Working Paper
in Economics and
Development Studies

Department of Economics
Padjadjaran University

No. 201004

Estimates of the "Green" or "Eco" Regional Domestic Product of Indonesian Provinces for the year 2005

Arief Anshory Yusuf

Department of Economics,
Padjadjaran University

July, 2010

Center for Economics and Development Studies,
Department of Economics, Padjadjaran University
Jalan Cimandiri no. 6, Bandung, Indonesia.
Phone/Fax: +62-22-4204510
http://www.lp3e-unpad.org

For more titles on this series, visit:
http://econpapers.repec.org/paper/unpwpaper/

Estimates of the "Green" or "Eco" Regional Domestic Product of Indonesian Provinces for the year 2005[1]

Arief Anshory Yusuf[2]
Padjadjaran University, Bandung, Indonesia

July, 2010

Abstract

A trial estimate of the Green or Eco-Regional Domestic Product (ERDP) for 30 provinces in Indonesia for the year 2005 was attempted. ERDP was calculated by subtracting from "brown" Gross Regional Domestic Product (GRDP), the value of liquidation of all kind of assets, man-made and natural. The types of assets covered are man-made capital, oil and natural gas, as well as other non-oil-gas minerals. The environmental assets liquidation included are environmental degradation of local and global pollution. This estimate is the first covering all provinces in Indonesia which enable informative cross-provincial comparison. It is found that the sustainability of the economic development of such provinces as Papua, East Kalimantan, West Nusa Tenggara, Riau and South Sumatra are in question as they rank low in term of the ratio of ERDP to GRDP. It implies that their future generations are among the most vulnerable. The rapid economic development in the provinces is dominantly caused by the liquidation of natural resource assets especially from oil, gas and other mineral extraction. The findings call for the need to diversify economic activity to avoid being too dependent on the extractive and polluting sectors. Sustainability could also be enhanced by way of increasing productivity so that for each unit of the liquidation of natural assets, we can generate welfare as much as possible.

Keywords: Green Regional Domestic Product, Green Accounting, Indonesia
JEL Code: Q56

1. Introduction

Previous studies that have attempted to measure sustainable development in one form or another for Indonesia are abound (Alisjahbana and Yusuf, 2004). Several of them developed sustainable development measurement for Indonesia, for example: Repetto et. al. (1989), Vincent and Castaneda (1997), BPS (various years), and Alisjahbana and Yusuf (2000a, 2000b, and 2003). While others, such as: Pearce and Atkinson (1993), Hamilton (1999,

[1] Paper presented at the 10th Indonesian Regional Science (IRSA) Association Conference, 28-29 July, 2010, Surabaya, Indonesia.
[2] The author would like to thank Mr. Victor Firmana and Mr. Megananda Suryana for their excellent research assistance. This paper is among the output of a research project commissioned by PT KACINDO with collaboration with the Indonesian State Ministry of the Environment and funded by DANIDA.

2000a, 2000b), Hamilton and Clemens (1996) have included Indonesia as a sample in their cross-country study coverage.

However, to the best of our knowledge, there has not been any attempt to estimate measures of sustainable development, particularly Green GDP, at the sub-national level such as provinces covering all provinces in Indonesia which enable an informative provincial comparison. This paper is an attempt to contribute to this line of literature and demonstrate that it can be done with existing available data and some assumptions. It is expected that with more serious, more resource, and integrated effort plus the political will of the policy makers at the national and sub-national level, we can have a better estimates of Green GRDP at sub-national level and other various measure of sustainable development that is applicable and useful as guidance for more environmentally sustainable development.

Specifically, the objective of this paper is to estimate the Green GRDP (Gross Regional Domestic Product) or the Eco Regional Domestic Product (ERDP) of 30 provinces in Indonesia for the year 2005. It does not aim to measure the ERDP comprehensively but to provide a rough picture of cross-provincial variation of the most popular indicator of sustainable development in Indonesia and stimulate others especially relevant agencies and academicians to perform a better and more comprehensive calculation. It is unavoidable that in the calculation in this paper, we use methodologies and approaches based on some strong assumptions due to limited data and information

This paper is organized as follows. First it will describe the methods, approaches, and assumptions used in the calculation including the source of data. Some of immediate results of the calculations will be presented here. After that, the final results of the calculation i.e., the ERDP and its components will be discussed. This paper ends with a concluding remark.

2. Methodology

2.1. Scope

ERDP (Eco Regional Domestic Product) is calculated using the following identity:

$$\boldsymbol{ERDP = GRDP - D^{K} - D^{NR} - D^{R} - ED} \qquad \textbf{(1)}$$

Where *ERDP* is Green GRDP or Eco Regional Domestic Product, *GRDP* is the Gross Regional Domestic Product; D^K is the depreciation of man-made capital goods; D^{NR} is the depreciation of non-renewable or exhaustible natural resources; D^R is the depreciation of renewable natural resource; and *ED* is the environmental degradation that consists of ED^L, environmental degradation from local pollution and ED^G, environmental degradation from global pollution.

Based mainly on data availability, the scope of the components of both man-made and natural assets depreciation in this ERDP calculation is as follows:

1. Depreciating of man-made capital goods (asset)
2. Depletion of non-renewable natural resource which includes oil, natural gas, and all mining commodities.
3. Depletion of renewable natural renewable resources which include forest resources.
4. Local environmental degradation which includes NO_x pollution.
5. Environmental degradation of the global pollution which include only carbon dioxide emissions.

2.2. Data

The Data used in this ERDP calculation is as follows:

1. The 2005 Inter-Regional input-output obtained from BAPPENAS (National Development Planning Agency). This Input-Output table is a result of collaboration between BAPPENAS and BPS (Indonesian Statistical Agency). From this IO table, we can obtain information to calculate the following:
   a. Gross Regional Domestic Product
   b. Depreciation of capital goods (to calculate D^K)
   c. Output of the forestry sector (to calculate the depletion of the forest sector)
   d. Output of oil and gas sector (to calculate the depletion of oil and gas sector)
   e. Output of the mining sector (to calculate the depletion of non-oil mining sector)
2. BPS' Integrated System for Environmental and Economic Accounts (SINERLING[3]). From this publication, we use particularly the following information:
   a. Unit Rent of oil and gas sectors (in proportion to the price to be used to calculate depletion of oil and gas sector).
   b. Unit Rent of non-oil mining sector (in proportion to the price to be used to calculate depletion of non-oil mining sector).
3. Environmental Statistics of Indonesia 2008. From this publication we used data to estimate:
   a. NO_x emission for each province in 2005 to calculate the environmental degradation of local pollution.
   b. Data on the number of vehicles for each province to calculate the share of each province in carbon dioxide emissions from the transportation sector.
4. Handbook of Economic and Energy Statistics from the Department of Energy and Natural Resource. From this we obtained data on carbon dioxide emissions of Indonesia in 2005 by type of energy (coal, gas, and fuel) and sector (electricity, industry, households, and transport).
5. Statistics of Indonesian manufacturing industry 2005. This is to calculate the share of each province in carbon dioxide emissions from the industrial sector. In particular, we obtain and use the following information:
   a. Coal Consumption by industrial sector for each provinces
   b. Fuel Consumption by industrial sector for each provinces
6. Online database of Ministry of Energy and Natural Resource. From this we obtain electricity consumption by each province to calculate the share of each province to the national emissions from the consumption of electricity.
7. Energy Balance 2005, published by Ministry of Energy and Natural Resources. This is used to disaggregate carbon dioxide emissions by different type of fossil fuel-based energy.
8. Various years of national Socioeconomic Survey (SUSENAS), obtained from the BPS. This is used to disaggregate carbon dioxide emissions originating from households consumption of energy, using the provincial share of the consumption of kerosene and LPG.

[3] In Indonesian "Sistem Terintegrasi Neraca Ekonomi dan Lingkungan".

2.3. Calculation of ERDP components and assumptions used

In the following discussion we will describe the step by step process, along with the assumptions used in calculating the Eco Regional Domestic Product for the 30 provinces in Indonesia in 2005.

GRDP and depreciation of man-made capital

GRDP data for each province was obtained from the BPS and matched with data from the IRIO table. Capital depreciation data for each province is obtained from IRIO table. When we find that the total depreciation of all the provinces (national) are not exactly equal to the total depreciation of the national level obtained from other data sources, we then adjust by scaling-up those of each province to ensure the consistency between the sources of data.

Depletion of natural resources (petroleum, gas, non-oil mining, and forest)

Calculation of the value of the depletion of non-renewable natural resources uses the following formula:

$$\boldsymbol{D_i^{NR} = r_i P_i Q_i} \quad \textbf{(2)}$$

Where r_i is a unit of rent in proportion to the price of output produced (between 0 and 1), and P_iQ_i is the value of output from the non-renewable natural resource sector i. P_iQ_i is the nominal value in rupiahs, therefore, contain both prices and quantity component. P_iQ_i was obtained from the output values in the inter-regional input-output table (IRIO).

Because IRIO table consists of only 35 sectors where oil and gas sector combined in one sector, then for the unit rent (in the proportion of the price), we used the average unit rent of oil and gas sector used in SINERLING. As the unit of the variable is proportion, we used geometric mean instead of a simple mean. Similarly, for the unit rent at the non-oil mining sector (which is a combination of all non-oil mining sector), we used the geometric average of unit rent (in proportion to the price) of various mining commodities covered in the publication of SINERLING from BPS. Implicitly we are assuming that for a specific natural resource, the unit rent (in its proportion to the price of output) is the same across all provinces in Indonesia. However, this assumption does not imply that the price and unit cost of production is the same across Indonesia as unit rent can also be calculated by subtracting unit cost from the output's price.

For renewable resource, ideally, the depletion is calculated by multiplying unit rent with the net increment of the resource. Net increment is the quantity of depletion minus its natural growth. However, for the forestry sector, there are difficulties in obtaining information to calculate the natural growth of timber stock. Therefore, in this analysis, we do not include the natural growth; hence use instead the quantity of gross increment. Therefore we can consider this as the upper-bound of the value of the depletion of the forestry sector. For forest resource we use the unit rent (in proportion to its price) used by the World Bank to calculate the genuine saving for Indonesia.

Environmental Degradation: Local Pollution (NOx)

Due to both data availability (on emissions) and the availability of a reference to calculate the (unit) value of environmental degradation, for this trial estimate, we included only local pollution from motor vehicle emissions in the form of Nitrogen-Oxide (NOx). The source of the data the Indonesian Environmental Statistics published by BPS.

The valuation is done by multiplying the NOx emissions (in tons/year) with the value of the external damage of each ton of emission. The value of the damage was obtained from studies conducted by the European Commission to several countries in Europe as compiled by AEA (2007). In these studies, external value of damage is calculated for several countries in Europe. For this analysis, we selected the value calculated for the state of Latvia because of similarity in terms of GDP per capita. Based on this it was found that the damage of NOx emission per ton per year amounts to 3,366 Euro / tonne for the year 2000 or about 31.7 million rupiah per ton for the year 2005.

The component of the external damage included are:

1. Deaths / tonne (PM2.5 function)
2. Infant mortality (1-11 month)
3. Chronic bronchitis, population aged> 27
4. Respiratory hospital admissions, all ages
5. Cardiac hospital admissions, all ages
6. Restricted activity days (RADs) working age population
7. Respiratory medication use by adults
8. Respiratory medication use by children
9. IRS (Lower Respitory symptons), including cough, Among adults with chronic symptoms
10. IRS (including cough) Among children

Environmental Degradation: Global Pollution (CO2)

The first step in calculating the environmental degradation from the carbon dioxide emissions is to obtain information concerning national carbon dioxide emissions in 2005. Data for total emissions (not based on an energy source) was obtained from the Handbook of energy economics. Furthermore, these emissions figures is divided different the type of energy (coal, oil, and natural gas) using energy balance data and the carbon content (carbon content) of various types of energy. The result is shown in the table below.

Table 1. Carbon dioxide emissions in 2005 (million tonnes)

	Coal	Natural Gas	Oil	Total
Power plant	40.40	8.81	28.80	78.01
Industry	47.41	20.34	40.62	108.37
Households	0.05	0.04	23.82	23.90
Transportation		0.01	67.67	67.68
Total	87.86	29.19	160.91	277.96

Source: Handbook of economy and energy and author calculations based on energy balance and carbon content.
Note: Not including sector 'other' such as commercial and agricultural sectors.

Due to the data constraints, the figures in underline, will not be disaggregated by provinces and will not be included in the calculation. Nevertheless the total emissions included in the calculation already cover as much 88% of total national emissions in 2005.

One important assumption here is that emissions will be considered being emitted by one province based on where the emissions-emitting energy is used. For example, if coal and fuel is used in Province A, then Province A is the one who bear the external damage (polluter's pay principle). For electricity, it is based on where the final electricity is used and not based on where the electricity is produced (including not based on where the coals are burned to produce electricity).

The steps in disaggregating carbon-dioxide emissions by provinces are as follows:

1. The provincial disaggregation of emissions of carbon dioxide from coal use by industrial sector is based on the share of coal as energy usage for each province. This are calculated from statistics of manufacturing industries 2005. Statistics manufacturing industry recorded the use of coal in units of quantity (tons).
2. The provincial disaggregation of CO2 emissions from fuel (petroleum products) usage by the industrial sector is based on the share of fuel use for each province. This are calculated from statistics of manufacturing industries in 2005. Statistics manufacturing industry recorded the use of fuel in units of quantity (Liter).
3. The provincial disaggregation of CO2 emissions from the use of fuel by households is based on the share of the use of non-vehicle-fuel (or domestic use in this case only kerosene and LPG) by household for each province. This is calculated from the National Socioeconomic Survey (SUSENAS) 2002. The Implicit assumption is that the share of consumption of kerosene and LPG by households per province did not experience significant changes from year 2002 to year 2005. Use of the SUSENAS 2002 data is based on data availability at the time of this analysis was written.
4. The provincial disaggregation of carbon dioxide emissions from the use of fuel by the transportation sector is based on the share of fuel use by the transportation sector for each province. This is calculated from IRIO tables (inter-regional input-output). Because the value in the table IRIO is in rupiah, the purchasing value, is implicitly assumed to be across provinces
5. The provincial disaggregation of emissions of carbon dioxide from electricity is based on the share of electricity sales across province.

The results of provincial disaggregation of carbon dioxide emissions can be seen from Table 2. To calculate the value of external cost of carbon dioxide emissions we used the value based on calculations of marginal external cost by Frankhauser (1992), which has been used in various other studies. The value of marginal external cost is $ 20/ton for the year 1990. This value is then adjusted to the year 2005.

Table 2. Carbon dioxide emissions by province and sector in 2005 (million tonnes)

Province	Industry (Coal)	Industry (fuel)	Household (fuel)	Transpot (fuel)	Electricity	TOTAL
1 NAD	0.00	0.05	0.25	1.40	0.74	2.45
2 SUMUT	0.02	1.34	1.31	4.08	3.93	10.68
3 SUMBAR	7.50	0.21	0.60	1.22	1.21	10.73
4 RIAU	3.82	1.36	0.54	2.31	1.27	9.29
5 JAMBI	0.00	1.71	0.39	1.12	0.47	3.68
6 SUMSEL	1.46	1.55	0.64	1.36	1.35	6.36
7 BABEL	0.02	0.05	0.37	0.43	0.22	1.09
8 BENGKULU	0.00	0.02	0.29	0.33	0.25	0.89
9 LAMPUNG	0.05	1.44	0.68	1.20	1.24	4.61
10 DKI	0.02	3.12	3.70	15.03	17.99	39.87
11 JABAR	2.77	12.94	3.08	4.09	15.10	37.98
12 BANTEN	1.32	8.80	0.95	0.61	2.17	13.85
13 JATENG	5.69	1.79	1.97	10.08	8.01	27.54
14 DIY	0.01	0.09	0.55	2.00	1.16	3.81
15 JATIM	12.28	3.54	2.57	10.35	13.21	41.94
16 KALBAR	0.05	0.45	0.63	1.20	0.78	3.12
17 KALTENG	0.00	0.08	0.37	0.57	0.34	1.36
18 KALSEL	1.57	0.25	0.55	1.34	0.92	4.63
19 KALTIM	0.00	0.48	0.51	1.55	1.02	3.56
20 SULUT	0.00	0.13	0.35	0.44	0.59	1.51
21 GORONTALO	0.00	0.02	0.19	0.12	0.14	0.46
22 SULTENG	0.00	0.02	0.35	0.99	0.35	1.71
23 SULSEL	10.22	0.23	0.91	1.24	1.99	14.58
24 SULTRA	0.30	0.03	0.42	0.22	0.25	1.22
25 BALI	0.00	0.03	0.72	2.80	1.79	5.35
26 NTB	0.00	0.02	0.45	0.67	0.43	1.56
27 NTT	0.31	0.02	0.30	0.31	0.32	1.27
28 MALUKU	0.00	0.23	0.09	0.27	0.21	0.80
29 MALUT	0.00	0.14	0.03	0.00	0.12	0.29
30 PAPUA	0.00	0.49	0.06	0.35	0.42	1.32
Total	**47.41**	**40.62**	**23.82**	**67.67**	**78.01**	**257.52**

Source: Statistical Handbook of Energy and Energy Economics, and author calculations.

3. Results and discussion

Table 3 below shows the results of calculations ERDP of the 30 provinces in Indonesia in 2005 in current prices. Meanwhile, table 4 shows the results of calculations PDRH in the proportion of GDP.

Table 3. Eco Regional Domestic Product (ERDP) by province in 2005 (Rp Billion)

	GRDP	Depretia-tion	Depletion			Degradation		ERDP
		D^K	D^{NR}		D^R	ED^L	ED^G	
			Migas	Non-migas	Hutan	NOx	CO2	
1 NAD	56,952	1,582	6,045	193	254	829	568	47,481
2 SUMUT	139,618	6,903	439	492	961	2,411	2,474	125,938
3 SUMBAR	44,675	2,270	0	908	343	720	2,487	37,946
4 RIAU	180,004	5,611	32,998	638	5,851	1,761	2,153	130,992
5 JAMBI	22,487	556	2,078	126	350	660	853	17,864
6 SUMSEL	81,532	2,862	10,795	1,544	705	806	1,475	63,345
7 BABEL	14,172	640	0	1,388	39	253	252	11,601
8 BENGKULU	10,134	518	0	174	118	196	207	8,921
9 LAMPUNG	40,907	1,444	525	337	121	711	1,069	36,700
10 DKI	433,860	19,656	1,078	0	0	8,876	9,239	395,011
11 JABAR	389,245	23,310	5,934	468	178	2,416	8,802	348,137
12 BANTEN	84,623	5,747	0	48	31	359	3,210	75,228
13 JATENG	234,435	12,834	54	1,195	734	5,952	6,383	207,283
14 DIY	25,338	965	0	109	182	1,180	882	22,019
15 JATIM	403,392	29,308	466	3,950	513	6,117	9,721	353,319
16 KALBAR	33,869	1,434	0	234	775	707	722	29,997
17 KALTENG	20,983	706	0	137	604	338	316	18,882
18 KALSEL	31,794	1,829	345	2,234	230	791	1,074	25,291
19 KALTIM	180,289	7,757	27,386	11,313	2,230	916	825	129,862
20 SULUT	18,763	750	0	446	36	261	349	16,921
21 GORONTALO	3,481	218	0	18	16	69	108	3,052
22 SULTENG	17,117	638	0	176	503	586	397	14,817
23 SULSEL	56,203	3,214	69	2,512	73	733	3,380	46,223
24 SULTRA	12,981	986	0	397	200	128	283	10,987
25 BALI	33,946	2,121	0	125	1	1,657	1,239	28,804
26 NTB	25,683	1,252	0	5,130	10	393	361	18,536
27 NTT	14,810	561	0	121	22	183	295	13,629
28 MALUKU	4,571	227	10	12	52	158	186	3,925
29 MALUT	2,583	150	0	63	56	1	66	2,247
30 PAPUA	51,529	2,666	807	17,528	879	206	306	29,136
Total	2,669,976	138,714	89,030	52,016	16,067	40,374	59,681	2,274,093

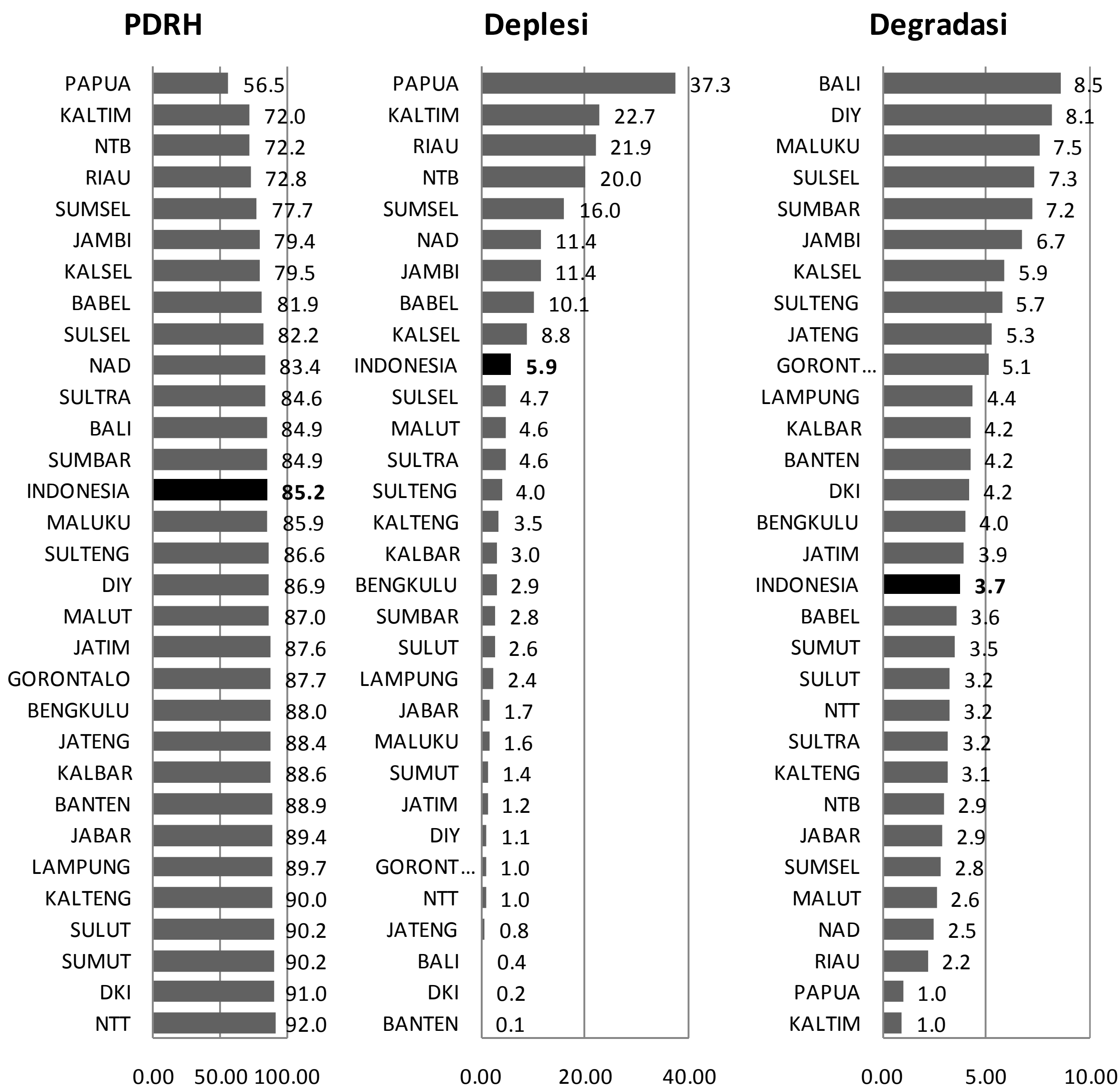
Source: author's calculation

Table 4. Eco Regional Domestic Product (ERDP) by province in 2005
(As a percentage of GRDP)

	GRDP	Depreti-ation	Depletion			Degradation		ERDP
		D^K	D^{NR}		D^R	ED^L	ED^G	
			Migas	Non-migas	Hutan	NOx	CO2	
1 NAD	100.00	2.78	10.61	0.34	0.45	1.46	1.00	83.37
2 SUMUT	100.00	4.94	0.31	0.35	0.69	1.73	1.77	90.20
3 SUMBAR	100.00	5.08	0.00	2.03	0.77	1.61	5.57	84.94
4 RIAU	100.00	3.12	18.33	0.35	3.25	0.98	1.20	72.77
5 JAMBI	100.00	2.47	9.24	0.56	1.56	2.94	3.79	79.44
6 SUMSEL	100.00	3.51	13.24	1.89	0.86	0.99	1.81	77.69
7 BABEL	100.00	4.52	0.00	9.79	0.27	1.78	1.78	81.86
8 BENGKULU	100.00	5.11	0.00	1.72	1.16	1.93	2.04	88.03
9 LAMPUNG	100.00	3.53	1.28	0.82	0.30	1.74	2.61	89.71
10 DKI	100.00	4.53	0.25	0.00	0.00	2.05	2.13	91.05
11 JABAR	100.00	5.99	1.52	0.12	0.05	0.62	2.26	89.44
12 BANTEN	100.00	6.79	0.00	0.06	0.04	0.42	3.79	88.90
13 JATENG	100.00	5.47	0.02	0.51	0.31	2.54	2.72	88.42
14 DIY	100.00	3.81	0.00	0.43	0.72	4.66	3.48	86.90
15 JATIM	100.00	7.27	0.12	0.98	0.13	1.52	2.41	87.59
16 KALBAR	100.00	4.23	0.00	0.69	2.29	2.09	2.13	88.57
17 KALTENG	100.00	3.36	0.00	0.65	2.88	1.61	1.50	89.99
18 KALSEL	100.00	5.75	1.08	7.03	0.72	2.49	3.38	79.55
19 KALTIM	100.00	4.30	15.19	6.28	1.24	0.51	0.46	72.03
20 SULUT	100.00	4.00	0.00	2.38	0.19	1.39	1.86	90.18
21 GORONTALO	100.00	6.26	0.00	0.52	0.45	1.98	3.10	87.69
22 SULTENG	100.00	3.73	0.00	1.03	2.94	3.43	2.32	86.57
23 SULSEL	100.00	5.72	0.12	4.47	0.13	1.30	6.01	82.24
24 SULTRA	100.00	7.60	0.00	3.06	1.54	0.99	2.18	84.64
25 BALI	100.00	6.25	0.00	0.37	0.00	4.88	3.65	84.85
26 NTB	100.00	4.87	0.00	19.97	0.04	1.53	1.41	72.17
27 NTT	100.00	3.78	0.00	0.82	0.15	1.24	1.99	92.02
28 MALUKU	100.00	4.97	0.22	0.26	1.13	3.46	4.07	85.88
29 MALUT	100.00	5.80	0.00	2.43	2.17	0.03	2.56	87.00
30 PAPUA	100.00	5.17	1.57	34.02	1.71	0.40	0.59	56.54
TOTAL	100.00	5.20	3.33	1.95	0.60	1.51	2.24	85.17

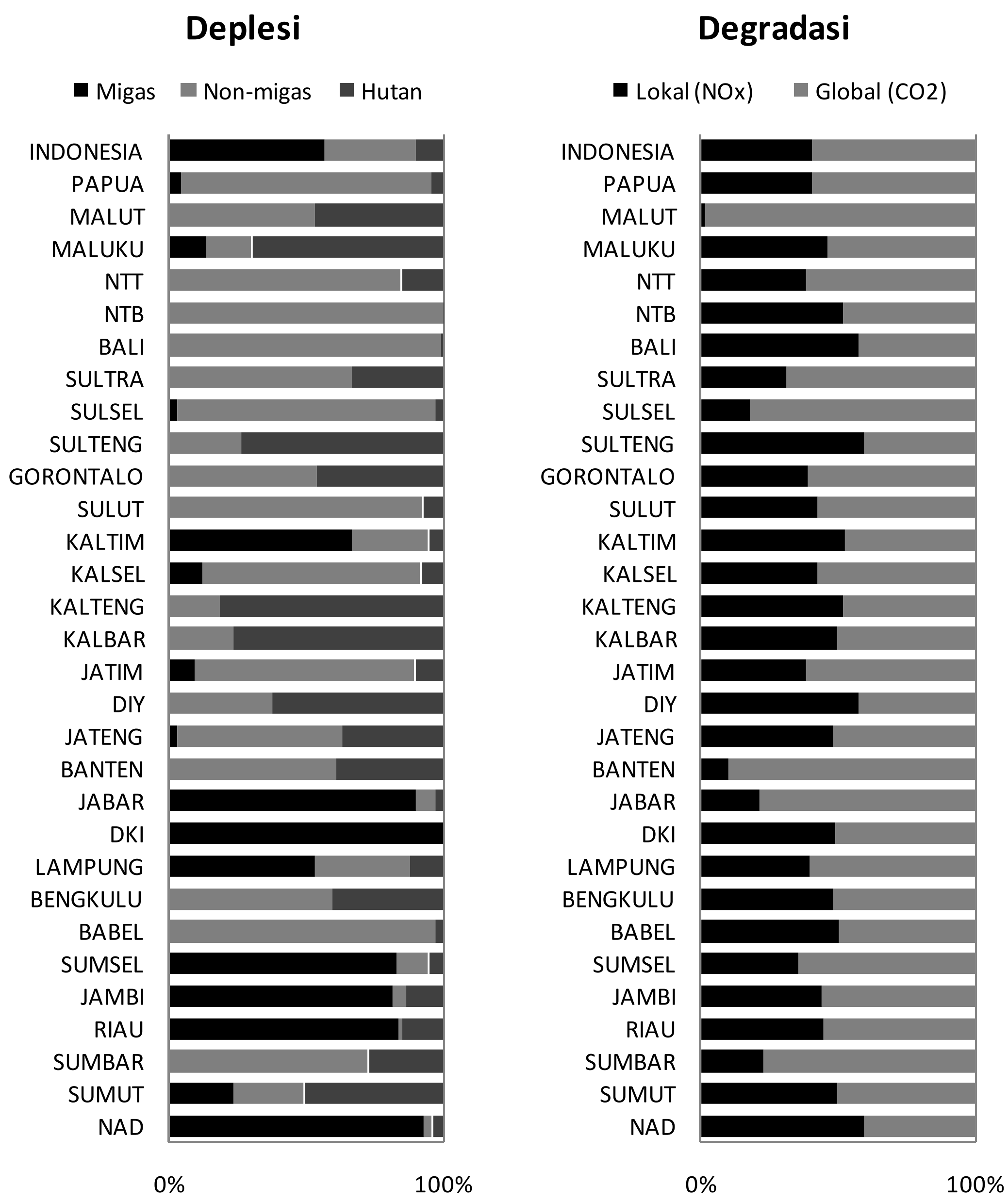
Source: Author's calculation

Figure 1. ERDP, depletion, and degradation (percent of GRDP)



Source: Calculation of the author, notes: sorted by percentage of GDP

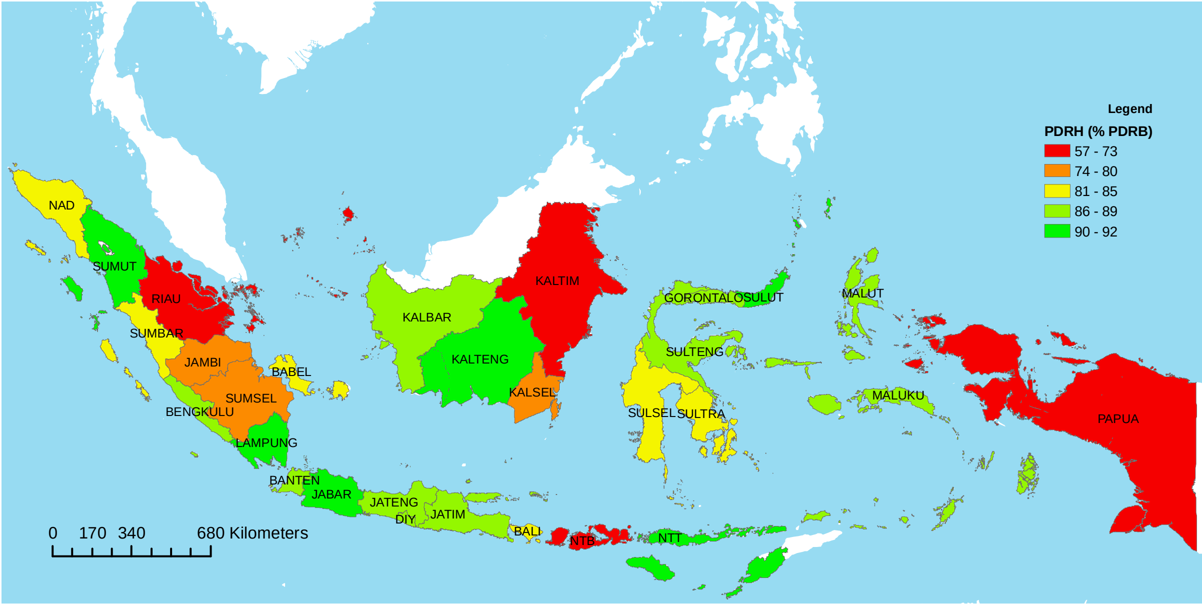
Figure 2. Composition of depletion and degradation (percent of total)



Source: author's calculations

The result of the calculation suggests that provincial ERDP ranges from 56.5% to 92% of GDP, with a national average of 85.2% to GDP. Province with lowest ERDP (relative to GRDP) is the province of Papua, followed by East Kalimantan, West Nusa Tenggara (NTB), and Riau. These are province where their output are heavily dependent on natural resource sectors. On the map In figure 3, area of provinces marked with red color indicates low value of ERDP value relative to its GRDP. Besides other provinces under his PDRH national average was South Sumatra, Jambi, South Kalimantan, Bangka Belitung, South Sulawesi, Nagroe Aceh Darussalam, Southeast Sulawesi, Bali and West Sumatra. Meanwhile, the highest provincial ERDP (relative to GRDP) is the East Nusa Tenggara (NTT), followed by DKI Jakarta and North Sumatra (see Figure 1)

Figure 3. The Map Eco Regional Domestic Product (ERDP) by Province (% GDP)



It is obvious that there is a tendency that the low share of ERDP is typical to the provinces where its GRDP is sustained predominantly by resource extractive sectors. The province of Papua's depletion of its natural resources, for example, amounted to 19 trillion rupiah in 2005, the majority of which (17.5 trillion rupiah) was from mineral depletion of non-oil sector. Total depletion of natural resources in Papua province was 37% of its GRDP, the highest in Indonesia. This makes the province of Papua has the lowest ERDP in proportion to its GRDP in Indonesia. This is an indication that the development in Papua province is relatively non-sustainable. Other provinces which have comparatively low ERDP caused by the high rate of depletion of non-oil mining include the province of West Nusa Tenggara. Mineral depletion of non-oil sector is about 20% of GRDP. This makes this province ranked fourth in term of ERDP relative to GRDP.

Several other provinces have low ERDP due to the depletion of natural resources from oil and gas. These provinces include East Kalimantan, Riau, South Sumatra and Jambi. Depletion of East Kalimantan and Riau Province are similarly around 130 trillion rupiah. However, the depletion of oil and natural gas of Riau province is relatively higher than that of East Kalimantan while for East Kalimantan; it is the depletion of non-oil and gas resources which is higher. In addition, Riau also record higher rate of depletion of forest resources. The high depletion of natural resources, especially oil and gas, has made the depletion of East Kalimantan and Papua rank second and third consecutively in Indonesia. Depletion of natural resources of East Kalimantan is at 7.22% of GDP, while the depletion of natural resources in Riau province amounted to 21.9% of its GRDP.

With the national average of depletion of natural resources to GRDP of 5.9%, other provinces that fall into the provinces with above national average depletion rate include NTB, South Sumatra, Aceh, Jambi, Bangka Belitung, and South Kalimantan.

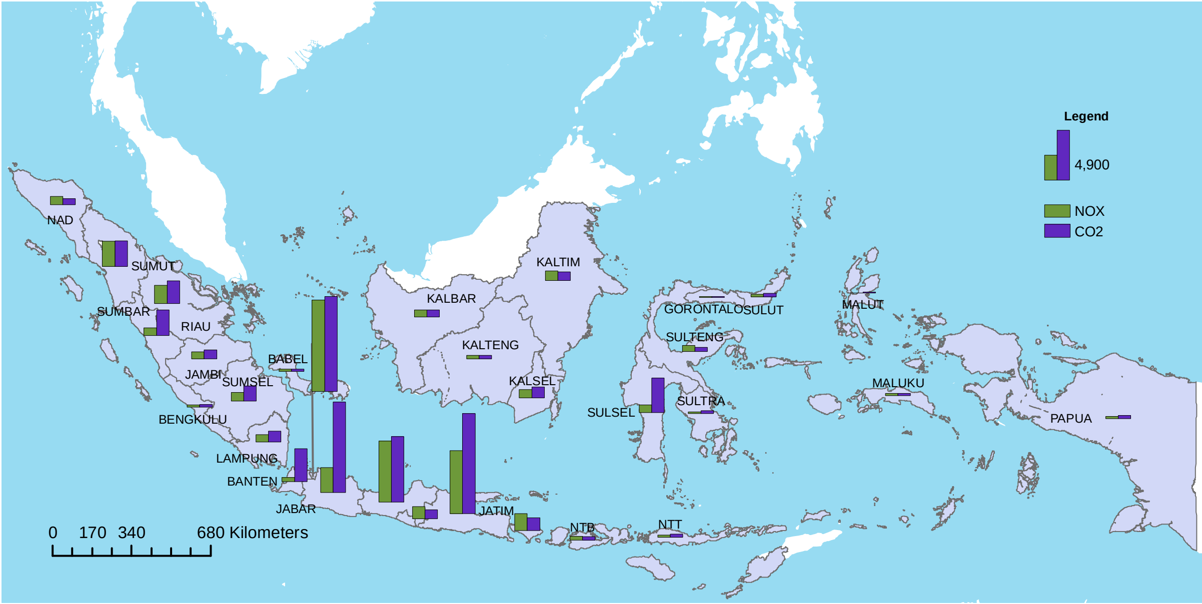
Figure 4. The map natural resource depletion by provinces (Billion Rupiah)

In summary, low ERDP of certain provinces in Indonesia is predominantly driven by high depletion of natural resources from oil, gas and other minerals. In nominal value, as seen in Figure 4, the largest depletion is the depletion of oil and gas in the provinces of Riau and East Kalimantan. In addition, the massive liquidation of natural assets also occurs in Papua province in the form of non-oil resource depletion.

If the ratio of ERDP to GRDP indicates the degree of sustainable development of the respective provinces, then we can conclude that the economic development of provinces like Papua, East Kalimantan, West Nusa Tenggara, Riau and South Sumatra rely excessively on the extraction of natural resources. The sustainability of the development of these provinces is at risk and their future generations are more vulnerable.

Meanwhile, high environmental degradation is concentrated in the provinces with high activity of manufacturing sector and those with high population density. The highest environmental degradation occurred in the provinces of DKI Jakarta, with the value of environmental damage caused by local and pollution amount to 18 trillion rupiah, then Followed by East Java province (amounted to 16 trillion rupiah) and Central Java provinces (amounted to 12 trillion rupiah).

Figure 5: The Map of Environmental Degradation by Province (Billion Rupiah)



However, in term of its proportion to GRDP, provinces with high environmental degradation are the province of Bali, Jogjakarta, Maluku, South Sulawesi and West Sumatra. Although such provinces as Jakarta, East Java and Central Java have high value (in nominal terms) of environmental degradation (See figure 5) and they are still above the national average, they are not in the top-list. This generally shows that such provinces such as Bali and Yogyakarta experience environmental degradation which is higher for each unit of its GRDP. This is an indication that these provinces' economic activities are relatively more polluted and energy-intensive. High concentration of motor vehicles and high electricity consumption to sustain tourism activities can be the explanation. In contrast, in the Province of Jakarta, although in nominal or absolute value, its environmental degradation is quite high, but the economy manages to produces even a larger amount of output relative to its liquidation of its environmental assets. In short, the economy is more productive, has a lot lower intensity of environmental damage. Another case is West Java province, a region with also a relatively high concentration of pollution. However, because it also sustained by more varied economic activities like agriculture which is relatively less polluted, its environmental degradation relative to GDP is not so high.

4. Concluding remarks

In this paper, we estimate the green or eco regional domestic product (ERDP) of as many as 30 provinces in Indonesia for the year 2005. Due to mostly data limitation, the main objective of this paper is not to give a comprehensive picture of provincial ERDP for Indonesia, but to demonstrate the feasibility of such calculation and stimulate all relevant stake holders like political leader, policy makers, government agencies, and researchers to attempt to do the same calculation and analysis in a better, more comprehensive, and regular manner.

Using various available data source, standard methods, approach, and some assumption, in the calculation of provincial ERDP we include the following types of assets deprecation. They are depreciation of the man-made capital, depletion of exhaustible natural resources (oil, natural gas, and all mining commodities), depletion of renewable natural resources (forest resource); local environmental degradation (NOx pollution), and global environmental degradation (carbon dioxide emissions).

From the estimated ERDP as its percentage of GRDP, we can imply that the regional development of provinces like Papua, East Kalimantan, West Nusa Tenggara, Riau and South Sumatra is relatively not sustainable, making their future generation are vulnerable, not ensured of at least having the same well being as the current generation.. This is because the rapid development in the provinces is dominantly caused by the liquidation of environmental assets such as oil, gas, and other mineral and forest resources.

The policy implication drawn from this analysis is that for a regional development to be more sustainable there is an urgent need to diversify its economic activities so as not to rely too much from the extractive and polluting sectors. Another strategy is to increase the economic productivity so that for each unit of natural or environmental assets liquidated, we can maximize the region's value added and its population's welfare. Both of these strategies, if successful, will be reflected with higher proportion of its 'green' GRDP to its more traditional 'brown' GRDP.

References

AEA, 2007, METHODEX: Methods and data on environmental and health externalities: harmonising and sharing of operational estimates, Final Technical Report.

Alisjahbana, Armida and Arief A. Yusuf, 2004, Green Accounting and Sustainable Development in Indonesia, UNPAD Press.

Alisjahbana, Armida S. and Arief Anshory Yusuf, 2000a, "Trial Estimates of the 1990 and 1995 System of Integrated Environmental and Economic Accounting", Report submitted to the United Nations University/Institute for Advanced Studies, Tokyo.

____, 2000b, "Indonesia's Genuine Savings Rates: 1980 - 1997". Report submitted to the United Nations University/Institute for Advanced Studies, Tokyo.

____, 2003, "Measuring Sustainable Development in Indonesia: Genuine Savings and Changes in Wealth Per Capita", Paper presented at the East Asian Development Network (EADN) Annual Forum 2003, 10-11 October 2003 at Hilton Hotel, Singapore.

Badan Pusat Statistik, various years, "Integrated Environmental and Economic Accounting", Jakarta, Indonesia.

Hamilton, Kirk, 2000a, "Sustaining Economic Welfare: Estimating Changes in per Capita Wealth", Policy Research Working Paper No. 2498, November 2000, World Bank.

_____________, 2000b, "Genuine Saving as a Sustainability Indicator". pp 65-78 In OECD Proceedings: Frameworks to Measure Sustainable Development, An OECD Expert Workshop, September 2-3, 1999, Paris, France. Paris, France: OECD.

Hamilton, Kirk and Michael Clemens, 1999, "Genuine Savings Rates in Developing Countries", World Bank Economic Review, 13, 333-356.

Pearce, David W. and Giles D. Atkinson, 1993, "Capital Theory and the Measurement of Sustainable Development", Ecological Economics, 8, 103-108.

Repetto, et. al., 1989, Wasting Assets: Natural Resources in the National Accounts. Washington: World Resources Institute.

Vincent, J and B. Castaneda, 1997, “Economic Depreciation of Natural Resources in Asia and Implications for Net Savings and Long-Run Consumption”, Development Discussion Paper 614, Harvard Institute for International Development, Harvard University.