Forest Diversity and its implication for biomass estimation approaches in Indonesia

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The Ecological and Economic Challenges of Managing Forested Landscapes in a Global Context - Focus: Asia

Outline

Introduction (Geographical location, altitude distribution, land and forest area)

Forest diversity

Biomass estimation approaches

Conclusions

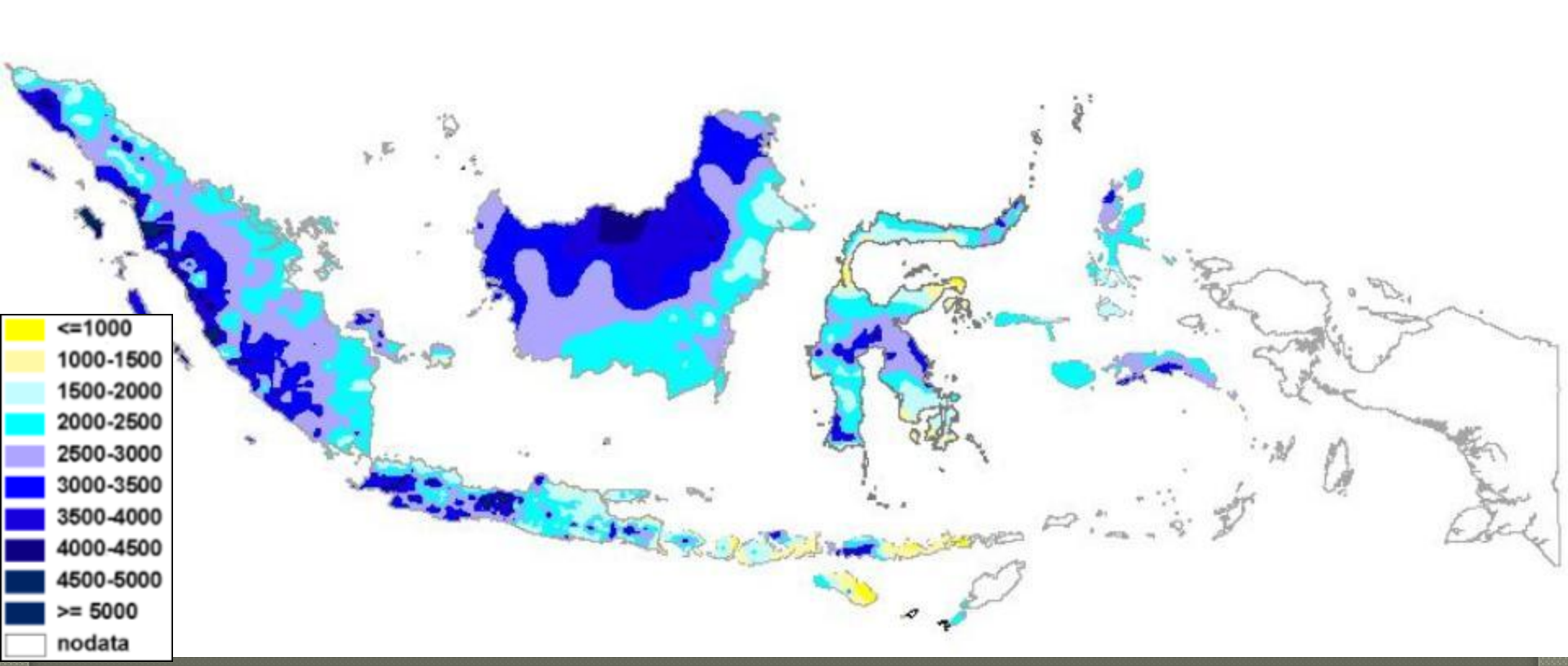
References

Geographical location

Area: 190 mio ha
Forest area: 131 mio ha

Source: http://www.worldatlas.com/webimage/countrys/asia/lgcolor/idcolor.htm

Climatic condition (rainfall intensity)



Source: http://banyudata.blogspot.com/2010/03/peta-hujan-wilayah-indonesia.html

The number of woody species in tropical forest tends to increase with precipitation (Givnish, 1999)

Forest formation (Ghazoul and Sheil, 2010)

Climate	Water and drainage	Geology or soil	location	Forest formation
Seasonally dry	Strong annual shortage			Monsoon forest)various formation)
	Slight annual shortage			Seasonal rain forest
Ever-wet (perhumid)	Dryland	Oxisols, ultisols	Lowlands	Non-seasonal lowland rain forest
			1200-1500 m	Lower montane rain forest
			1500-3000 m	Upper montane rain forest
			3000 m to tree line	Subalpine forest
			Mostly lowland	Heath forest

Forest formation (ctd.)

Climate	Water and drainage	Geology or soil	location	Forest formation
			Mostly lowland	Forest over limestone
			Mostly lowland	Forest over ultrabasic
	Water table high (at least periodically)		Coastal salt water	Beach vegetation mangrove Forest brackish water forest
		Oligotrophic peats	Inland freshwater	Peat swamp forest
		Eutrophic soil (organic and mineral)	Permanently wet	Freshwater swamp forest
			Periodically wet	Freshwater periodic swamp forest

Forest diversity

Definition: "The variability among forest living organisms and the ecological processes of which they are part; this includes diversity in forests within species, between species and of ecosystems and landscapes" (CBD, 1992)

Tropical rain forest are the most diverse of terrestrial ecosystems and tropical rain forest is one of the major vegetation types of the globe (Whitmore, 1998)

Historical point of view of species distribution

Source: http://catalog.flatworldknowledge.com/bookhub/reader/10997?e=berglee_1.0-ch12_s01
cecep_kusmana.staff.ipb.ac.id/2010/06/15/keanekaragaman-hayati-flora-di-indonesia/

Species diversity

Estimated 25,000 flowering plants (10% of the world's flowering species, 55% endemic)

4000 woody species

209 common as commercial species

Tree families: 106

Tree genera: 785

Source : Martawijaya *et al.* (2005), Muchlish (2013)

Why biomass assessment is important?

1. For resource use
2. For environmental management

- How much fuel wood/ timber is available
- To assess the productivity and sustainability of the forest
- Important indicator in carbon sequestration (50% of the forest dry biomass is carbon)
  (Losi et al 2003, Samalca, 2007)
- Forest as potential carbon storage (Brown, 2002)

How to measure / estimate sample tree biomass?

1. Destructive (sample tree felling and weighing)
2. Non-destructive (computing volume, use tree density to convert volume into biomass)

Biomass estimation approaches (Picard *et al* 2012)

1. Biome: Biomass average of a biome * biome area

   Remote sensing application

2. Forest/ set of forests: Use of biomass/ nutrient content tables (trees are felled for this)

   The other compartments biomass is estimated from volume expansion factor, mean wood density measurements, nutrient concentration

3. Biomass measurement of a tree: Species-specific allometric equation

   Tree segmentation into compartments of homogenous dry weight density

The status of forest biomass-related researches

Basuki (2009)	: Use dbh to estimate AGB in lowland Dipterocarp forest Berau East Kalimantan
Brown (1997)	: AGB tree = f(dbh, total height, wood density, Holdridge life zones)
Hashimotio (2000)	: logistic curve based on tree age
Ketterings et al (2001)	: allometric equation for mixed secondary forest in Sumatera (Jambi)
Yamakura (1986)	: Use dbh and height to predict stem dry weight of Dipterocarp forest in Sebulu-East Kalimantan

No	Forest type	Above Ground Carbon Stock (ton C/ha)	Source	Remarks
1	Dipterocarp forest	204.92-264.70	Dharmawan and Siregar (2009)	Destructive sampling method, Sampit Central Kalimantan
			Samsoedin et al (2009)	Chave allometric, Malinau- East Kalimantan
2	Protection forest	211.86	Noor'an (2007)	Brown allometric, Protection forest Sungai Wain - East Kalimantan
3	Post fire secondary forest	7.5-55.3	Hiratsuka et al (2006)	Destructive sampling method, East Kalimantan, 2-5 years post forest fire
4	Secondary mangrove forest	54.1-182.5	Dharmawan and Siregar (2008, 2009)	Destructive sampling of *Avicennia marina* and *Rhizophora mucronata*, West Java
5	Secondary	171.8-249.1	Dharmawan	Chave allometric, Malinau-East

No	Forest type	Above Ground Carbon Stock (ton C/ha)	Source	Remarks
6	Lowland primary forest	230.10-264.70	Samsoedin et al (2009)	Chave allometric, Malinau-East Kalimantan
7	Highland primary forest	103.16	Dharmawan (2010)	AGB=0.1728 DBH 2.2234, Sukabumi-West Java
8	Highland secondary forest	113.20	Dharmawan (2010)	40 years Agathis and mixed species, Sukabumi-West Java
		39.48		17 years Agathis and mixed species, Sukabumi-West Java
9	Peat swamp forest	200	Agus (2007)	Average of all peat swamp forest type, literature study

Source: Masripatin *et al* (2010)

National level (Indonesia) forest biomass carbon stocks estimates (Million tonnes of carbon)

Compilation of harvest data			Forest inventory		Range
Olson et al (1983)/ Gibbs (2006)	Houghton (1999)/ DeFries et al (2002)	IPCC (2006)	Brown (1997)/ Achard et al (2002, 2004)	Gibbs and Brown (2007)	
13,143	25,547	25,397	16,448	20,504	13,143-25,547

Olson et al (1983) provides a single value for all tropical forest (120 Mg C/ha)
Gibbs (2006) translated and applied the original Olson et al (1983) data to FAO Global Land Cover Map 2000

Source: cited partly from Gibbs et al (2007)

Conclusions

Geographical position, climatic condition, and topographic configuration giving a complex forest types in Indonesia, range from lowland forest to subalpine forest

Historical land formation giving Indonesia a unique characteristics of flora distribution, divide into Sundaland, Sahul land, and transition between both, hence contribute to forest diversity as a whole

Out of 4000 tree species, only 10% considered to have economical value although only 50% of it recognized as common commercial species

There are different biomass estimation approaches in term of scale: biome, forest/ set of forest, tree/ species specific biomass estimation

The high level of diversity but low magnitude of information related to it implies to biomass estimation challenge, especially in producing accurate and precise forest biomass value

THANK YOU

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