User Guide for Critical Land Reforestation

Indonesia 2050 Pathway Calculator

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Introduction

This User Guide is intended for users of Indonesia in 2050 Pathway Calculator, especially of the Critical Land Reforestation sectors. There are four sections in this User Guide, which is an Overview, Assumptions, Methodology and Modeling Results. Overview section contains basic information about the critical area which is useful as an introduction to understanding the context of management and physical characteristics of critical land in Indonesia. Assumption section presents assumption of reference data used for basic calculations while on Methodology presents the calculation equations and levels used. After obtaining basic information, assuming the reference data, as well as the equation used, the result of the projected changes in the area of critical land in Indonesia until 2050 is presented in the Modeling Results at the end of this user guide.

1. Overview of Critical Land in Indonesia

Critical land issues have been affecting land use in Indonesia since long time ago, however there has not been a comprehensive policy that attempt to improve this critical land problems. Critical land not only signify degradation of environmental quality, but also reduced the production potential of Indonesia. Therefore, I2050PC intends to propose profit potential for State's revenue in connection with a simulations on critical land area changes of Indonesia in the future. Although I2050PC quantitative models can only indicate the potential for reducing emissions from critical land area changes, this simulation results are expected to encourage further discussions on land use for more attention on possible potential lost if critical lands area in Indonesia continues to grow.

According Wicke et al (2011), Indonesia critical land area tends to increase in the three decades from 1975 to 2005 (Figure 1). This indicates that most of the expansion of land for agriculture, oil palm, and other uses of the period came from the forest areas (p. 201). The tendency of forest cover clearing is giving highly influential in Indonesia emission reduction potential of the land use sector. If in the future demand for land to support the growth is able to be fulfilled from the use of critical (degraded) land rather than opening new forest area, the amount of avoided emissions would be enormous.

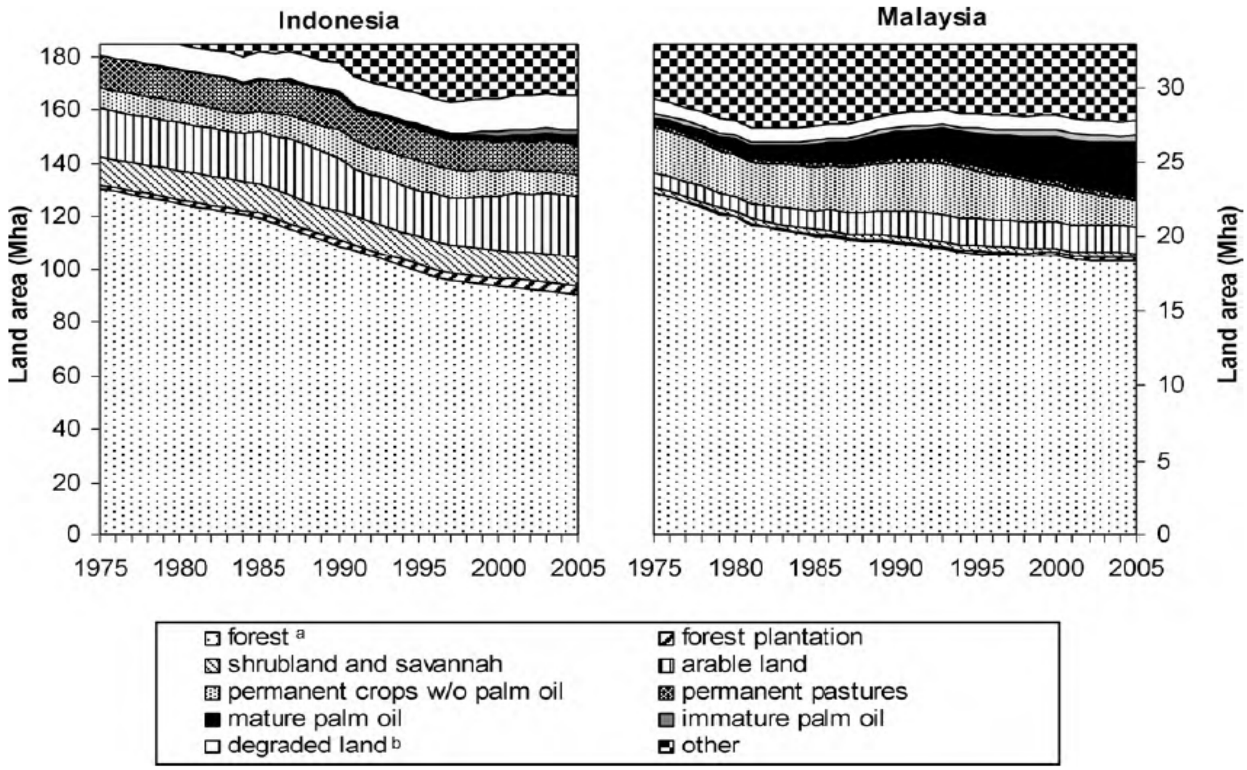

Figure 1. The division of land cover Indonesia and Malaysia (Wicke et al, 2011, p. 201)

Meanwhile, Nugroho (2000) describes critical land is the land that has undergone physical, chemical or biological damage as a result of excessive land use or land management that uses the land beyond its carrying capacity (p. 74 The existence of critical area indicates potential hazard of hydro-geological function, agricultural production, housing, economic and social life in and around the area of the critical/degraded land (*ibid*). Criterion such as vegetation cover, nicks or density of soil, land use and vegetation, as well as the depth of the soil can be used as a basis for determining the existence of critical/degraded land (Table 1). These criteria are important to consider for the purpose of determining the three attributes of degraded land that is land area, the level of carbon content, as well as its potential uses. Obviously the specific conditions of critical/degraded land and the local context of land will greatly affect the three attributes mentioned above, but as to achieve the objectives of I2050PC macro modeling there may be some aspects should be assumed uniform.

Table 1. Criteria for assessment of critical/degraded land (Nugroho, 2000, pg. 75)

Parameter	Tingkat Kekritisan			
	Potensial kritis	Semi kritis	Kritis	Sangat kritis
Penutup vegetasi	> 75 %	50 - 75 %	25 - 50 %	< 25 %
Tk. torehan/ kerapatan	agak tertoreh cukup tertoreh	cukup tertoreh sangat tertoreh	sangat tertoreh sangat tertoreh	sangat tertoreh drainase sekali
Penggunaan lahan/ vegetasi	hutan, kebun campuran, belukar, perkebunan	pertanian lahan kering, semak belukar, alang-alang	pertanian lahan kering, rumput, semak	gundul, rumput semak
Kedalaman tanah	dalam (> 100 cm)	dalam (60 - 100 cm)	dalam (30 - 60 cm)	sangat dangkal (< 30 cm)

According to the Ministry of Forestry (2012), in 2007 the critical and very critical land area of Indonesia amounted to 30,196,802 hectares (p. 115). Meanwhile, in 2010 the figure dropped to 29,404,462 hectares (p. 105). Broad downward trend of this critical area seems to continue in 2011 where the land area of critical and very critical decreased to 27,294,842 hectares (p. 115 A similar figure is shown by the data in 2013 where critical areas and very critical Indonesia were covering an area of 27,294,842 hectares (DJPK 2014, p. 70). Meanwhile, data from BPS (Central Bureau of Statistics) shows that there may be problems in determining the methodology and calculation of critical land area of Indonesia. According to BPS data (2014a), in the year of 2004, 2006, 2007, 2009, and 2010, the “slight critical” land area is also taken into account, but in 2011 and 2012 only "critical area" and "very critical" that counts. Furthermore, critical lands data in 2011 and 2012 of BPS seem exactly the same as the data of Ministry of Forestry in 2011 and data of DJPK in 2013 (CBS, 2014a). Selain itu, nampak bahwa usaha reboisasi Indonesia, khususnya pada tahun 2010, 2011, dan 2012, tidak berdampak banyak terhadap luas lahan kritis di Indonesia (BPS, 2014b). Based on these findings, there are many factors to consider, among others, the availability and accuracy of critical land area data in Indonesia as well as the potential for reforestation efforts in addressing and improving the condition of critical land in Indonesia.

Related to reduction efforts and improvement of critical land, the potential for reducing emissions from reforestation of critical land will depend on two things: the value of carbon content attributed to the critical area which will be in-reforestation and the carbon content in the secondary forest resulted from reforestation program. Carre et al (2010, p. 95), shows that the standard soil carbon stock used by IPCC (Intergovernmental Panel on Climate Change) calculation for forest areas with canopy cover below 30% is between 19 to 45 tons/ha and for shrubs is approximately 46 tons/ha. It also showes that the value of total soil carbon stocks of secondary tropical forests is ranging from 101 to 230 tons/ha depends on the level of humidity and forest canopy cover (Carre 2010, p. 92). Associated with the carbon content of secondary forest, Agus et al (2013) have put together the results of various studies examining the carbon content of various types of canopy cover in Indonesia and Malaysia. The research showed that the carbon content of shrubland in Indonesia and Malaysia is ranged from 18 to 35 tons/ha; from 37 to 250 tons/ha in secondary forest; and between 61 to 399 tons/ha in primary forest (Agus et al 2013, pp. 10, 11, 13). BAPPENAS (2015) also uses the value of the soil carbon stock of shrubland about 30 tons/ha while for secondary forest was 169.7 tons/ha and for forest primer was 195.4 tons/ha.

After outlining the background of management and physical characteristics of critical land in Indonesia, this document will discuss the most appropriate assumptions, methodology used and the final modeling of critical land use of Indonesia in I2050PC.

2. Assumptions

The main assumptions in the modeling of critical land use of Indonesia in I2050PC is that all critical land expansion derived from the primary forest canopy cover while all canopy cover of critical land will become secondary forest. This is considerably appropriate as stakeholders (policy) discussions' results indicates that most of critical land is located in forest designated areas so that conversion to other classification can cause administrative problems and raises potential for conflict. Furthermore, the policy makers suggest that reforestation programs should be enhanced through community empowerment. Through a similar discussion, the formation of partnerships and by the support of the surrounding community it would possible to embody rehabilitation on criticial land as to reduce emissions and also to contribute on food and energy needs fulfillment.

Due to the above assumption, critical land conversion to secondary forest, the baseline determination of critical land carbon content will greatly affect the calculation of critical land emission reduction potential. Related to this, according to the results of discussions of various stakeholder consultation in the preparation of I2050PC land use modeling, ranges of values in the carbon content based on Agus *et al* findings can be considered as in accordance with the conditions of Indonesian land. At the same time, since BAPPENAS used the values which are in the ranges of Agus *et al* (2013) findings in the preparation of RAN-GRK (National Action Plan - GHG) baseline, it is expected that if I2050PC using similar figures the simulation results in I2050PC will be comparable with BAPPENAS simulations or their greenhouse gas emissions modeling. Thus, I2050PC critical land modeling will use the same values with BAPPENAS calculation which is 30 tons/ha for shrubland, 169.7 tons/ha for secondary forest, and 195.4 tons/ha for primary forest. In addition, it is important to note that the baseline value used in I2050PC will be easily updated and adjusted if necessary.

Based on discussions with the stakeholders, several inputs for modeling were obtained, namely: range of changes in critical areas, the determination of the critical potential of land use change and the range of carbon content. For critical land area, it was determined that the base area in 2011 amounted to 27,294,842 acres based on the Ministry of Forestry data is suitable for use. Related to potential critical land use change and the range of carbon content, discussions with policy makers also determined a range and potential changes that can be achieved through policy stipulation, which will be explained further in the modeling results.

3. Methodology

In consideration to the suitability of BAPPENAS modeling methodology, ease of use, and user-friendliness, the emissions change of land-use in Indonesia with regard to the critical land reforestation will be calculated based on the enhancement of carbon stocks contained. Therefore, the equation to be used are:

Emission = Area Change x Carbon Content Change

atau $E = A \times AGC$

where

E = Emission (in ton of CO_{2eq})

A = Area (in hectares or ha)

AGC = Above Ground C-stock (in ton of CO_{2eq} per hectares)

Based on the background and assumptions as described above, the modeling of Indonesian potential of critical land reforestation in I2050PC are as follows:

Level 1

Level 1 assumes the extractive land use practice and climate change trigger a 10% increase of degraded land area in 2050 compared to the base year 2011.

Level 2

Level 2 assumes no significant change of degraded land area until 2050. The actions taken to improve the system only able to offset the damage that occurs due to mismanagement and climate change.

Level 3

Level 3 assumes land reforestation can reduce the degraded land area by 10% in 2050 compared to the base year (2011). It can be achieved by acquiring support from local community through land rehabilitation programs that facilitate community empowerment such as agroforestry

Level 4

Level 4 assumes the achievement of 25% degraded land area reduction by 2050 compared to the base year 2011. It can be achieved when land rehabilitation program is actually empowering local people. Through a comprehensive system of agro-forestry assistance, land rehabilitation programs will contribute to the availability dimension of food, water, and energy of the community.

4. Modeling Result

Based on above presented overview, assumptions and methodology used, the modeling results obtained in the form of projection of changes in the area of critical land in Indonesia until 2050 is as follows: 10% increase to 30 million hectares; relatively unchanged at around 27 million hectares; reduced by 10% to 24 million hectares; or reduced by 25% to 20 million hectares (**Figure 2**).

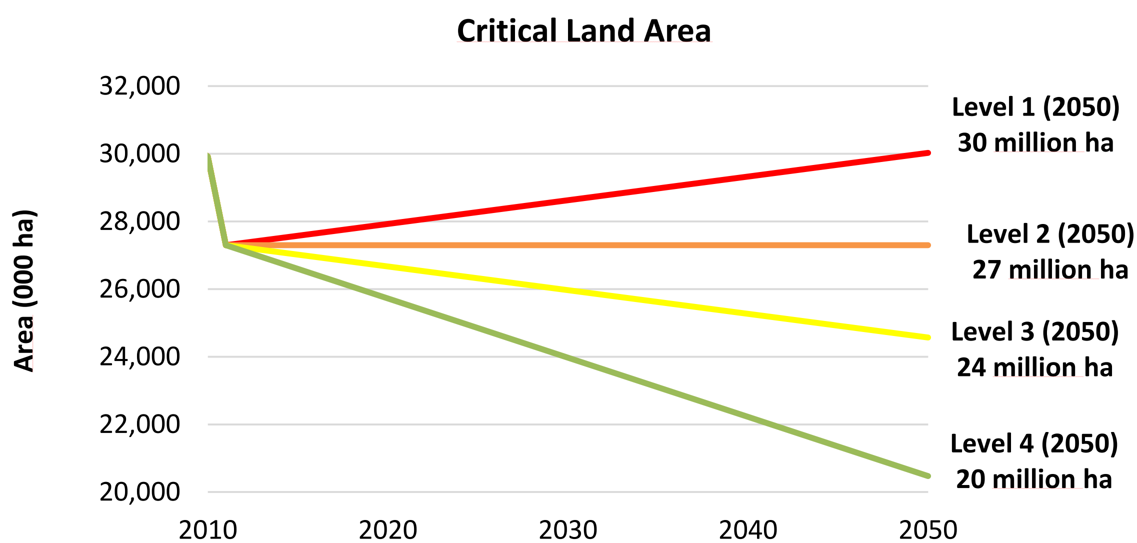

Figure 2. Range of potential changes of critical land in Indonesia (source: author)

Based on these projections, the potential contribution of emissions from critical land reforestation of each level are:

Level 1

Level 1 assumes that the improvement of critical land area of 3 million hectares has increased the emission at approximately 496.2 million tons of CO_{2eq}.

Level 2

Level 2 assumes there is no significant change in total of critical land area, therefore there is no flux of emissions from this sector beyond the value of forest quality degradation around critical land that has been taken into account in the baseline emission.

Level 3

Level 3 assumes a decrease in the critical land area of 3 million hectares has an impact on emissions reductions of about 419.1 million tons $CO_{2eq.}$

Level 4

Level 4 assumes a decrease in the critical land area of 7 million hectares has an impact on emissions reductions of about 977.9 million tons of CO_{2eq}

By selecting the desired level, users can indicate a policy option necessary to achieve the listed emissions savings. Policy options which are indicated in each level selection is determined by stakeholders consultation in the process of I2050PC modeling. The policy options are indicative in nature and aim to trigger cooperation and discussion among all stakeholders engaged both nationally and locally.

5. References

Agus, F, Henson, IE, Sahardjo, BH, Haris, N, van Noordwijk, M & Killeen, TJ 2013, "Review of Emission Factors for Assessment of CO_2 Emission From Land Use Change to Oil Palm in Southeast Asia", *Reports from the Technical Panels of the 2nd Greenhouse Gas Working Group of the Roundtable on Sustainable Palm Oil*, hal. 7-28.

BAPPENAS (Kementerian Perencanaan Pembangunan Nasional) 2015, *"Pembentukan BAU Baseline Bidang Berbasis Lahan"*, Sekretariat RAN-GRK, diunduh 30 Maret 2015, <http://www.sekretariat-rangrk.org/english/home/9-uncategorised/173-baulahan>.

BPS (Badan Pusat Statistik) 2014a, *"Luas dan Penyebaran Lahan Kritis Menurut Provinsi Tahun 2004, 2006, 2007, 2009-2012 (ribu ha)"*, Badan Pusat Statistik, diunduh 26 Januari 2015, <http://bps.go.id/tab_sub/view.php?kat=3&tabel=1&daftar=1&id_subyek=60&notab=8>.

—— 2014b, *"Luas Kegiatan Reboisasi (ha), 2000-2012"*, Badan Pusat Statistik, diunduh 26 Januari 2015, <http://bps.go.id/tab_sub/view.php?kat=3&tabel=1&daftar=1&id_subyek=60&notab=5>.

Carre, F, Hiederer, R, Blujdea, V & Koeble, R 2010, *Background Guide for the Calculation of Land Carbon Stocks in the Biofuels Sustainability Scheme – Drawing on the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*, Office for Official Publications of the European Communities, Luxembourg.

DJPK (Direktorat Jenderal Planologi Kehutanan) 2014, *"Statistik Kawasan Hutan 2013"*, Kementerian Kehutanan, Pemerintahan Republik Indonesia, Jakarta.

Kementerian Kehutanan 2012, *"Statistik Kehutanan Indonesia 2011"*, Kementerian Kehutanan, Pemerintahan Republik Indonesia, Jakarta.

Nugroho, SP 2000, "Minimalisasi Lahan Kritis Melalui Pengelolaan Sumberdaya Lahan dan Konservasi Tanah dan Air Secara Terpadu", *Jurnal Teknologi Lingkungan*, vol. 1, no. 1, hal. 73-82.

Wicke, B, Sikkema, R, Dornbug, V & Faaij, A 2011, "Exploring land use changes and the role of palm oil production in Indonesia and Malaysia", *Land Use Policy*, no. 28, hal. 193-206.