

## Current Achievements to Reduce Deforestation in Kalimantan

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Received: 2017-04-03 / Revision: 2017-09-14 / Accepted: 2018-08-10  
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**Abstract** Indonesia has developed its forest reference emission level (FREL), using a historical reference period of 1990-2012. Based on official Ministry of Environment and Forestry (MoEF) data, this paper analyses gross deforestation rates and emissions from deforestation in the five provinces of the island of Kalimantan which occurred in the time after 2012, i.e. 2013 until 2015, and puts them in relation to the average annual deforestation and emission rates of each province in the reference period. Even though the overall linear trend of deforestation and emission rates in Kalimantan from 1990 until 2015 goes down, this trend is not reflected in all of the five provinces equally. West and North Kalimantan's rates even seem to be on the rise. The potentials to achieve emission reduction targets thus remain unequal for each province in Kalimantan Island.

**Keywords:** deforestation, emission reduction, forest reference emission level, REDD+, Kalimantan, Indonesia

**Abstrak** Indonesia telah membuat tingkat referensi emisi hutan (FREL), menggunakan data referensi historis dari tahun 1990-2012. Berbasis data resmi dari Kementerian Lingkungan Hidup dan Kehutanan (KLHK), tulisan ini menganalisis laju gross deforestasi dan emisi pada lima provinsi di Pulau Kalimantan yang terjadi pada waktu setelah tahun 2012, yaitu 2013 sampai 2015 dan mengkaitkannya dengan rata-rata deforestasi tahunan dan laju emisi di setiap provinsi selama periode referensi. Meskipun secara umum kecenderungan tingkat deforestasi dan emisi di Kalimantan dari tahun 1990 sampai 2015 terus menurun, kecenderungan ini tidak merefleksikan kondisi yang sama pada kelima provinsi tersebut. Laju deforestasi di Kalimantan Barat dan Kalimantan Utara terlihat menjadi naik atau meningkat. Oleh karena itu pencapaian dari target penurunan emisi pada setiap provinsi di Kalimantan menjadi tidak akan sama.

**Kata kunci:** deforestasi, pengurangan emisi, tingkat referensi emisi hutan, REDD+, Kalimantan, Indonesia

### 1. Introduction

In 2015, Indonesia submitted its Forest Reference Emission Level (FREL) to UNFCCC during the COP21 in Paris, hence implementing Decision 1/CP.16 (paragraph 71) from the climate change conference in Cancun in 2010 which requests developing countries to develop a national REDD+ strategy or action plan, a national forest reference emission level, a robust and transparent national forest monitoring system, and a safeguards information system. In the framework of REDD+, a FREL is the required baseline to allow performance-based payments for the reduction of emissions from deforestation and forest degradation.

For assessing and quantifying deforestation and forest degradation is necessary to compare them against this now established baseline. There are numerous publications assessing deforestation on various scales. The study from Hansen et al. (2013) quantifies forest

cover loss from 2000 until 2012 on a global scale using Landsat imagery, resulting in an average annual deforestation rate of more than 1.2 million ha in Indonesia. But as noted by Margono et al. (2014), the results actually describe tree cover loss, i.e., including the clearing of pulp plantation and oil palm estates. Margono et al. (2014) use a different forest definition and quantify the loss of primary forests to improve the analysis for the Indonesian context, resulting in an average annual deforestation rate of only about 386.000 ha in 2000-2012. There are many publications which assess deforestation on national level but lead to quite different results of average annual deforestation rates, e.g. about 1.7 million ha (1985-1997; Holmes 2002), 1.78 million ha (1990-2000; Hansen et al. 2009) and 0.71 million ha (2000-2005; Hansen et al. 2009), about 880.000 ha (2000-2010; Miettinen et al. 2011) or about 1.2 million ha (1990-2014; MoEF 2015). Even though these publications are mostly based on the same raw data source, namely Landsat imagery and/or MODIS, methodologies, forest definitions and reference period vary distinctively, and thus comparison of deforestation figures is difficult or even impossible. Other studies tackle deforestation on regional (e.g. Curran et al. 2004, Langner et al. 2007, Gaveau et al. 2009, Broich et al. 2011, Margono et al. 2012) or even local scale (e.g. Linkie et al. 2004, Dennis & Colfer 2006, Carlson et al.

2012) in Indonesia. Neither of them, though, yet relates recent deforestation and associated emissions to the Indonesian FREL to analyze the development of forest cover and carbon emissions with respect to an officially recognized baseline in the frame of REDD+.

There are also several publications assessing the role of the legal and political framework on deforestation and attempts to reduce emissions from deforestation, forest degradation, and peatland exploitation. Arnold (2008) performs an interesting analysis on how legislation and deforestation are related and how Indonesian law is to some extent responsible for deforestation and its increase during certain political settings. Murdiyarso et al. (2011) elaborate the potential impact on forest governance of the Indonesian Forest Moratorium, which first came into effect in 2011 (Presidential Instruction (Inpres) No. 10/2011) and has since been extended three times (Inpres No. 6/2013, No. 8/2015 and No. 6/2017). Edwards et al. (2012) analyze the moratorium with respect to potential future REDD+ payments and conclude that in its initial form (which basically has not changed in the subsequent extensions), it is unlikely to majorly support potential REDD+ payments. Such considerations about the legal framework are important in order to understand the causes for (non-) achievements in reducing emissions from deforestation but are not further analyzed in this paper.

The Indonesian FREL (MoEF 2016) which has already been subject to the technical assessment by UNFCCC (February to November 2016; UNFCCC 2016), applies to all areas which have been naturally forested in 1990 (see Figure 2) regardless of the legal status of the land (forest land or non-forest land) or soil type (mineral or organic soils). It covers the activities of deforestation and forest degradation and considers carbon pools in aboveground biomass as well as soil carbon in peatlands experiencing deforestation or degradation (peat decomposition). The reference period is 1990-2012. The analysis of this paper uses the exact same assumptions, except that it focusses on deforestation only but does not look into forest degradation or peat decomposition and aims to provide a comparison of recent deforestation rates against the FREL for Kalimantan and thus, information on how the provinces perform in terms of REDD+.

The average annual deforestation rate of Indonesia in the period 1990 to 2012 was roughly 920,000 ha (MoEF 2016). The annual average deforestation rate for Kalimantan is not provided directly in the FREL document but can be calculated using the provided activity data (i.e. land cover change data) and amounts to roughly 360,000 ha. The national average annual historical emissions from deforestation have been determined as 293.2 MtCO<sub>2e</sub> yr<sup>-1</sup> (MoEF 2016). Even though the FREL document does not provide emission values for subnational level, it does give information on the spatial dimensions of deforestation per island

and forest type by which these emissions are caused. These figures allow together with the emission factors provided in the document (MoEF 2016) to calculate a subnational average emission level for the island of Kalimantan which amounts to 121 MtCO<sub>2e</sub> yr<sup>-1</sup>.

This paper analyses deforestation rates and emissions from deforestation in the five provinces of the island of Kalimantan which occurred in the time after the reference period up to now according to current data availability, i.e., 2013 until 2015, using the same official data by MoEF that were used for the Indonesian FREL. Results are put in relation to the average annual deforestation and emission rates of each province in the reference period. The analysis is thus a subset of the national gross deforestation and FREL but does not reflect the currently ongoing process of MoEF to develop specific subnational reference emission levels taking into account historical carbon stocks.

## 2. The Methods

For the analysis of the performance regarding deforestation and emission reduction in 2013, 2014 and 2015 the same base data, methodology and underlying definitions as stated in the Indonesian National FREL (MoEF 2016) have been used. In detail, the data comprises:

- Land cover data 1990, 1996, 2000, 2003, 2006, 2009, 2011, 2012, 2013, 2014 and 2015 produced and published by MoEF (edition June 2016)
- Emission factors for six natural forest classes for the island of Kalimantan as published in Indonesia's FREL (MoEF 2016)
- Administrative boundaries: Geospatial Information Agency (BIG) 2014

The land cover classification system used for the national land cover data is based on the Indonesian National Standard 7645 (BSN 2010) and comprises 23 different classes, including six natural forest classes (primary and secondary dryland forest, primary and secondary swamp forest, primary and secondary mangrove forest). Further details on Indonesia's forest resource monitoring and development of the land cover data can be found in Margono et al. (2016).

The province of North Kalimantan has been created only recently in 2012 (Law 20/2012). Nevertheless, the present-day province boundaries are used for the whole analysis period since 1990.

The analysis at hand considers deforestation only. As defined in the national FREL (MoEF 2016), deforestation is considered as "conversion of natural forest cover to other land-cover categories that occurred once in an area," i.e., natural regrowth or reforestation and subsequent re-deforestation on a previously deforested plot were not taken into account. For each of the five provinces in Kalimantan, a reference average annual deforestation level, as well as a reference average annual emission level, have been calculated in accordance to the national FREL methodology. These

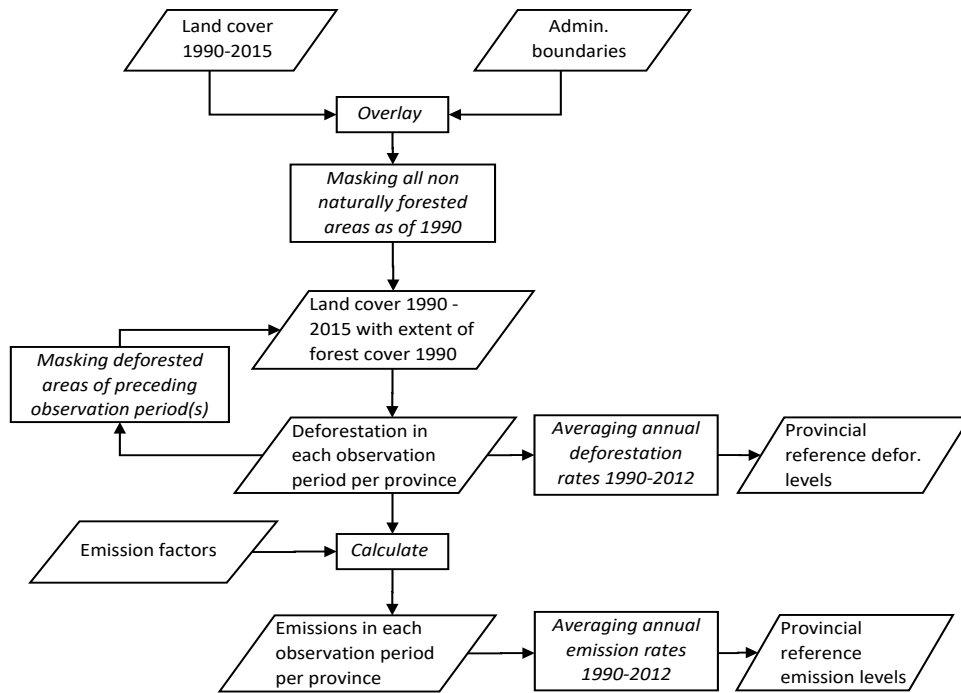


Figure 1. Workflow to calculate the reference levels for deforestation and emissions from deforestation at province level for Kalimantan

Table 1. Overview of the reference deforestation rates 1990-2012 of the five Kalimantan provinces and the deforestation rates in 2013, 2014 and 2015. Green indicates performance, red non-performance in relation to the respective reference level

	reference level 1990-2012		2013		2014		2015	
	[ha]	[ha]	[ha]	% of reference level	[ha]	% of reference level	[ha]	% of reference level
Kalimantan total	361,039	495,141	137	137	154,175	43	347,606	96
South Kalimantan	45,537	9,760	21	21	1,176	3	19,574	43
Central Kalimantan	144,715	87,942	61	61	71,584	49	186,005	129
West Kalimantan	68,953	297,125	431	431	37,360	54	47,544	69
East Kalimantan	77,415	70,431	91	91	31,578	41	58,462	76
North Kalimantan	24,418	29,883	122	122	12,476	51	36,020	148

reference levels were used as a baseline to determine whether the provincial deforestation and emission rates in 2013, 2014 and 2015 have been reduced or not. Figure 1 shows the workflow how the provincial levels have been calculated.

### 3. Results and Discussion

#### Deforestation and associated emissions in Kalimantan

The map in Figure 2 shows the spatial distribution of deforestation in Kalimantan from 1990 until 2015. Areas deforested during the reference period 1990-2012 are cumulatively displayed while deforestation that happened in the subsequent observation periods

is displayed separately for each period. In 2013, two out of the five provinces in Kalimantan, namely West and North Kalimantan, had a deforestation rate above their respective reference levels, thus did not perform in terms of reducing deforestation. The other three provinces reduced deforestation compared to their reference levels. In 2014, however, all provinces had deforestation rates lower than their reference levels. In 2015, three out of five provinces had deforestation rates below their respective reference levels while two provinces (Central and North Kalimantan) showed a value above the reference level. Two provinces (South and East Kalimantan) performed throughout all three years (see Table 1).

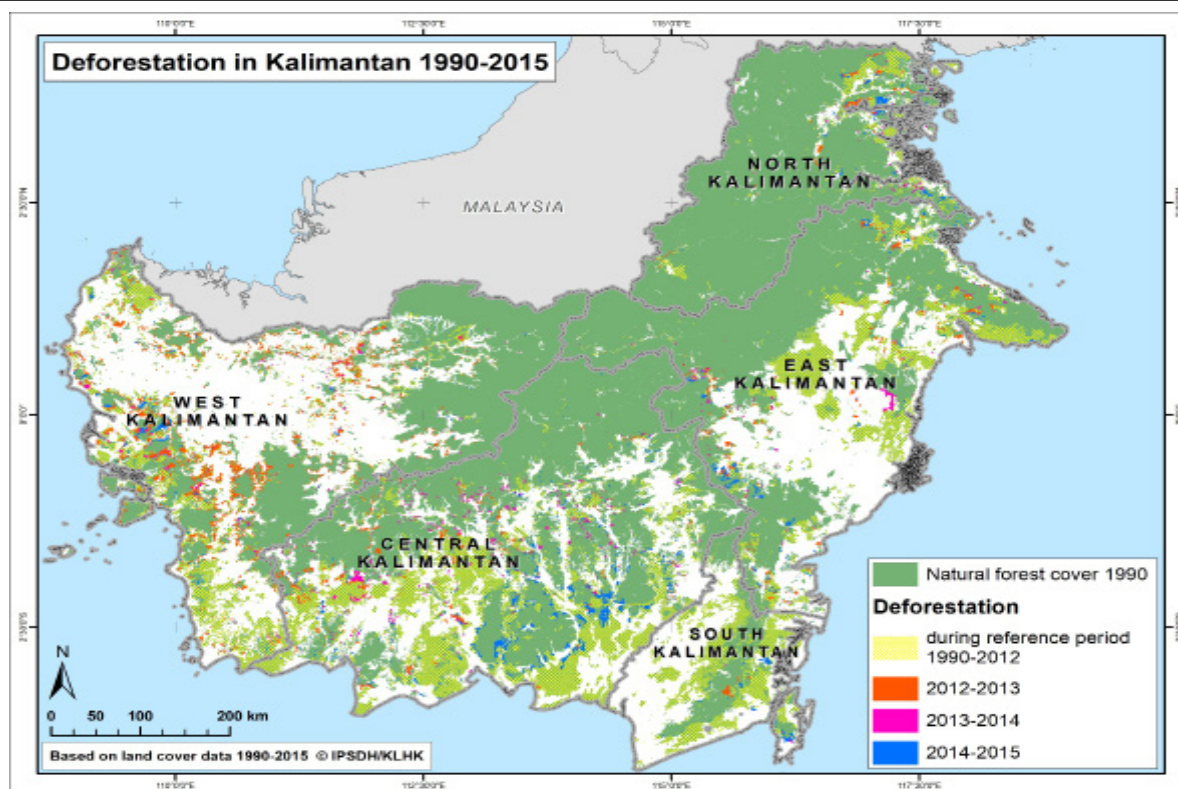


Figure 2. Spatial distribution of deforestation in Kalimantan during the reference period 1990-2012 (accumulated) and the subsequent observation periods 2012-13, 2013-14 and 2014-15, and the natural forest cover as of 1990.

In order to put these general observations in context, the overall historical development of forest cover in each province should be kept in mind. South Kalimantan, for example, already lost most of its forest cover between 1990 and 2000 (natural forest cover decreased from 48% in 1990 to 25% in 2000, see Figure 3E), leading to a high average deforestation rate. Since the year 2000 deforestation rates are low (less than 20,000 ha yr<sup>-1</sup>). However, the province has not much natural forest left to be deforested (less than 1 million hectares of natural forest in 2000, and less than 800,000 ha in 2015). Figure 3 provides a detailed overview of the annual and average deforestation rates and the development of the forest cover since 1990 in each province. By presenting the historical forest cover developments in the provinces (Figure 3, right side), this paper tries to point out the relevance to consider these regionally different historical developments when setting up sub-national reference levels but does not actually take it into account when comparing the average deforestation and emission rates of 1990-2012 with the most recent rates of 2013, 2014 and 2015. However, for fair result-based payments among provinces, the historical and current carbon stocks should be considered when deforestation and emissions from deforestation are measured against the baseline.

Annual emission rates are closely linked to deforestation rates, and as the emission factors of the six natural forest classes are within a rather narrow range of

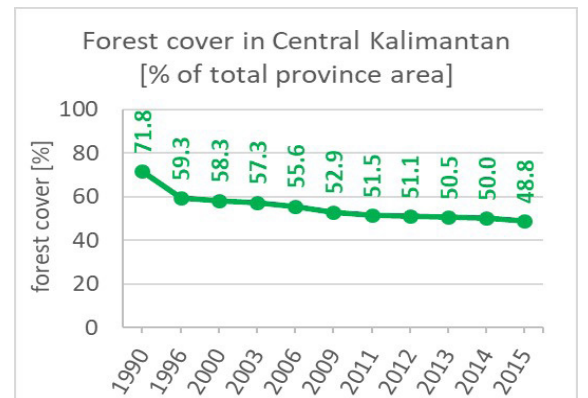
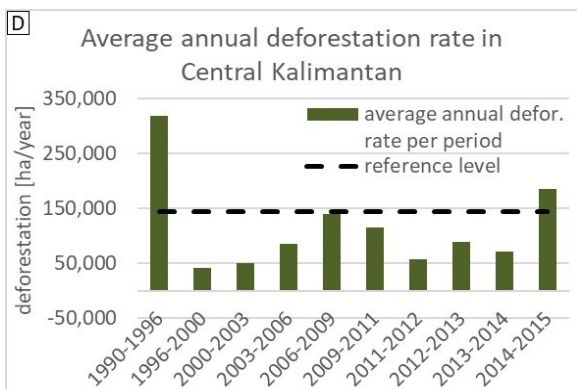
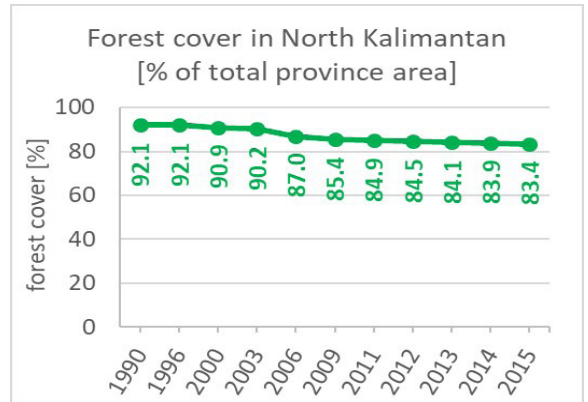
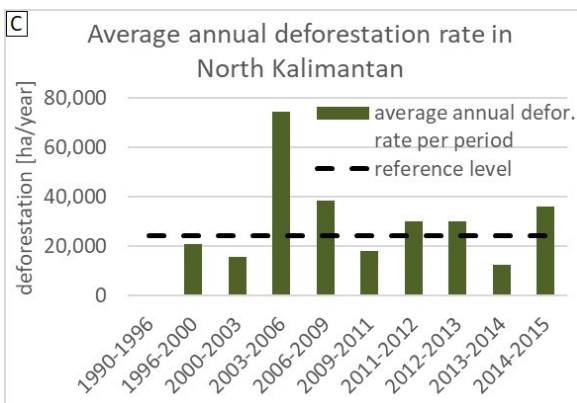
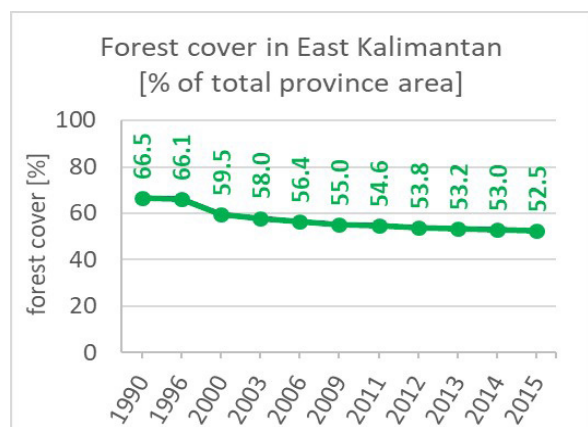
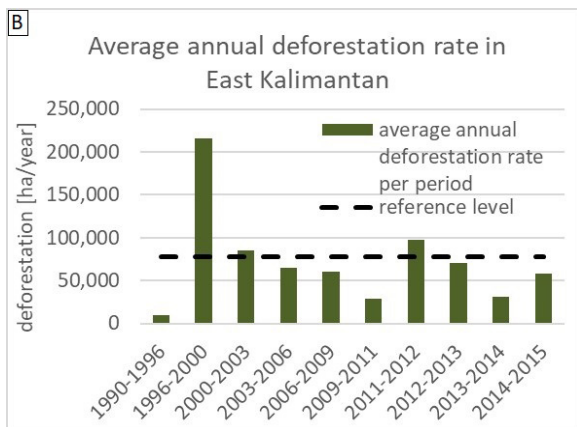
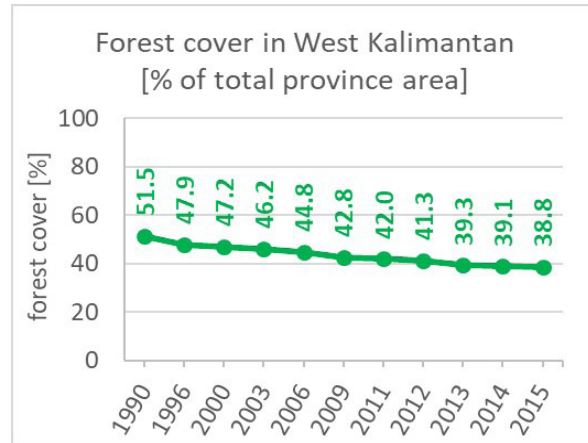
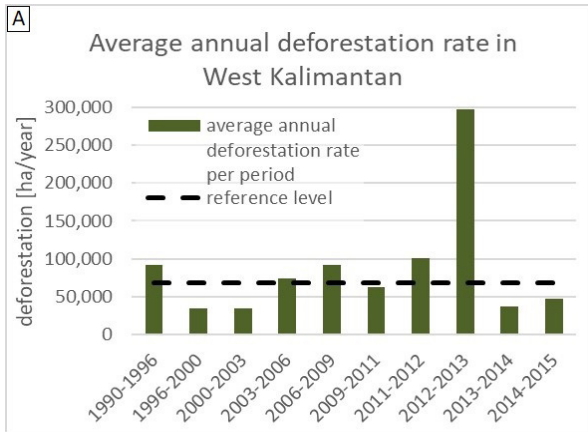
80.1 and 129.5 tC/ha with a standard deviation of 19.0 tC/ha (MoEF 2016), the patterns of annual emission rates look similar to those of the deforestation rates shown in Figure 3 and are therefore not displayed again separately.

#### Current achievements in reducing deforestation

Indonesia has pledged to reduce its greenhouse gas emissions by 26% (or 41% with international support) against the Business-As-Usual (BAU) scenario by 2020 (GoI 2016, MoEF 2016). Post-2020, the unconditional reduction target is 29% by 2030 (GoI 2016). The forestry sector (including peat fires) is to contribute most (emissions to be reduced by 70% until 2030 in an unconditional mitigation scenario) to achieve this goal. To reach this target, it is assumed that the national annual deforestation rate will be halved by 2020 compared to the deforestation rate under BAU scenario as determined by the FREL (GoI 2016). To what extent each province will be expected to contribute, though, has yet to be determined (Margono 2017). This also leaves the question open for a future REDD+ benefit sharing mechanism or where and how the potential international performance-based REDD+ funds will be distributed.

The percentile contribution of each province to Kalimantan's overall emissions are shown in Figure 4. Percentages are subject to considerable fluctuations over time as each province has a period of exceptionally





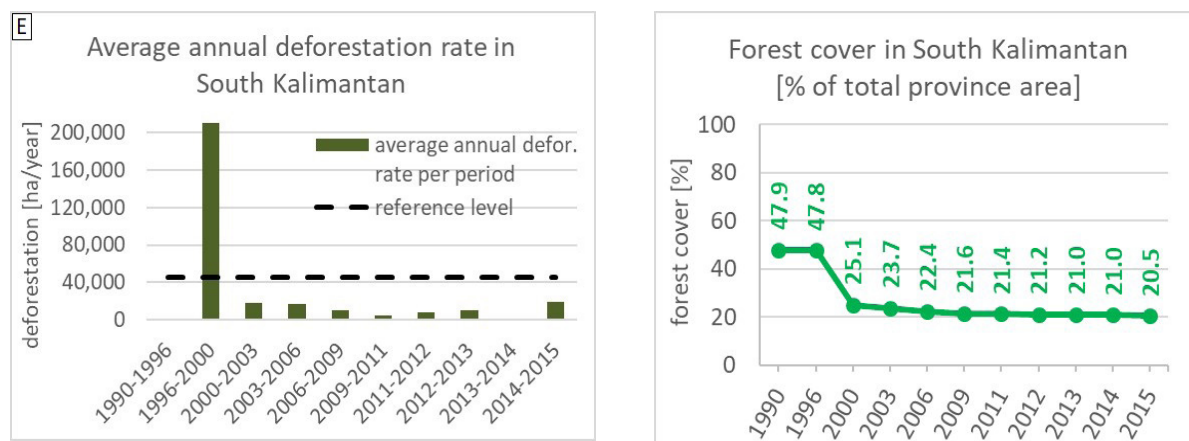


Figure 3. Deforestation rates and reference levels in West Kalimantan (A), East Kalimantan (B), North Kalimantan (C), Central Kalimantan (D) and South Kalimantan (E) (left side). and the development of the total natural forest cover in each province 1990-2015 (right side).

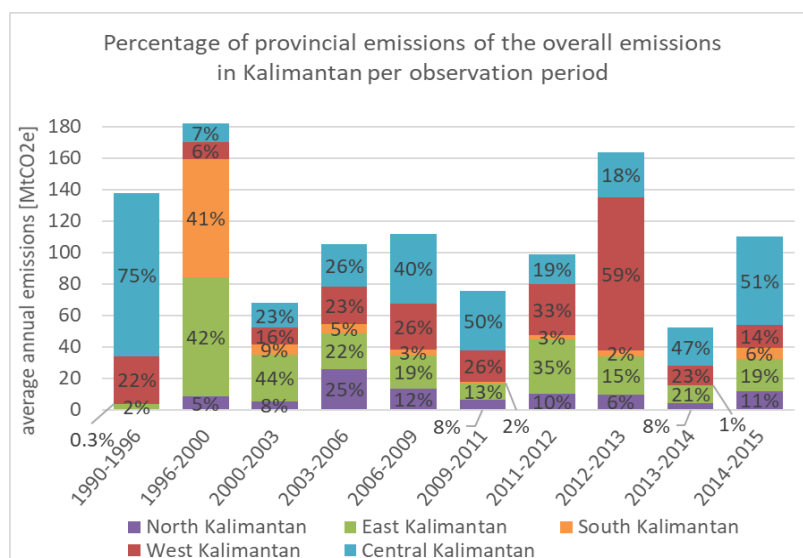


Figure 4. Percentage of emissions in the five provinces of the overall emissions in Kalimantan per observation period

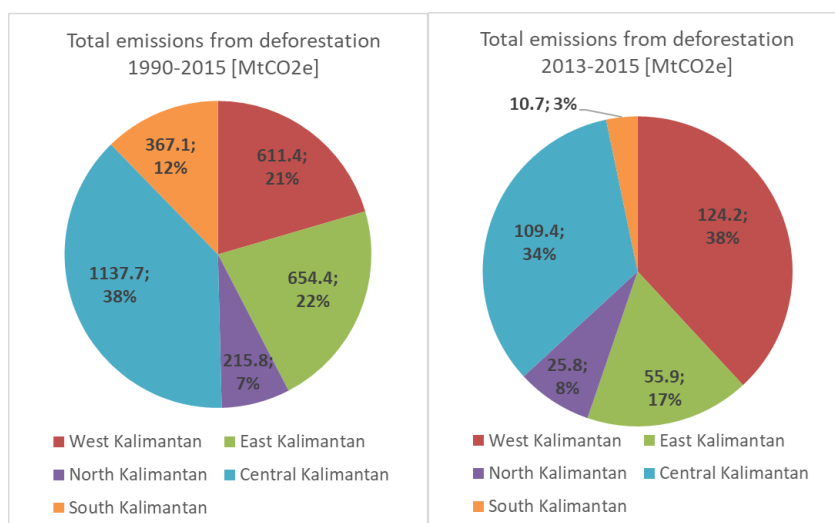


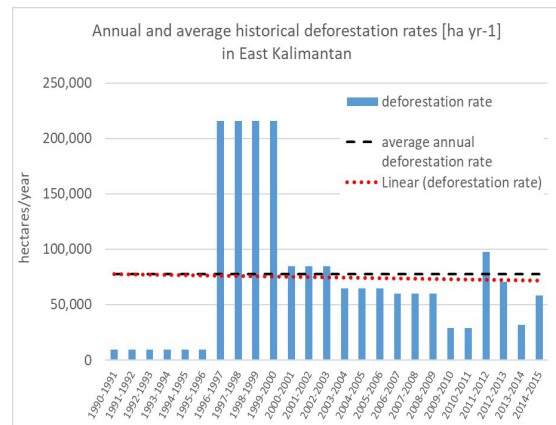
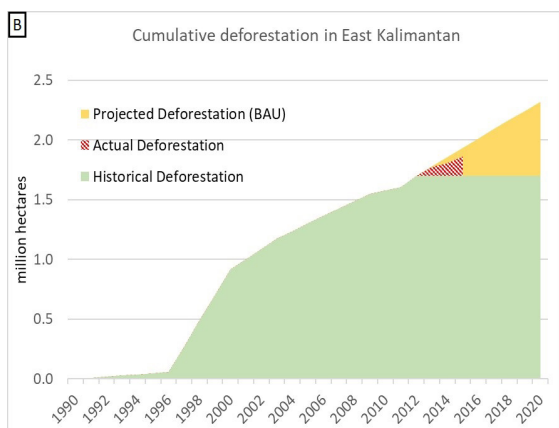
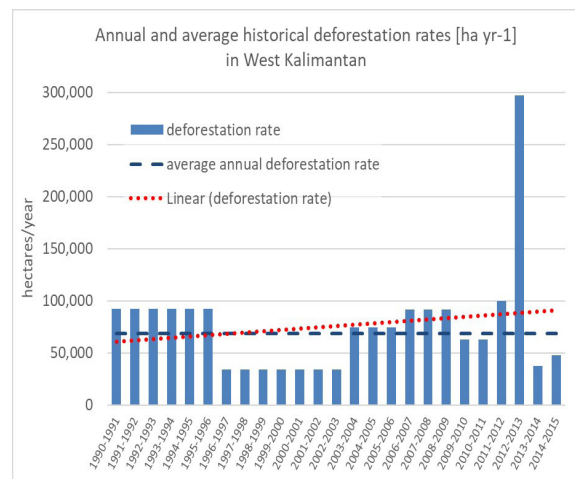
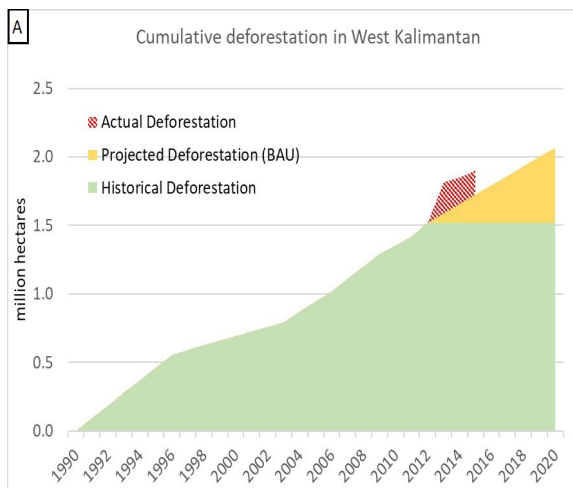
Figure 5. The proportion of emissions per province with respect to the total emissions in Kalimantan in the whole analysis period 1990-2015 (left) and the period after the FREL historical period, i.e., 2013-2015 (right)

high emissions. While in the earliest observation period 1990-1996 most emissions are caused by Central Kalimantan (75%), the emissions in the period 1996-2000 are dominated by East and South Kalimantan (42 and 41% respectively). During 2003-2006 all provinces except South Kalimantan contribute to an almost equal amount to the overall emissions (22-26%), but this is the peak period of North Kalimantan's emissions (see also the deforestation rates in Figure 6C). In the periods 2006-2009, 2009-2011, 2013-2014 and 2014-2015 Central Kalimantan is again the main emitter (40-51%). In 2011-2012 emissions mainly originate from East (35%) and West Kalimantan (33%), while in 2012-2013 most emissions were produced by West Kalimantan (59%).

Central Kalimantan as the largest of the five provinces (~ 15.3 million ha) still has the largest absolute forest cover (~ 7.5 million ha) and third largest relative forest cover (49% of the total province area) as of 2015. It is also the province that emitted the largest share of the total emissions from deforestation produced during the whole analysis period 1990-2015 (38%) (see Figure

5 left) and the second largest share of emissions during the period potentially relevant for performance-based payments 2013-2015 (34%) (see Figure 5 right). East Kalimantan holds the second largest share of emissions from 1990-2015 (22%) and third largest for 2013-2015 (17%, Figure 5) while still being covered with roughly 6.7 million ha of forest in 2015 (52% of the total province area). West Kalimantan is responsible for 21% of the total emissions in 1990-2015 and was the leading emission source in 2013-2015 (38%, Figure 5), which reflects particularly the high deforestation rates that occurred in the period 2012-13.

The average annual deforestation rates for Kalimantan can be used to create a Business-As-Usual (BAU) scenario for each province. Figure 6 (left side) shows the cumulative deforested areas since 1990 for each province and the projected deforestation until 2020 using the reference level as a linear annual increment. The right side of Figure 6 shows the annual deforestation rates (blue bars), the reference level (blue dashed line) and the linear trend of the annual deforestation rates (red dotted line).



continue figure 3...



Figure 6. Left side: Cumulative emissions from deforestation in West Kalimantan (A), East Kalimantan (B), North Kalimantan (C), Central Kalimantan (D) and South Kalimantan (E); historical deforestation from the historical reference period (1990-2012) is displayed in green, the BAU for the projection period (2013-2020) in yellow and the actual deforestation in 2013, 2014 and 2015 in red. Right side: Annual average deforestation rates (blue bars) with reference levels (blue dashed line) and the linear trend of deforestation rates (red dotted line).



Mainly due to the extraordinary high deforestation rate in West Kalimantan in 2012-2013 (see Figure 6A, right), the actual deforestation of the province was catapulted way above the projected BAU. Also, the overall, linear trend of deforestation rates in West Kalimantan is pointing upwards. The annual deforestation and emission rates for 2015-2020 should not exceed 34,000 ha and 10.6 MtCO<sub>2</sub>e respectively – which equals approximately the average rates in the period 1996 until 2003 and is roughly half of the actual reference levels – in order to stay at least in line with the BAU scenario. It will require considerable efforts and strong political will to achieve the goal of reducing deforestation until 2020. And indeed, in the Rio Branco Declaration of the Governors’ Climate and Forests Task Force (GCF) of which three of the five provinces in Kalimantan are members, namely West, East and Central Kalimantan which are by the way the three primary sources of emissions in Kalimantan (see Figure 5), the ambitious target of reducing deforestation by 80% by 2020 has been set (GCF 2014). In the case of West Kalimantan, this would mean to achieve an annual deforestation rate of roughly 14,000 ha – a value by far lower than any historical annual rate.

East Kalimantan’s actual deforestation is slightly below the projected BAU, and also the linear trend of deforestation rates points slightly downwards (see Figure 6B). Central and South Kalimantan both show

a considerable linear downward trend, and actual cumulative deforestations are below BAU (see Figure 6D and Figure 6E). Despite the overall downward trend of deforestation rates of these three provinces, the most recent deforestation rates of the period 2014-15 are considerably higher than the preceding periods (see also Figure 7).

North Kalimantan, on the other hand, shows an upward trend of deforestation (see Figure 6C). Even though the actual deforestation is currently still more or less in line with the projected BAU, the rates in the recent past are on the rise. The province is still home to 5.8 million hectares of natural forests (83% of the province area). These forests bear a huge economic potential which became even more important since the splitting of East and North Kalimantan into two separate provinces in 2012. Further exploitation and deforestation are thus to be expected.

If looking only at the trends of deforestation rates in the post-FREL period, i.e., 2013 until 2015, trends in South, Central, and West Kalimantan are reversed (see Figure 7) with rates going up (South, Central) and down (West) respectively. The recent trends of East and North Kalimantan as well as the overall trend in whole Kalimantan, however, are similar to those of the whole analysis period 1990-2015.

Even though the annual deforestation and thus also emission rates in each province strongly fluctuate,

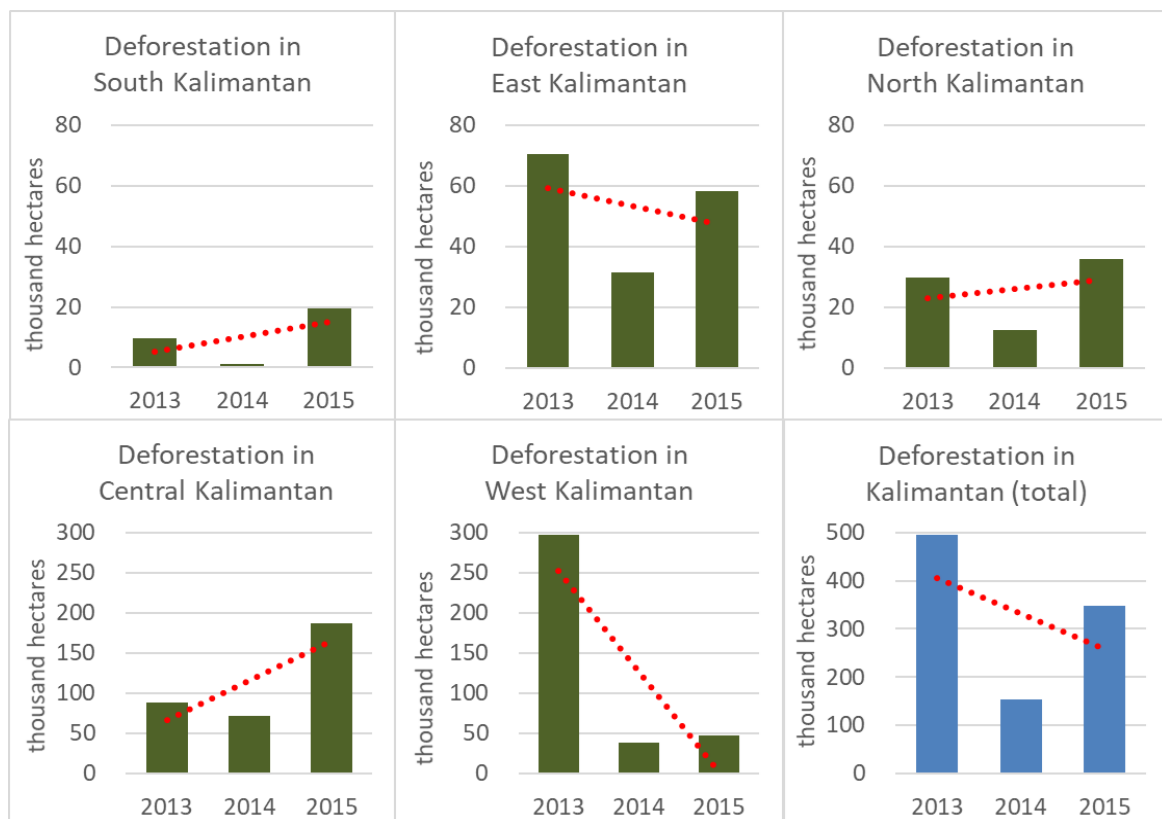


Figure 7. Trends in deforestation rates in the five Kalimantan provinces and whole Kalimantan from 2013 until 2015.

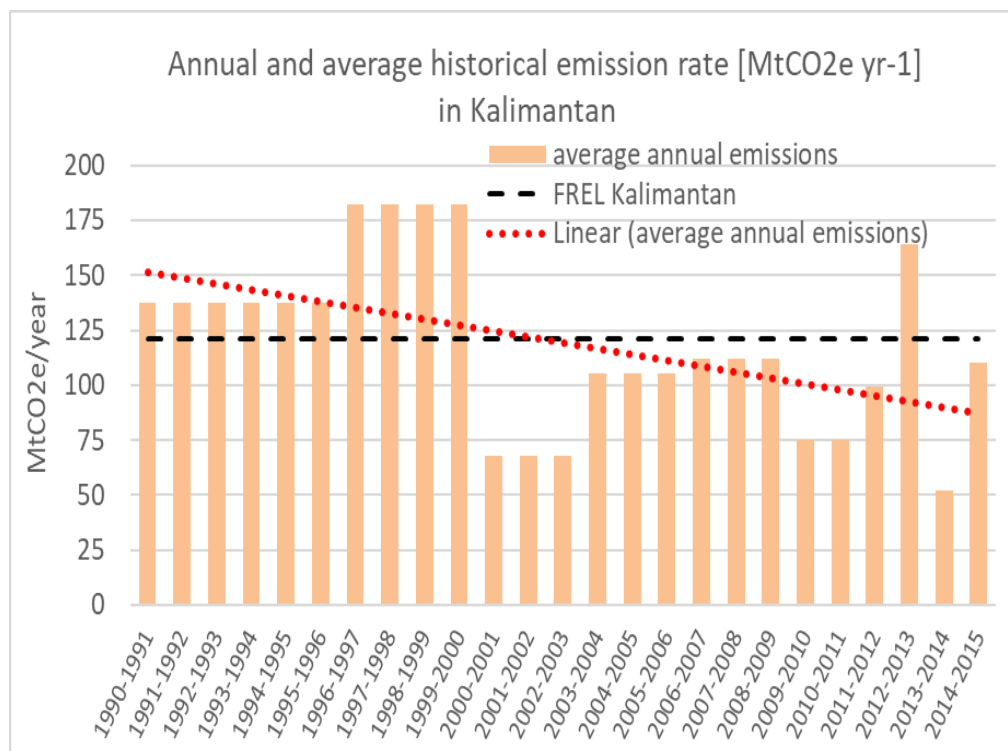


Figure 8. Annual average emission rates for the island of Kalimantan (red bars) with FREL (black dashed line) and the linear trend of the annual emissions (red dotted line).

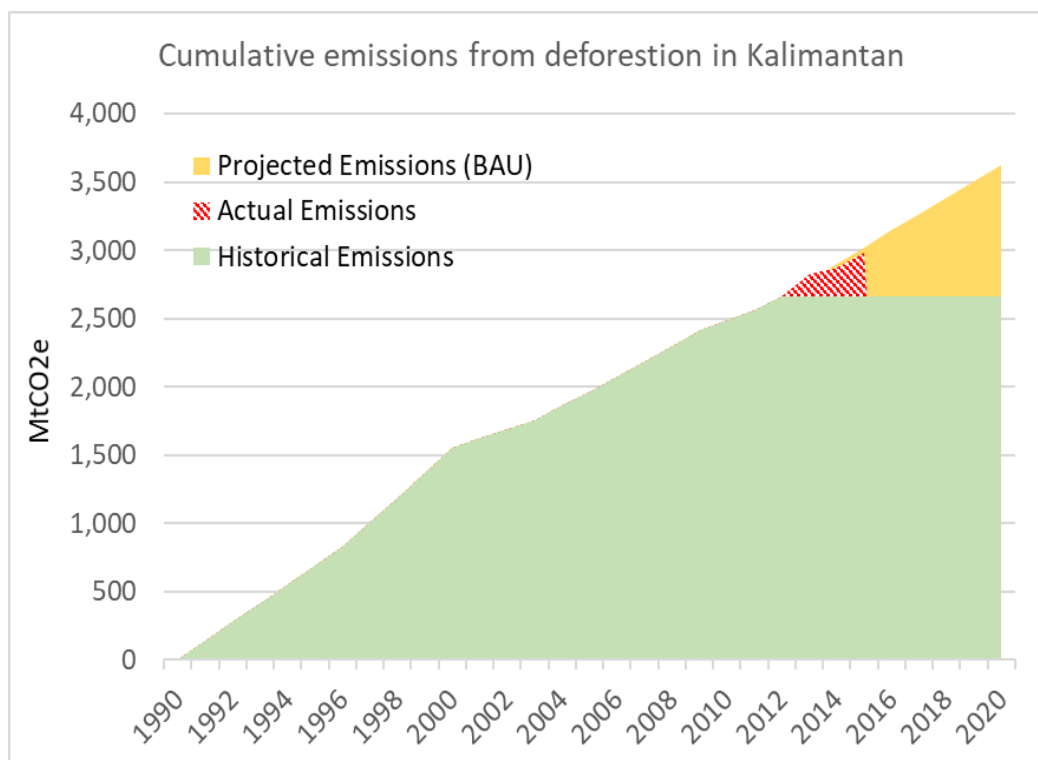


Figure 9. Cumulative emissions from deforestation in Kalimantan. Historical emissions from the historical reference period (1990-2012) are displayed in green, the BAU for the projection period (2013-2020) in yellow and the actual emissions in 2013, 2014 and 2015 in red.

particularly in the recent past (see Figure 6 and Figure 7), the overall trend of deforestation and emissions in Kalimantan points downwards (see Figure 8). Nevertheless, the actual emissions from deforestation amount approximately to the BAU scenario (see Figure 9). This shows that the overall efforts across all five Kalimantan provinces were up to now not sufficient to achieve significant emission reductions compared to the BAU scenario.

#### 4. Conclusions

The overall linear trends of gross deforestation and emission rates in Kalimantan are pointing downwards but with considerable annual fluctuations particularly in the recent past. The developments in reducing emissions from deforestation vary greatly between the five Kalimantan provinces, as it is to be expected due to their different biogeophysical and economic settings, logging histories and initial and remaining forest resources. Two provinces, namely West and North Kalimantan, show a rather bad performance in terms of reducing deforestation, with North Kalimantan having a general upwards tendency of deforestation and emissions rates and West Kalimantan experiencing deforestation more than four times higher during the observation period 2012-13. The other three provinces in Kalimantan, i.e., South, Central, and East Kalimantan, do have a linear downward trend in the long term and thus seem to be on a good way in terms of reducing deforestation. However, achieving the emission reduction goal even in these provinces can by no means be taken as given, especially as South and Central Kalimantan's rates are on the rise again in the recent past since 2013.

Annual deforestation rates are generally subject to considerable fluctuations due to various political, economic and natural influences on various levels (global, national, regional) which are not analyzed in this paper, but which also lead to great variations of the proportions of emissions from each province. These fluctuations have presumably always been happening constantly over time but became essentially only visible in recent years since land cover data are available on a more frequent (i.e., annual) basis.

From the perspective of stock-taking until 2015, it remains open if the provinces of Kalimantan will indeed be able to considerably reduce their emissions from deforestation until 2020 without further substantial economic incentives as foreseen in the international REDD+ framework, even though there are some positive trends and especially also strong political signals and commitments, both on national and provincial level.

Updating the analysis when new land cover data becomes available is desirable in order to receive a better overview of the trends in deforestation in Kalimantan over a longer time since the FREL period. Likewise, an in-depth analysis of the drivers of deforestation, which are likely to differ in the provinces, is necessary

in order to better being able to draw conclusions and give recommendations on how to tackle deforestation in the future.

#### Acknowledgments

This paper was prepared in the framework of cooperation between the Indonesian Ministry of Environment and Forestry with GIZ Forests and Climate Change (FORCLIME) programme by the German Federal Ministry for Economic Cooperation and Development (BMZ).

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