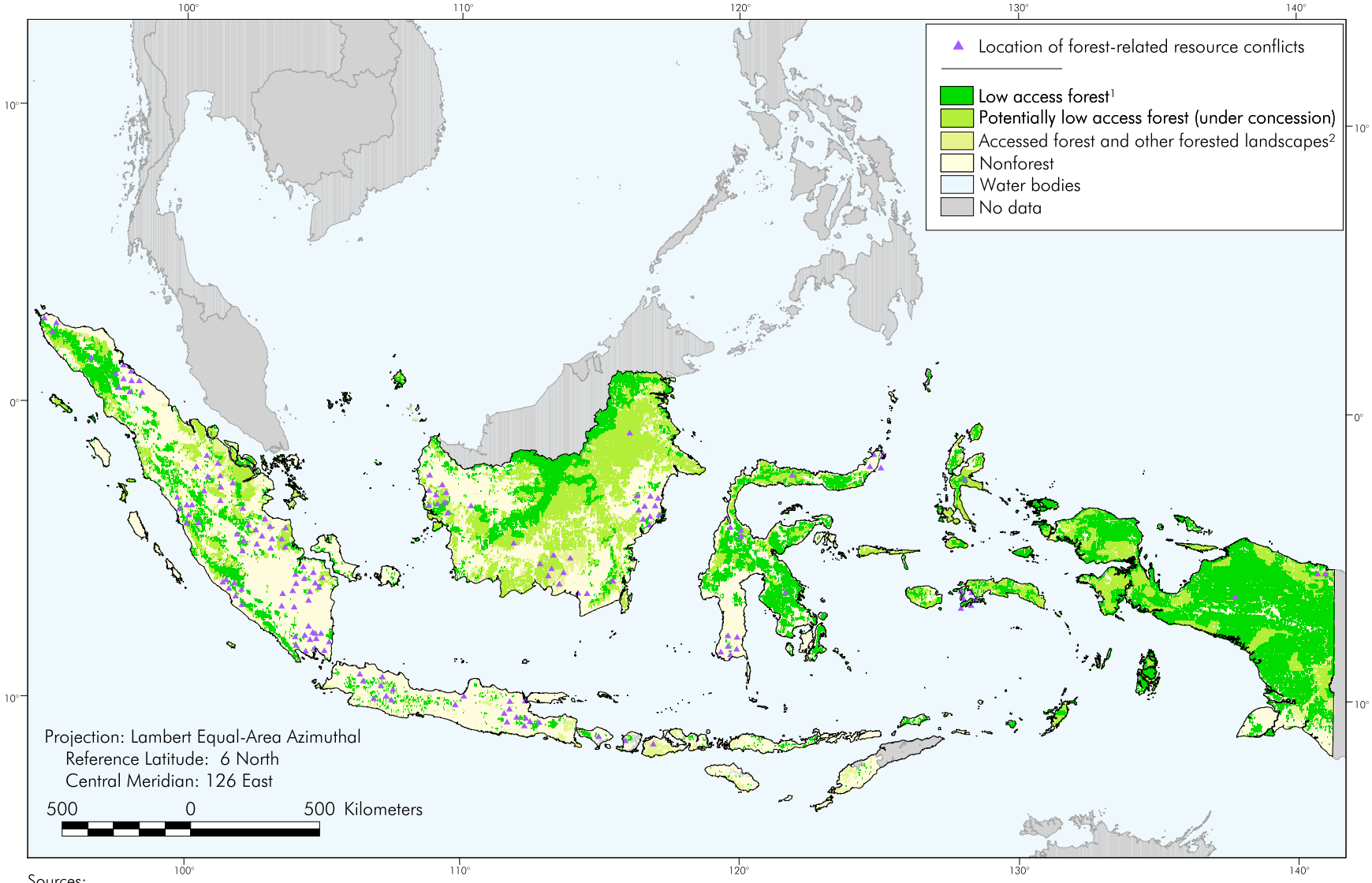
Notes:
[1] Low access forests are presumed natural forests; however, the dataset does not identify forests that have been degraded by fires or other human activities.
[2] Includes areas of forest reported as plantations (see Map 1) and accessed forests within 1km of roads or navigable waterways.

MAP 12 Forest Uses and Areas Burned in 1997-1998: East Kalimantan



Sources:
Protected areas: UNEP-WCMC, 2000. Plantations, estate crops, logging concessions, and fires: A. Hoffmann, A. Hinrichs, and F. Siegart (Deutsche Gesellschaft für Technische Zusammenarbeit), 1999. Boundaries: ESRI Digital Chart of the World, 1993 and FWI, 2001.

MAP 13 Limited Data Survey of Reported Conflicts Over Forest Resources, 1997-1999



Sources:
Base forest cover: GOI/World Bank, 2000 modified with GOI/FAO, 1996. Forest concessions: GOI/FAO, 1996. Forest-related conflicts: FWI compilation of information from Indonesian newspapers between 1997 and 1998. Boundaries: ESRI Digital Chart of the World, 1993 and FWI, 2001.

Notes:
[1] Low access forests are presumed natural forests; however, the dataset does not identify forests that have been degraded by fires or other human activities.
[2] Includes areas of forest reported as plantations (see Map 1) and accessed forests within 1km of roads or navigable waterways.