Oxford Policy Management

Growth in Indonesia: is it sustainable?

The environmental sustainability of growth

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Preface

Oxford Policy Management Ltd. (OPML) is delighted to present the study entitled 'Growth in Indonesia: is it sustainable?' The study present analysis on the sustainability of Indonesia's economic growth model conducted for the UK Climate Change Unit (UKCCU) in Jakarta.

This paper reviews the environmental sustainability of Indonesia's growth as part of our study of whether Indonesia's growth is sustainable. Our other papers review the political economy of deforestation, the impact of the commodity boom, and the drivers of recent economic growth. We use the World Bank's 'adjusted net savings' framework to integrate these papers in an overview paper.

OPML is grateful to the many individuals who generously gave their time to the preparation of this study. We are particularly grateful to the stakeholders who met team members in Jakarta and gave us their valuable time and insights, and to Smita Notosusanto and the OPML Jakarta office for their support during our visits to Jakarta. We would also like to thank the UK Climate Change Unit (UKCCU) in Jakarta for their assistance and comments throughout the process.

This study was led by OPML Chief Economist Mark Henstridge and co-authored with Gaber Burnik, Federica Chiappe, Mateo Cabello, Lee Crawford, Sourovi De, Maham Farhat and Maja Jakobsen. It was peer reviewed by David Bevan, Kurnya Roesad and Gustya Indriani.

Any errors or omissions are, of course, the responsibility of the authors. For more information about OPML please visit www.opml.co.uk/.

Executive Summary

Gross domestic product (GDP) does not account well for environmental degradation. When forests are cut down to create farmland, or coal is burnt and the atmosphere is polluted, GDP only captures the economic gain from these activities, not the environmental costs.

The World Bank's 'adjusted net savings' framework presents a way of accounting for environmental degradation. The framework adjusts saving and investment in physical capital with simple measures of changes in environmental and human capital. In other words, it captures changes in the broader national balance sheet. Negative adjusted net saving rates imply that total wealth is in decline and that the policies in place are ultimately unsustainable.

In this paper we analyse environmental degradation in terms of greenhouse gas emissions, a central manifestation of the depletion of natural resources, with a focus on deforestation as one of the largest sources of emissions in the country.

Indonesia is among the world's 15 largest emitters of greenhouse gases and its emissions are growing. According to official statistics, in 2005 Indonesia accounted for 4.5% of global emissions or 2.4 Gigatons of Carbon Dioxide Equivalent (GtCO2e) (GoI, 2010), doubling over the previous two years. Peat and land use, land use change, and forestry (LULUCF)-related emissions are considered to contribute to over three quarters of Indonesia's emissions, and will be the largest source in the next 20 years (DNPI, 2010).

Substantial deforestation has continued to take place in Indonesia. There are many discrepancies between data sources of forest cover and deforestation rates. However, the evidence points to sustained deforestation over the past thirty years. An estimated 1.1 million hectares per year have been lost between 2000 and 2010; in other words, nearly 1% of the forest cover is cut down each year. Planned deforestation has happened due to expansion of oil palm plantations and mining activities. Unplanned deforestation is a consequence of illegal logging, forest fires, and swidden agriculture, and we estimate that it accounts for nearly half of the total deforestation (0.5 million hectares each year).

Planned deforestation takes place through a permitting system, and unplanned deforestation takes advantage of the weaknesses in the system. Nearly the entire forest cover (approximately 130 million hectares in 2010) is under the jurisdiction of the Ministry of Forestry (MoF) that assigns these lands as state forest areas (*kawasan hutan*). While the law establishes that these areas must be gazetted, in reality, only 10% to date have been gazetted, leaving space for unplanned deforestation.

Deforestation has severe impacts both at the national and at the global level. Deforestation contributes to approximately 17% of global emissions. While tropical forests are an important carbon sink, their carbon capture capacity is not the only benefit they bring: they also provide a variety of ecosystem services vital to livelihoods and food security that are yet to be fully valued.

According to the World Bank's net adjusted savings data, Indonesia's wealth has been falling over the past decade, recently dropping below zero, suggesting that growth is no longer sustainable. Net forest depletion, the main proxy for natural capital, is however not adequately represented.

The monetary valuation of the environment presents some tough challenges. The monetary cost of environmental change, and deforestation in particular, is difficult to measure. We estimate

that Indonesia may have lost around $150 billion worth of forest between 1990 and 2007 (or nearly 5% GDP each year).

List of Abbreviations

ADB	Asian Development Bank
BPS	Badan Pusat Statistik, Indonesia Statistical Office
CIFOR	Center for International Forestry Research
CO2e	Carbon Dioxide Equivalent
DEFRA	Department for Environment, Food and Rural Affairs
DNPI	Dewan Nasional Perubahan Iklim (National Council on Climate Change)
FAO	Food and Agriculture Organisation
FWI	Forest Watch Indonesia
GDP	Gross Domestic Product
GFW	Global Forest Watch
GNI	Gross National Income
GoG	Government of Guyana
GoI	Government of Indonesia
Gt	Giga tons
IPCC	Intergovernmental Panel on Climate Change
LULUCF	Land Use, Land Use Change, and Forestry
MoA	Ministry of Agriculture
MoF	Ministry of Forestry
NAMA	Nationally Appropriate Mitigation Actions
NSDI	National Spatial Data Infrastructure
OPML	Oxford Policy Management Limited
REDD+	Reducing Emissions from Deforestation and forest Degradation (including conservation, sustainable management of forests and enhancement of forest carbon stocks)
SNC	Second National Communication (to the UNFCCC)
UKCCU	UK Climate Change Unit
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
WAVES	Wealth Accounting and the Valuation of Ecosystem Services

Introduction

Sustainable development is *"development that meets the needs of the present without compromising the ability of future generations to meet their own needs."* – Brundtland Commission (World Commission, 1987).

A key dimension of sustainability is environmental. If growth takes place by depleting natural resources it is not sustainable in an environmental sense. Natural resources are collectively owned, and should benefit the country as a whole, and also future generations.

This paper discusses the environmental sustainability of Indonesia's recent growth. We start out by providing a brief outline of what we mean by sustainability. Then we centre the discussion on greenhouse gas emissions that by causing climate change contribute to what is defined as '*the greatest market failure the world has seen'* (Stern, 2006). In Indonesia, the majority of emissions come from the forestry sector, so in our analysis of environmental sustainability we focus on deforestation[1]. Indonesian forests are the third largest in the world, and among the richest in terms of biodiversity and tropical peat (an important sink of soil carbon). Depletion of natural resources in Indonesia, in particular in the form of deforestation, has a substantial local and global impact. Net forest depletion is also the main environmental indicator for natural capital in the World Bank's 'net adjusted savings' framework.

The paper is structured as follows: in Section 1 we provide a brief outline of sustainability, centred on the concepts of natural capital accounting. Section 2 presents Indonesia's profile in terms of current and projected greenhouse gas emissions, to highlight the country's contribution to climate change. In Section 3 we then focus on deforestation, due to its very high contribution to emissions in the country. We discuss how it happens, the purposes for which it takes place, and the consequences of it. In Section 4, we outline the size of the deforestation costs in the context of the overall economy through adjusted net savings, and present a rough estimate of loss of ecosystem services from deforestation. The last section concludes.

[1] There are many other specific environmental concerns. The most pressing issues related to environment and natural resources include: loss of forest and terrestrial biodiversity; deterioration of coastal and fisheries resources; degradation of water resources; and; waste and pollution (ADB, 2011).

1 Measuring environmental sustainability

"Gross domestic product, the leading economic measurement, is outdated and misleading...It's like grading a corporation based on one day's cash flow and forgetting to depreciate assets and other costs." — J. Stiglitz, Nobel Prize, Economics (World Bank, 2012).

The predominant approach to measuring the sustainability of economic growth is based on understanding the underlying stock of wealth and assets which generates a stream of income. GDP is a measure of annual income, a flow, and does not sufficiently explain the underlying assets generating this income.

The concept of 'green accounting' or 'natural capital accounting' has been developed in response to criticisms of GDP as a measure of economic wealth, given the shortcomings of GDP. When a forest is cut down to create farmland, or coal is burnt and the atmosphere is polluted, GDP only captures the economic gain from these activities, without accounting for the environmental costs.

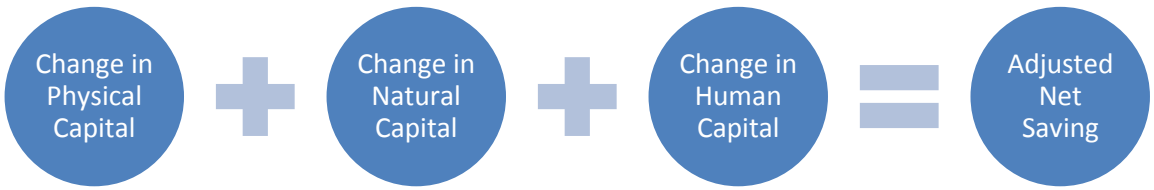
The concept of wealth accounting is based upon the idea that economic growth and income is underpinned by the wealth stock or capital available to a country. This includes buildings, machinery, highways and ports, as well as natural assets such as land, forests, fish, minerals and energy, and human or social assets such as education, and conducive economic systems. Wealth accounting measures these assets and capital goods that are inputs to our economic well-being.[2]

Wealth accounting exercises typically look at three kinds of capital; produced capital, which includes buildings and machinery; natural capital, which includes forests, wetlands, and agricultural land; and intangible capital, which includes human capital, social capital, the rule of law and institutions, and changes in technology.

In practice, although 'green accounting' has been around for more than 30 years, progress on implementation has been slow. Few countries maintain regular wealth accounts, and still focus their national accounts solely on income measures such as GDP. The World Bank estimates wealth accounts for 120 countries, though these are only published at irregular intervals (World Bank, 2011).

One implementation of 'green accounting' is the World Bank's 'genuine' or 'adjusted net savings'. These estimates adjust traditional measures of national savings and investments in physical capital with some simple measures of changes in environmental and human capital.

Figure 1 – The composition of 'adjusted net saving' [3]



[2] Much of the work in operationalising methods for measuring sustainability come from Pearce and Atkinson (1993) and Hamilton (1994), who establish that movements in wealth can be used to judge the sustainability of development paths. Sustainable development is an economic path along which overall wealth does not decline.

[3] Change in Physical Capital= Gross National Saving - Consumption of Fixed Capital; Change in Human Capital = Education Expenditure; Change in Natural Capital= Net Forest Depletion + Energy Depletion + Mineral Depletion + C02 Damage + PM10 Damage.

If adjusted net saving rates are positive, the present value of social welfare is increasing. Negative adjusted net saving rates imply that total wealth is in decline and that the policies in place are unsustainable. This measurement can provide some information to understand whether natural capital has been drawn down, without an adequate investment in physical and human capital.

2 Greenhouse gas emissions in Indonesia

Climate change, caused by anthropogenic greenhouse gas emissions, is one central manifestation of the depletion of natural resources. Greenhouse gas emissions are an increasingly important element to consider in the analysis of the environmental sustainability of growth. An analysis of these emissions is also useful to explain how environmental damage at the local level can reach a global scale.

Indonesia's greenhouse gas emissions are amongst the highest 15 in the world, and are growing. This section provides an overview of the historic emissions and emission sources and highlights what could be the future scenario if Business As Usual (BAU) growth continues.

2.1 Current emissions: size and sources

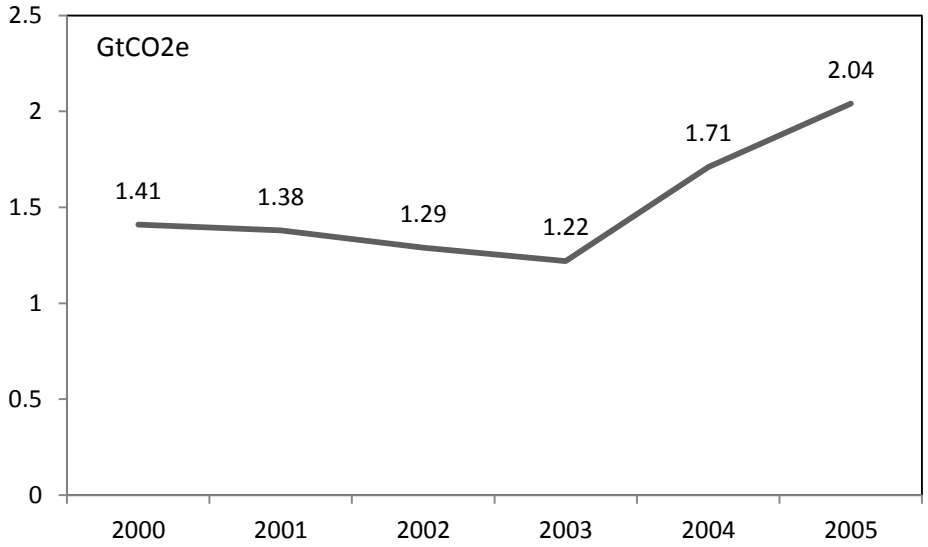
Indonesia is one of the world's largest emitters of greenhouse gases, but emission estimates vary considerably between sources. We predominantly use official statistics from the National Council on Climate Change (DNPI), as we find it the most recent and complete, although we cross-check its consistency with other data.[4] We also use data from the Government of Indonesia's Second National Communication (SNC) to the United Nations Framework Convention on Climate Change (UNFCCC).[5]

DNPI (2010) shows Indonesia accounted for 4.5% of global emissions or 2.04 Giga tons (Gt) of CO2e in 2005.[6] Independent studies have put Indonesia's emissions much higher: a 2007 PEACE, World Bank and DFID study suggested Indonesia to be the 3rd largest emitter country with total emission of about 3 Gt CO2 and Land Use, Land Use Change, and Forestry (LULUCF) contributing to about 85% or about 2.5 Gt CO2 (PEACE, 2007). Climate Analysis Indicators Tool (CAIT) rank Indonesia 13th in terms of emissions (China is top, and the US is second). However, CAIT uses data from World Resources Institute (2012) which does not consider a major source of emissions: LULUCF.

The figure below shows the Indonesia's greenhouse gas emissions between 2000 and 2005, as reported in the SNC to the UNFCCC (GoI, 2010). It is important to highlight that the data for 2005 reported in Indonesia's SNC is lower than the DNPI data by approximately 18%.

[4] It is important to highlight that there is not sufficient evidence on the underlying data used in DNPI reports.
[5] Indonesia is a party to the United Nations Framework Convention on Climate Change (UNFCCC). It is also a signatory of the Kyoto Protocol. Developing countries are required to report on their emissions and develop Nationally Appropriate Mitigation Actions (NAMAs) (UN, 2008) every four years. The data of the Second National Communication of 2010 is related to 2005 as final year.
[6] As some greenhouse gasses are more potent than others, to be able to talk about the effect of greenhouse gases in general, the 'radiative forcing' of each gas is converted into the amount of CO2 required to produce the same effect.

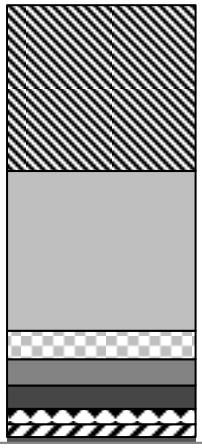
Figure 2 – Greenhouse gas emissions (2000-2005)



Source: GoI, 2010.

We use the DNPI data to present a detailed overview of the different emission sources. The most recent data available to us in terms of emissions and sector contributions to emissions is from 2005. Figure 3 below visually shows the sector contributions to the country's emissions in 2005.

Figure 3 – Sector contributions to Indonesia's emissions in 2005 (GtCO2e)



	2005
Peat	0.77
LULUCF (net)	0.75
Agriculture	0.13
Petroleum and gas	0.12
Power	0.11
Buildings	0.07
Transportation	0.06
Cement	0.03

Source: DNPI, 2010.

Peat and LULUCF-related emissions contributed to over 75% of Indonesia's emissions in 2005.[7] Peatlands store a large amount of carbon in the form of organic matter. Fires are the major cause of the release of carbon from peatlands, accounting for approximately 60% of the emissions (DNPI, 2010; Van der Werf et al., 2009). Emissions from peatlands were 0.772 GtCO2e in 2005. In terms of land use change, 60 GtCO2e of carbon would be emitted if 130 million hectares were completely deforested (DNPI, 2010). Gross emissions derive from deforestation, forest degradation, and forest fires. Net emissions from LULUCF were 0.74 GtCO2e in 2005.

Agriculture, power, and petroleum and gas sectors account for almost the same share of emissions, contributing to approximately 18% of total emission in 2005. Agricultural carbon emissions are mostly methane and nitrogen oxide, and the major sources are: water management practices for rice crops, artificial fertiliser application, and the burning of crop residues. The power sector's emissions come from coal burning (above 50% of sector emissions) – an industry which significantly expanded production volume the last decade. The petroleum sector includes production (including gas flaring) and refining activities, and the gas sector's emissions are generated from production and liquefaction of natural gas.

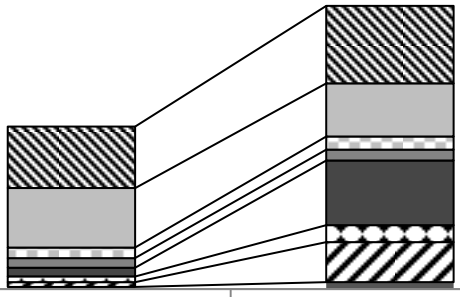
Less significant sectors in terms of emissions are transport, cement, and buildings, contributing to 8% of total emissions in 2005. Although the transport sector emits relatively small amounts, it is noticeable that 95% of the sectors emission is generated from private vehicles. The majority of emissions from the cement industry derive from the use of clinker, a key element of cement production. Emissions from buildings are driven by energy consumption in the residential and commercial sectors.

2.2 Indonesia's projected emissions

We recall that peat and LULUCF-related emissions contributed to over 75% of Indonesia's emissions in 2005. Emissions from these sources will also be the largest contributors to Indonesia's future emissions, although emissions from fossil fuels are expected to grow exponentially by 2030 (DNPI 2010; Resosudarmo et al., 2010). It is important to highlight, however, that there are large differences in the estimations between institutions calculations, in particular due to differences in estimates of forest cover and of carbon. Figure 4 shows sectors' contributions to greenhouse gas emissions, comparing 2005 estimates to projections in 2030 following a BAU scenario.

[7] It is important to highlight that the sectors considered in the Second National Communication to the UNFCCC are: Land Use Change and Forestry, energy, peat fire related emissions, waste, agriculture, and industry. In particular, this model does not consider waste as one of the major sources of emission. GoI (2009) indicates that the population of Indonesia in 2005 was 218.8 million and the level of solid waste production from households amounted to 33.5 Mt/year.

Figure 4 – Sector contributions to Indonesia's emissions: 2005 and projected (GtCO2e)



	2005	2030
Peat	0.77	0.97
LULUCF (net)	0.75	0.67
Agriculture	0.13	0.16
Petroleum and gas	0.12	0.14
Power	0.11	0.81
Buildings	0.07	0.22
Transportation	0.06	0.50
Cement	0.03	0.09

Source: DNPI, 2010.

Box 1 – The impacts of climate change in Indonesia

The impact of man-made climate change caused by carbon emissions poses a potentially large threat for Indonesia and the country could lose 6.7% of GDP by 2100.

Being an archipelago, Indonesia is vulnerable to any increase in frequency of extreme weather events, and the occurrence of prolonged droughts or heavy rainfall leading to intense floods, will have harmful effects on agriculture and industry (World Bank, 2008; PEACE, 2007). 16% of the population is exposed to droughts, floods, and extreme temperatures, threatening food security and livelihoods. 11% of the population lives at an elevation below 5 metres (World Development Indicators).

The ADB (2009) published the Economics of Climate Change in Southeast Asia. The region is particularly affected to climate change, and it is estimated that it could lose 6.7% of GDP by 2100.

We next will focus on deforestation, due to the importance it has as a source of greenhouse gas emissions in Indonesia.

3 Deforestation in Indonesia

Indonesia is endowed with some of the largest and most biologically diverse tropical forests in the world, that provide important ecosystem services at different levels, including livelihoods to millions of people. But the size of this asset, and the relatively easy way to deplete it obtaining quick revenues, means that Indonesia also faces some of the highest risks of deforestation. The country has attracted substantial attention at the domestic and international level to reduce the depletion of this natural resource.

3.1 Overview of Indonesian forests and deforestation

There is plenty of evidence pointing to substantial deforestation over the past thirty years in Indonesia. There are however many discrepancies in the data, including different definitions of forest, forest classifications, and different data analysis methods. The differences in estimates of forest cover and deforestation make it difficult to provide sufficiently clear estimates (Indrarto et al., 2012; DNPI, 2010; FWI/GFW, 2002). No integrated record of forest area has been kept in Indonesia (FWI/ GFW, 2002; Broich, 2010).

At the most fundamental level, there is no agreed definition of a 'forest'. According to Law No. 41/1999 on Forestry (the Forestry Law), a 'forest' is defined as '*an integrated ecosystem within a landscape containing biological resources, dominated by trees in harmony with its natural environment inseparable from one another'* (Indrarto et al., 2012). The FAO (2006) defines forest as '*land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10%, or trees able to reach these thresholds in situ*'. Furthermore, the Indonesian government classifies areas as 'forested' and 'unforested', whilst the FAO divides areas into 'forest', 'other woodland', 'other land' and 'other land with tree cover' (MoF, 2008; FAO, 2006).

Forests in Indonesia are also subdivided according to their functions. *Production forest* is a forest with the primary function of producing forest products, such as timber or paper. Production forests are then further categorised into permanent production forest (in which the whole area is allocated to the production of forest products), limited production forest (in which only part of the area is allocated to the production of forest products) and convertible production forest (which is reserved for other land uses); *Protection forest* is a forest with the primary function of protecting life support systems to regulate water, prevent flooding, control erosion, prevent seawater intrusion and maintain soil fertility; and *Conservation forest* is a forest with the primary function of conserving plant and wildlife biodiversity and their ecosystems (Indrarto et al., 2012).

Production forest dominates forest cover. The area allocated to production forest, over 82 million hectares, is larger than the total area allocated to both conservation and protection forest (see Table 1). Utilisation of the forest as a development resource is an important element of Indonesian forestry.

Table 1 – Comparison of forest area by type, 2005 and 2008 (million hectares)

Forest type	2005	2008
Conservation forest	20.1	19.9
Protection forest	31.8	31.6
Production forest	71.6	82.2
Total	**123.5**	**133.7**

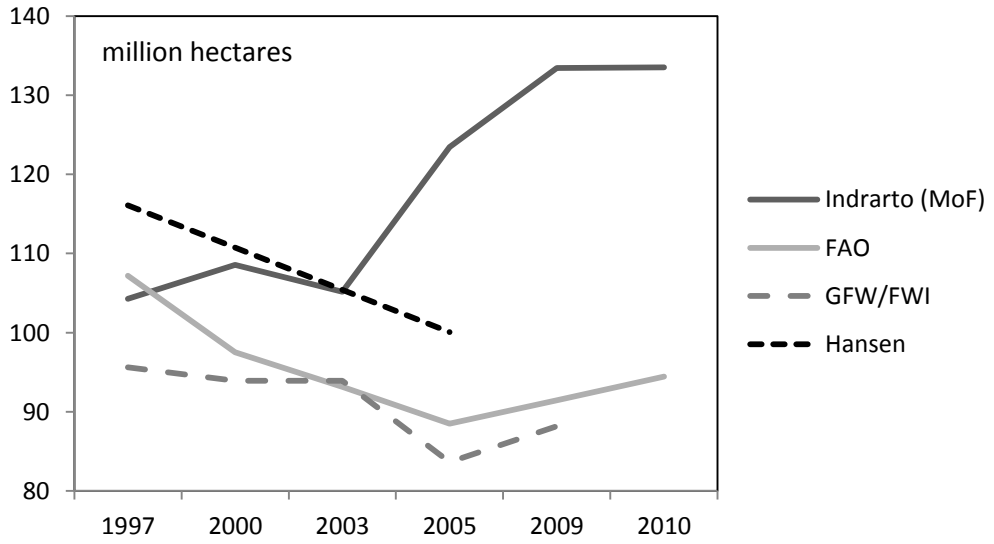
Source: MoF data from Indrarto et al., 2012.

3.1.1 Indonesia's forest cover

With unclear definitions, estimates of the size of forest cover and trends also vary substantially. We have found two different set of figures of forest cover from the Ministry of Forestry. One set of official national numbers for forest cover report 134 million hectares in 2008, up from 123 million hectares in 2005 (MoF 2008; Indrarto et al., 2012). Another set of official numbers, reported by individual provinces, sums to a total forest size of just 120 million hectares for the same time period (MoF, 2007).

Using different definitions than the Ministry of Forestry, other institutions produce more conservative estimates. In 2010 the FAO reports forest cover of 94 million hectares, up from 88 million hectares in 2005 (FAO, 2010). The government's calculations are higher, mostly because they include forest that the FAO would consider as 'other woodland.' Hansen et al. (2009) produce estimate of around 115 million hectares in 1997, decreasing to around 100 million hectares in 2005. Forest Watch Indonesia and Global Forest Watch (FWI/GFW, 2002) report lower estimates than all the others.

Figure 5 – Comparison of the area of forest and forest land

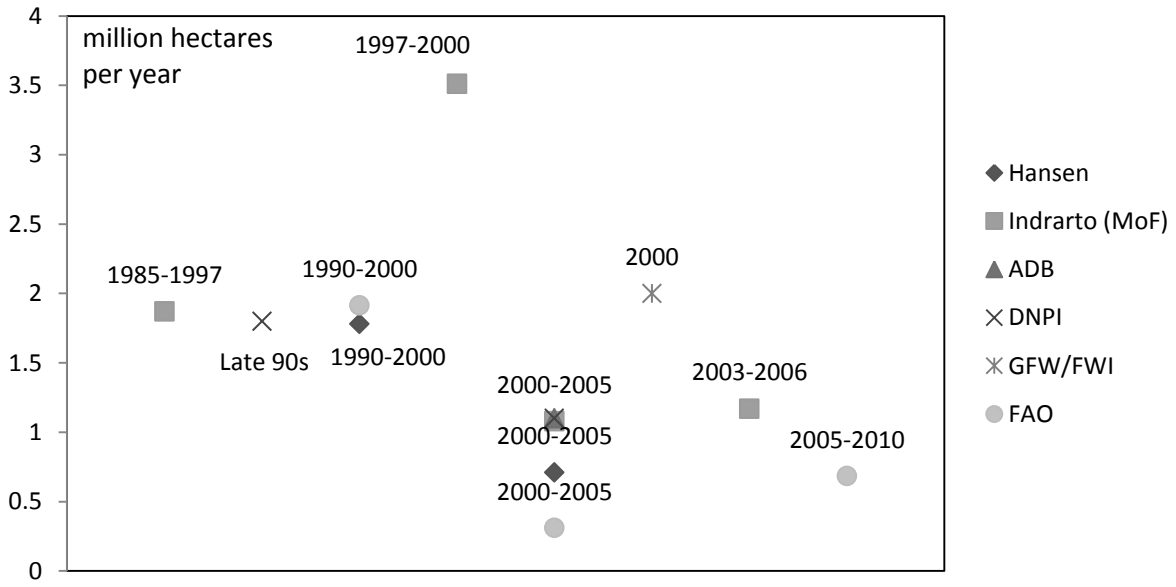


Source: Indrarto et al., 2012; FAO, 2010; Hansen et al., 2009.

Apart from the differences in trends, also the differences in levels of forest cover are difficult to explain. Ministry of Forestry data (Indrarto et al., 2012) seem to suggest that around 10 million hectares of forest have been created between 2005 and 2008, following from a period of loss of forest cover before 2003. Increase in cover can happen through reforestation and afforestation, including rehabilitation of degraded land. However, it is difficult to identify data to explain this increase: Ministry of Forestry (2008) reports that between 2003 and 2007 1.3 million hectares have been rehabilitated, and 0.7 million hectares have been reforested, for a total of approximately 2 million hectares, a much lower estimate than the above 10 million.

Estimates of deforestation rates[8] are also subject to divergence between sources, and vary from year to year (Figure 6). We estimate an average of 1.1 million hectares lost a year in the last 20 years. Based on Ministry of Forestry data between 1985 and 2006, the average rate is estimated to be around 1.1 million hectares annually (MoF 2008; Indrarto et al., 2012). National Development Planning Agency (Bappenas) data also show an estimate of 1.12 million hectares lost between 2000 and 2010 (Indrarto et al., 2012). Deforestation peaked in the late 1990s, at a rate of more than 1.8 million hectares annually, before decreasing slightly, averaging roughly 1.1 million hectares annually between 2000 and 2005.[9]

Figure 6 – Differences in estimates of deforestation

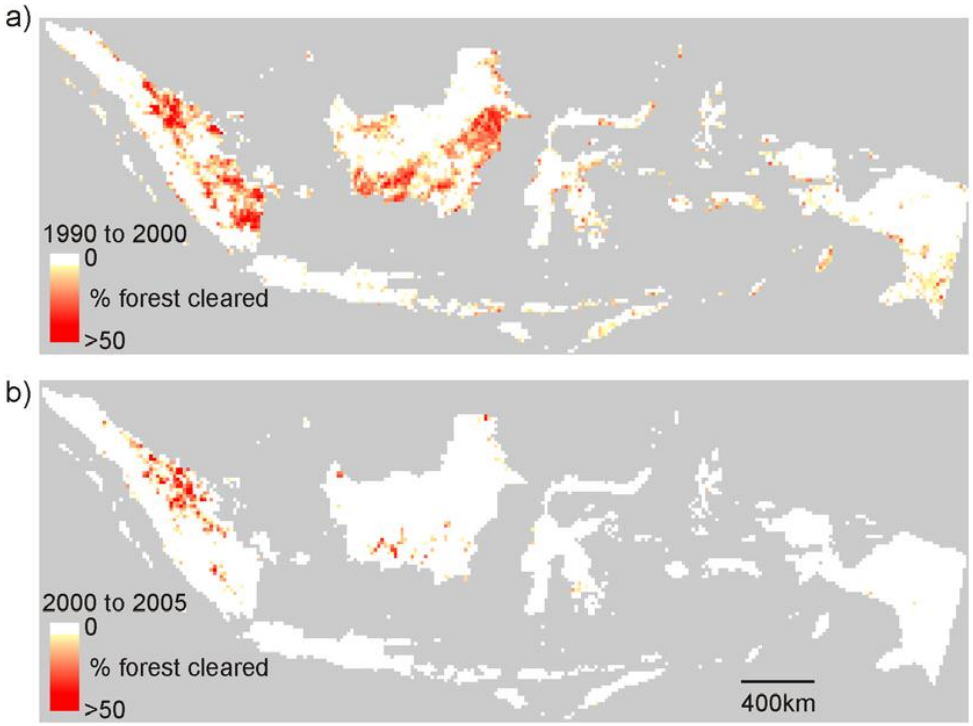


Source: Indrarto et al., 2011; FAO, 2010; Hansen et al., 2009; DNPI, 2010; ADB, 2011.

Remote sensing visually show the extent of deforestation and its geographical concentration.[10] Images reveal that more than 70% of total forest clearing within Indonesia between 1990 and 2005 took place on the lowlands of Sumatra and Kalimantan. Over 40% of the lowland forests of these island groups were cleared from 1990 to 2005 (Hansen et al., 2009; Figure 7).

[8] Deforestation is defined as "land cover changes from forested land to non-forested land, including for estate crops, settlement, industrial area, etc." (MoF, 2008).
[9] This data is difficult to compare to the data presented above, also from Ministry of Forestry, of a considerable and constant increase in forest between 2005 and 2008 (Indrarto et al., 2012).
[10] While there is a variety of data available, we have concentrated on work from Hansen et al. (2009), and Broich et al. (2010).

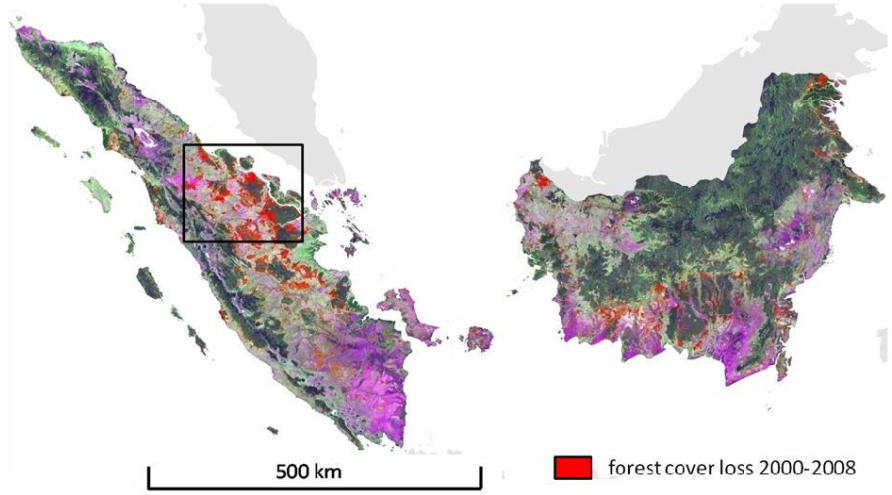
Figure 7 – Estimated forest clearing 2000-2005 through remote sensing[11]



Source: Hansen et al., 2009.

We find evidence that forest continues to be cut down in particular on Sumatra and Kalimantan. Work by Broich et al. (2010) shows the extent of forest cover loss in Sumatra and Kalimantan (Figure 8). The total forest cover loss for Sumatra and Kalimantan between 2000 and 2008 was 5.4 million hectares, which represents 5.3% of the land area and 9.2% of the year 2000 forest cover of these two islands. The average loss per year of the two islands between 2000 and 2008 is 0.7 million hectares, more than half of 1.1 million hectares of estimated yearly forest loss between 2000 and 2005.

Figure 8 – Forest cover loss in Sumatra and Kalimantan (2000–2008)



Source: Broich et al., 2010.

[11] Per 18.5 km block, or 34,225 hectares, based on satellite images.

Looking ahead more consistent data on forest and deforestation might become available. A National Spatial Data Infrastructure (NSDI) aim to provide one unique map for the entire country is currently being introduced, and it is hopefully going to make deforestation data more easily available and consistent throughout sources.

3.2 The drivers of change in forest cover

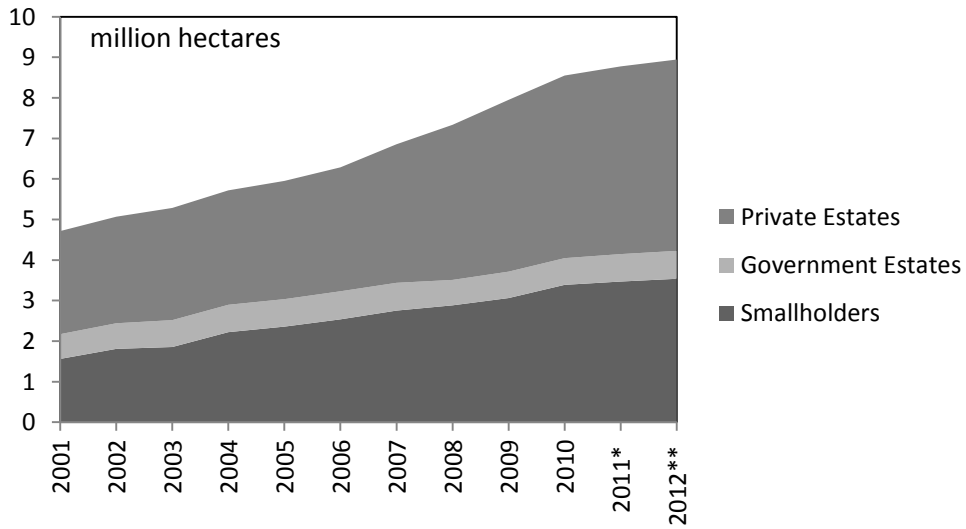
The drivers of change in forest cover are complex and interrelated. We can however identify direct and underlying ones. We will focus in this paper on the direct drivers of change in forest cover: planned and unplanned deforestation. The indirect drivers are investigated in our *Political Economy Analysis of Deforestation*.

Planned deforestation considers changes in forest area allocation and function (for example, changing from protection forest to production forest), mostly through the expansion of oil palm and mining.

Oil palm plantations are a major driver of land use change in Indonesia. The area of oil palm estates, both large and small, has been growing every year (Figure 9). According to Ministry of Agriculture data, the area of palm oil estates was approximately 7 million hectares in 2008 and 8.4 million hectares in 2010 (Indrarto et al., 2012). Also FWI (2008) produces much higher estimates (8.2 million hectares already in 1998).

From 1990 to 2010, 90% of land converted to oil palm plantations in Kalimantan were previously forested (Sizer, 2012). Koh et al. (2008) produce more conservative estimates: through analysis of land-cover data compiled by the FAO they suggest that in the period 1990–2005, at least 56% oil palm expansion in Indonesia occurred at the expense of forests.

Figure 9 – Expansion of oil palm plantations



Source BPS, 2007; BPS, 2011.
Note * is preliminary, ** is an estimation.

Oil palm will continue to drive deforestation with future plans for conversion of forest. The government has set aside 12% of forest land for future conversion (Indrarto et al., 2012). With land availability in the current oil palm centres of Kalimantan and Sumatra becoming more limited, expansion is planned for Papua (DNPI, 2010). The spread of oil palm is also considered to be

related to human-induced forest fires, which claimed approximately 10 million hectares of forest between 1997 to 1998 (VV.AA., 2011).

Opportunity costs for avoiding forest conversion into estate crops or timber plantations are high, reaching close to $30 per avoided ton CO2e, due to the high economic returns obtainable from crops such as palm oil and pulpwood (DPNI, 2010). These costs can be significantly reduced if those plantations can be established on already degraded or deforested areas.

Mining is also a driver of deforestation, although it is difficult to estimate the area effectively covered by mining operations. According to Ministry of Forestry data, lease-use permits for mining covered only around 0.34 million hectares up until 2008**.** In reality, however, mining in forest areas covers a much larger area, as many mining operations, including those authorised by regional government permits, do not actually operate under lease-use permits (Indrarto et al., 2012). In addition, there are many small-scale illegal mining operations in forest areas (Resosudarmo et al., 2012). The real cost of mining to deforestation is therefore unknown.

Another large part of deforestation is unplanned, or deforestation that does not specifically fall into the category of change in allocation and function. Unplanned deforestation includes illegal logging, forest fires, and small-scale agriculture, and it could reach 8.7 million hectares of currently forested land by 2025 (Indrarto et al., 2012).

Illegal logging is a major threat to forests in Indonesia (Luttrell et al., 2011; Indrarto et al., 2011; Dermawan et al., 2011). Illegal loggers operate differently in conservation/protection and production forests: in the former, illegal logging takes place without permits, while in active production forest it usually occurs through activities such as permit violations or clearing of logging roads outside concession areas and cutting. In addition, illegal logging occurs through unlicensed and licensed mining activities that violate procedures or the terms of their permits (Indrarto et al., 2012). Other illegal logging behaviours can happen during timber transport and distribution processes[12] - in fact illegality is possible in every phase of the process.

Box 2 – Illegal logging bridges some of the demand and supply gap of wood in Indonesia

Low domestic prices leads to illegal logging due to a large price gap between international and domestic willingness to pay for forest products. The licencing and permitting system was designed to develop a heavily export orientated forestry industry. By the end of the 1980s, Indonesia had become the world's largest producer of tropical plywood (Klassen, 2010; Human Rights Watch, 2009).

Klassen (2010) argues that for legally sourced and produced timber to be available in Jakarta, the selling price would have to be at least $273.13/m^3. In other words, the existing timber prices would have to increase by at least 114%. Given the much higher prices of plywood on the international markets, it is clear that the only way the country's plywood factories utilising logs from the legally licensed concessions can stay in business, is by exporting all of their production. Indonesia however consumes domestically an estimated 10 million m^3 of round wood volume per year – the vast majority of which is from illegal logging.

The primary cause of forest and land fires is considered to be human activity.[13] The area of land subject to forest fires between 1999 and 2008 has been around 0.012 million hectares (Indrarto et al., 2012). Even though the areas lost due to forest and peatland fire seem small compared with that lost to land use change, fires have serious environmental, health and economic impacts. Fires are particularly used to make way for forest conversion, and are also an instrument to make land right claims in areas with unclear land tenure. Currently, forest fires are forbidden by

[12] Through, for example, falsifying documents, changing wood species and volume, smuggling high-value wood by concealing it under cheaper species (Dermawan, 2011).
[13] Particularly intense dry seasons are considered to be contributing to the increase of hot spots and forest fires.

law, but Indonesia still lacks a comprehensive system to adequately manage fires (Applegate et al., 2001).

Between 1985 and 1997 the expansion of small-scale agriculture caused the loss of approximately 4 million hectares of forest, more than 20% of the total forest loss. If this trend continued between 2000 and 2010 it would mean that approximately 2.5 million hectares have been lost in that period (Indrarto et al., 2012). Traditional shifting cultivation involves growing subsistence crops in a rotational system that includes a long fallow period. The slash-and-burn methods used exacerbated the problem, resulting in the government issuing several regulations prohibiting swidden agriculture and burning (Indrarto et al., 2012).

Box 3 – Accounting for the 1.12 million hectares of forest loss per year

Indonesia's total deforestation rate between 2000 and 2010 has been an average of 1.12 million hectares of land.

Based on the information available to us, we try to map out the different sources:

- Land conversion for oil palm has contributed to an average of 0.42 million hectares per year.
- There is insufficient data on clearing for mining (a total of 0.34 hectares measured until 2008).
- Forest fires contribute to around 0.012 million hectares being deforested a year.
- 0.225 hectares are being lost due to swidden agriculture.
- We have no estimates for logging concessions. They are intended to maintain forest lands in permanent production, however they are considered to be a major cause of deforestation.

The sum of these estimates is 0.997 hectares a year. There is no account of how the rest is been deforested.

Source: MoF, 2010; MoA, 2010; Indrarto et al., 2012; FWI/GFW, 2002; author's calculations.

3.3 The deforestation process

Under the planned deforestation process, the Ministry of Forestry issues permits to cut down forests under its jurisdiction. Nearly the entire forest cover (approximately 130 million hectares in 2010) is under the jurisdiction of the Ministry of Forestry, that assigns these lands as state forest areas (*kawasan hutan*) (Dermawan, et al., 2011; Indrarto et al., 2012).

Indonesia's natural forests have been industrialised under a concession system since 1967 (Klassen. 2010). There are six different permits applicable to the forest use (Dermawan et al., 2011). They include area use permit (IUPK), environmental services use permit (IUPJL), timber concession permit (IUPHHK), non-timber concession permit (IUPHHBK), timber collection permit (IPHHK) and non-timber collection permit (IPHHBK). The first four types of permits are large-scale concession permits, whereas the last two – the collection permits – are issued for smaller businesses, smaller areas and shorter durations (Dermawan et al., 2011).

The permitting process is complex with three tiers of government allowed to issue permits. A concession is granted in response to an application (by a company or a community). The process does not involve tenders and concession areas are identified by applicants rather than the issuing authority. Since 1999 different laws have governed who can authorise a permit. Currently, this is done at three different levels of government:

- **The Ministry of Forestry** can approve and grant large scale plantation permits, on the basis of a technical recommendation from subnational government;
- **The Head of Province** (*Gubernur*) can issue permits for non-timber concessions, but requires approval or verification by the Ministry of Forestry or its technical implementing units; and

- **The Head of District** (*Bupati*) can issue small-scale community permits, but would also need an authorisation as in the case above.

While the law establishes that state forest (*kawasan hutan)* areas must be gazetted, in reality, only 10% to date have been gazetted, justified by different interpretations of the law and by unclear forest tenure. Even though state forests are officially state land, what is found on the ground is that they are often inhabited by local communities or have been allocated to estates.

In reality, forest use permits are essentially the same. They often cover more than 100 hectares, and permit holders use heavy machinery and disregard sustainable logging systems. Communities generally do not have the technological or financial capacity to carry out logging in large areas, so large timber companies are left to take advantage of policies and regulations (Indrarto et al., 2011).

The current permitting system is conducive to corruption and fraud, and there are a number of explanations to this, including (Dermawan et al., 2011):

- The lack of a tendering procedure or third-party involvement in the review and approval of applications;
- The complexity in the system involving a range of functions, scales, durations and other variables, hinders transparency;
- Loopholes in licensing regulations, opening the way to abuse and illegal logging; and
- The existence of multiple authorities, concentrated amongst specific individuals, preventing the screening of proponents.

Corruption and money laundering in the forestry sector are primarily related to illegal logging (Dermawan, 2011). Human Rights Watch (2009) estimate that the Indonesian government lost an average of nearly $2 billion annually between 2003 and 2006 due to illegal logging, corruption, and mismanagement. Many sources agree that illegal logging accounts for more than 40% of Indonesia's total wood supply (Luttrell et al., 2011).

3.4 The consequences of deforestation: loss of ecosystem services

Deforestation has impacts both at the national and at the global level. By understanding the importance of forests we can start to understand what is lost through deforestation. Deforestation contributes to approximately 17% of global emissions (IPCC. 2007). The importance of deforestation in relation to climate change is being increasingly recognised.[14] However, tropical forests provide a variety of other ecosystem services that are not yet fully valued. They contain over half of the world's terrestrial biodiversity and provide vital ecosystem services related to climate, water, food and energy security, as well as human health and livelihoods (Oakes et al., 2012).

Categorising ecosystem services is the first step towards ecosystem valuation. The Millennium Ecosystem Assessment (MA) identifies four broad categories of ecosystem services (DEFRA, 2007) and all can be applied to forests in Indonesia: provisioning services, regulating services, cultural services, and supporting services.

[14] The REDD+ initiative is framework to provide incentives to forested countries to reduce emissions from deforestation and forest degradation, and includes sustainable management of forests, conservation, and enhancement of carbon stocks.

Provisioning services relate to products obtained from ecosystems and can help in livelihood, food, and energy security. These cover a number of areas:

- **Between 80 and 95 million people in Indonesia depend on forest resources for their livelihoods,** and 40-65 million live in land classified as public forest (Lynch et al., 1995). Forests can provide raw material such as timber and non-timber forest products, but also employment opportunities in forest conservation activities and eco-tourism.

- **Forests are a source of food at different levels, from communities, to the global level.** Local communities and indigenous populations have survived on food collected in forests for thousands of years. At the regional level, it is estimated that as much as a third of fish caught each year in South East Asia depend on coastal mangrove forests, and forests help to recycle water vapour that falls as rain in agricultural areas far from the forest border.

- **Forests support energy security at the local, regional and global levels.** Local people use forests as a source of fuel (even though fuel wood collection is a major driver of deforestation). Forests are also essential to the production of hydroelectricity through the regulation of water flow and the reduction of sedimentation in rivers at regional scales.

- **Forests provide an essential source of wild- harvested medicines for both local communities and global pharmaceutical companies.** Trade in medicines and plants derived from tropical rainforests is estimated to be around $108 billion per year. Forests can also have a moderating effect on infectious diseases, such as malaria.

Regulating services are related to benefits obtained from the regulation of ecosystem processes. These types of services include:

- **Tropical rainforests have a double-cooling effect on the climate in terms of mitigation and adaptation.** On one side, forests contribute to climate change mitigation, by sequestering vast quantities of carbon dioxide – in fact, deforestation and forest degradation contribute to about 15% of global emissions. On the other side, forests also provide co-benefits in terms of climate adaptation. Climate change is likely to increase the frequency of extreme events such as droughts and floods, forests can reduce the strength of the water, as well as provide a buffer for local weather patterns.

- **Forests have the capacity to purify water, and the filtration service provides drinking water to forest dependent communities, and to populations of large cities in the forest surrounding.** Forests also help to regulate water flows as the roots in particular act like a sponge, helping to regulate cycles of flood and drought, particularly important for a very vulnerable country to floods like Indonesia. Jakarta has for example recently (2013) experienced floods of great magnitude.[15] In addition, the recycling of water vapour by forests back into air currents helps to maintain rainfall regimes.

Cultural services are nonmaterial benefits that people obtain through spiritual enrichment, cognitive development, or recreation. Forests are home to the majority of the biodiversity in the planet, in addition to preserving ancient cultures and lifestyles. In Indonesia, there are only approximately 7,300 Sumatran orangutans remaining, and they are categorised as 'critically endangered' by IUCN (Singleton, 2008).

[15] The most frequent hazards between 1907-2007 have been flooding, followed by landslides and water or vector borne diseases, wind storms, forest fires, drought, and high tide/storm surge. The first climate-related hazards occurred in the 1950s, and by the 1980s they had started to occur more frequently (GoI, 2010).

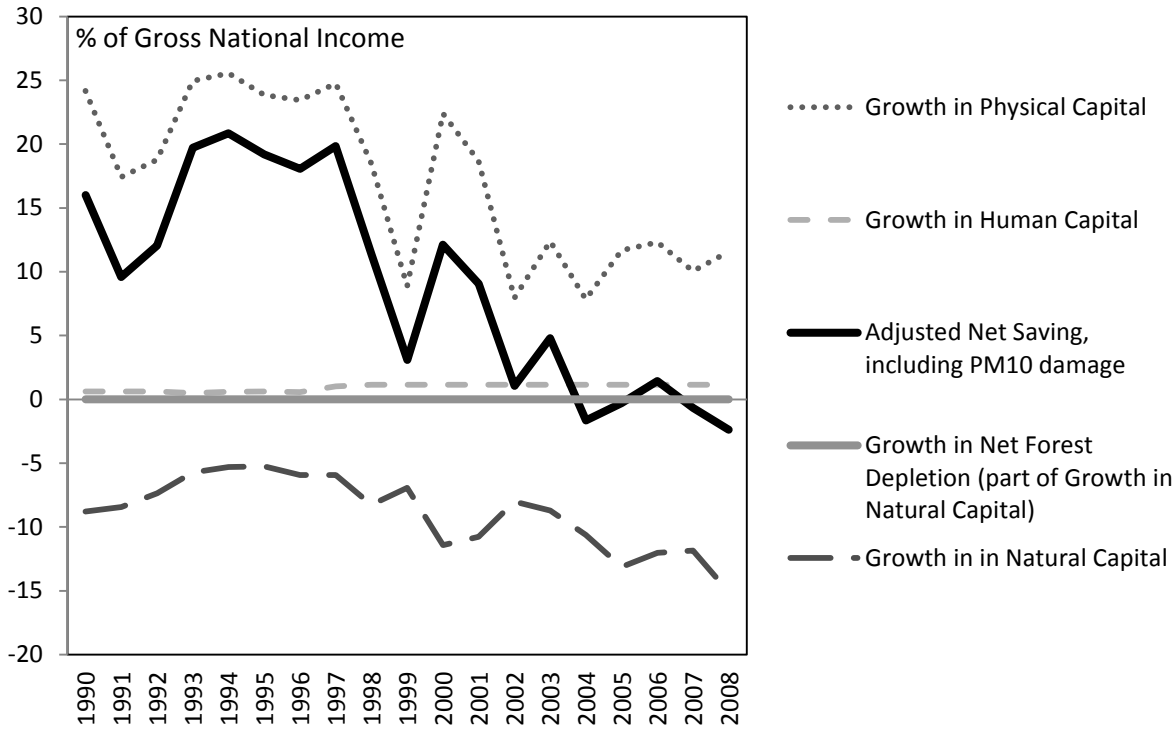
Finally, supporting services are necessary for the production of all other ecosystem services. Forests can contribute to soil formation, the production of atmospheric oxygen, and of habitats.

4 The costs of environmental change

In this section we discuss the costs of deforestation in the context of the wider Indonesian economy. A thorough analysis of the World Bank's 'adjusted net savings' framework has been carried out in our *Overview* paper. In this section we explain the role of net forest depletion, the proxy for natural capital in the framework, and also provide a rough estimate in monetary terms of the natural capital.

According to the World Bank's 'adjusted net savings' data, Indonesia wealth has been falling over the past decade, recently dropping below zero, suggesting that growth is no longer sustainable. At a closer look, there are issues related to this measurement, and limitations of the framework in measuring natural capital.

Figure 10 – 'Adjusted net savings' in Indonesia 1990-2008, World Bank data



Source: World Bank data, 2011.
Note: Natural Capital includes Mineral Depletion, Energy Depletion, Net forest depletion, CO2 damage and PM10 damage.

The World Bank data on 'net forest depletion' puts the current rate in Indonesia at 0% of GNI. The same model has been used on a number of countries, and while the concept of adjusted net savings is a sound one, the practicalities of operationalising it are subject to all of the constraints and difficulties of measurement and valuation of public goods. We have seen as a starting point how unreliable data on forest cover in Indonesia is, and forest cover is a fundamental component of net forest depletion.

Net forest depletion is based simply on the value of timber ignoring other benefits associated with forests. There are many environmental aspects which are not captured well – externalities such as ecosystem benefits, and assets which are not owned by individual or groups of people, such as the atmosphere, oceans, and uncultivated forests. A DFID-funded World Bank project is currently working with five developing countries to create a new global partnership for

valuing ecosystem services. "Wealth Accounting and the Valuation of Ecosystem Services" (WAVES) is working with Botswana, Colombia, Costa Rica, Madagascar, and the Philippines, to incorporate environmental accounts into national policy analysis and development planning (World Bank, 2012).

The 'adjusted net savings' framework assumes that it is possible, at the margin, to make some substitution between natural capital such as forests, and physical capital or intangible capital such as education and skills (World Bank, 2011; World Bank, 2012; Bolt, 2002). Sustainable economic growth can be consistent with environmental degradation, as long as losses to natural capital are compensated by savings and investments in other forms of capital. This assumption of 'substitutability' is controversial. Whilst it may be acceptable to allow for some substitution of forest for physical investment, there is a physical limit. We might be able to deplete some water resources, but we cannot replace all of our water resources with university degrees without going thirsty.

Finally, these measures take no account of for whom production is carried out. Due to international trade, the natural capital use and emissions embodied in production in one country may not equal the resources used in consumption. Although this insight does not change the nature of the sustainability calculation facing Indonesia, it does raise questions about global action to address climate change, in which some of the emissions produced and resource depletion carried out by Indonesia is to satisfy the demand of others.

4.1 Measuring the cost of deforestation for Indonesia

Measuring the costs of environmental change in monetary terms is challenging. Estimates of the value of forests vary substantially. One estimate reports that the world loses US$1.8 trillion to US$4.2 trillion in ecosystem services each year due to deforestation (Eliasch, 2008). The simplest calculations look only at the value of timber, but this focus ignores all of the ecosystem services, which though difficult to value are potentially substantial.

Indonesia may have lost around US$160 billion, or around 5% of GDP per year, between 1990 and 2005 from deforestation. One valuation of forest loss in the two major island groups of Kalimantan and Sumatra – that account for 70% of forest loss in Indonesia between 1990 and 2005 (Hansen et ., 2009) – puts the value of forested land at US$10,000 per hectare (VV.AA., 2011). If we assume that the same valuation applies to the entire forested area of Indonesia, then approximately 16 million hectares of forest were cleared between 1990 and 2005 and the loss to Indonesia from deforestation would be around US$160 billion.[16] Our estimate most likely underestimates the value lost as we do not account for vital ecosystem services.

As comparison, the Government of Guyana has attempted to estimate the value of the forest: if only carbon is considered, it would be in the range of US$6,500-US$20,000/hectare, while if all ecosystem services are considered, the estimate would rise to US$25,000/hectare (GoG, 2008). If a similar valuation was applied to Indonesia, then we could estimate that the country has lost, between 1990 and 2007, US$375 billion worth of ecosystem services, or approximately 10% of GDP each year.

[16] For illustration purposes and consistency we continue to use the deforestation estimate of 1.1 million hectares per year (MoF, 2008). Note, Hansen et al., (2009) and VV.AA (2011) report higher deforestation figures for the same period (1.2 million hectares).

In our *Overview* paper, we provide an alternative measure for 'adjusted net savings' in Indonesia, which takes into account the above estimate of the country possibly losing 5% of GDP per year due to deforestation.

5 Conclusion

We have discussed the environmental sustainability of Indonesia's recent growth. We have looked at the country's greenhouse gas emissions, the related extent and impact of deforestation, and how the costs of deforestation fit into the broader picture of the national economy through the World Bank's 'adjusted net savings' framework.

Indonesia is rapidly becoming one of the world's largest greenhouse gas emitters and is also highly vulnerable to the effects of climate change that could destroy 6.7% of GDP by 2100. It is therefore becoming increasingly important for the country to contribute to a substantial abatement in its emissions in order to reduce the probability of the most exreme global scenarios from taking place.

Indonesia would need to prioritise addressing deforestation, as emissions from LULUCF and peat land contribute to 75% of the country's emissions. Estimates vary, but the data suggests that there has been substantial deforestation over the past 30 years, which although levelling off somewhat in recent years, is still a very serious risk, due to both planned and unplanned, official and unofficial, logging and land use change.

'Adjusted net savings' have become negative. Even without proper estimates for net forest depletion, 'adjusted net savings' estimates for Indonesia suggest that the county's wealth has been falling over the past decade, recently dropping below zero, suggesting that growth is no longer sustainable.

Indonesia may have lost around US$160 billion, or around 5% of GDP each year between 1990 and 2005. This estimate does not account for all the vital ecosystem services that forests provide, so is an underestimation of the natural capital lost to deforestation.

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