Working Paper
in Economics and
Development Studies

Department of Economics
Padjadjaran University

No. 200307

To What Extent Green Accounting Measure Sustainable Development

Arief Anshory Yusuf
Armida Alisjahbana

Department of Economics,
Padjadjaran University

December, 2003

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

To What Extent Green Accounting Measure Sustainable Development [a]

by
Arief Anshory Yusuf[b]
Armida Alisjahbana[c]

Abstract

To what extent green accounting can properly measure sustainable development, not only depend on how well we maintain the link between the indicators and a clearly-defined concept of sustainable development but also on cautious interpretation of those indicators. Information from green accounting in general could be used to calculate adjusted, and better indicator of macroeconomic aggregates such as Green GDP, Genuine Savings, and Change in Wealth Per Capita. Green GDP, the most popular indicators, however, could not tell straightforwardly whether or not an economy is on sustainable path, neither could the growth of Green GDP. We show from a simple formal analysis of growth accounting that there are cases where interpretation of Green GDP growth could be misleading, especially when we are making comparison across economies (such as across province or districts) with differing resources dependence. Thus cautious interpretation of Green GDP (and its growth), is needed, and we propose that other indicators i.e. Genuine Saving and Change in Wealth Per Capita, which are easier to interpret, are better measures of sustainable development.

JEL Classification: E21, O40, Q01
Keywords: Green Accounting, Sustainable Development, Indonesia.

---

[a] Paper presented at The 3rd National Seminar and The 1st Congress of Indonesian Natural Resource and Environmental Account Professions and Practicioners, 12 – 14 December, 2003, Purwokerto, Indonesia.

[b] Lecturer/Researcher at Department of Economics and Development Studies, Padjadjaran University, Indonesia. e-mail: anshory@bdg.centrin.net.id

[c] Chairperson, of LP3E, Faculty of Economics, Padjadjaran University, Indonesia. e-mail: alisjahbana@bdg.centrin.net.id.

To What Extent Green Accounting Measure Sustainable Development

by
Arief Anshory Yusuf
Armida Alisjahbana

1. Introduction

There has been an increasing awareness in the development of green accounting as a response to the acknowledgment that standard conventional national account as indicators for the assessment of economic performance have neglected the scarcity of natural resources. Green accounting has begun to be widely applied both in developed and developing countries. In Indonesia, although still silently, green accounting has started to gain widespread recognition and some studies of green accounting has already been conducted by some domestic scholars and research institutes.

Some empirical exercises of green accounting in Indonesia, or at least include Indonesia in their cross-country studies are among others Repetto et al (1989), Pearce and Atkinson (1993), Vincent and Castaneda (1997), Hamilton (1999, 2000a, 2000b), Hamilton and Clemens (1996), BPS (1996), and Alisjahbana and Yusuf (2000a, 2000b, 2003) of which the classical study done by Repeto et al (1989) – cited in almost every literature of green accounting – was not only the first application of green accounting for Indonesia, but also a pioneering work in the literature of this area in general.

As decentralization in Indonesia started to gain its momentum, in which, the role of regional economies are put at the frontline of development, the need to also apply green accounting to improve standard regional economic indicator has also been acknowledged. Thus, in comparing economic performance across province or districts in Indonesia, we then would be able to use better measures of regional economic aggregates.

The need to apply green accounting was implicitly related to the need to create indicators that could measure sustainable development. Sustainable development is somewhat new concept and standard indicators has not been already established. It is

in this expectation that green accounting could produce good indicators of sustainable development, among which, Green GDP (or sometimes called eco-domestic product, or green NNP), is the most popular indicator derived from green accounting framework.

The objectives of this paper is to first, provide a short review on how green accounting – as a framework to devise better adjusted economic indicator – should be linked to the concept of sustainable development. Secondly, we will discuss and criticize the use of Green GDP as one of the most popular aggregate indicator from green accounting framework as an indicator of sustainable development, using some illustration, simple formal treatment, and empirical examples. We also propose Genuine Savings and Change in Wealth Per Capita as better measures of sustainable development.

2. Sustainable Development: from Definition to Indicators

Although sustainable development is a rather new concept, today it has been already an issue of popular conversation. People define hundreds different definition of sustainable development, and never-ending scholarly debates over how to achieve sustainable development could simply be caused by their differing interpretation of its definition. However, the most universally quoted definition is that produced in 1987 by the World Commission on Environment and Development (WCED), known as the Brundtland Commission:

> "Economic and social development that meets the needs of the current generation without undermining the ability of future generations to meet their own needs".

From this definition, we have to be able to derive indicators that could tell us whether or not an economy is sustainable. Those indicators, as OECD (1993, in Atkinson et al 1997, p. 21) summarized, must have among others the following characteristics.

(a) they must have policy relevance (easy to interpret, show trends over time, be responsive to changes in driving forces, have threshold or reference values against which progress may be measured;

(b) they must be analytically sound, based on a clear understanding of the goal of sustainable development;
(c) they must be measurable (no matter how attractive the theoretical construct, if it cannot be measured at reasonable cost, it is not useful).

This paper is not intended to provide in-depth review of the concept of sustainable development (interested readers could see for example, Pezzey and Toman, 2003, for a very recent review, or Atkinson et al, 1997, or Pearce, forthcoming), but in what follows, we just would discuss a few points – mostly from the perspective economics – we consider important in any attempt at linking the concept of sustainable development to the green accounting as indicators of sustainable development.

Sustainable development has many dimensions. There are many dimensions of sustainable development, of which among others are economic, environmental, social, political, or even cultural. Any attempt to measure this broad conception of sustainable development, especially into one single indicator is a very complex task, and if possible it will be at remarkable cost. Thus, most of the time, we have to limit the dimension of sustainable development. In practice is it could be just excluding those which are not easy to measure such as social, political, or cultural dimension.

Sustainable development has to be more specifically defined. To have a good indicator of sustainable development, the definition of sustainable development itself has to defined as specifically as possible. Economics, for example, propose to define sustainable development as "non-declining human well-being over time" (Pearce, et al, forthcoming, or Atkinson et al, 1997, p16). We opt to use this definition throughout this paper. The clearer the definition used, the easier would be the task of devising the relevant indicators. As far as sustainability indicator is concerned, we just need to know whether such indicator could tell us directly, and straightforwardly, whether the economy is on a non-declining welfare path, a sustainable path.

Sustainable development could be more easily approached by the concept of capital basis. If we have a perfect measurable proxy of human well-being, then it will be easy to calculate the best indicator of sustainable development, because we only need to

know whether the overtime trend of that proxy to determine whether or not and economy is on sustainable path. As this is not the case, then we need to find another second best proxy that could be used as a condition that guarantee the non-declining welfare. Economics then turn to capital. Capital stock indicates the ability of an economy to produce output, to generate well being. If we can sustain this productive capacity, then we can sustain our well-being. However, we need to broaden the concept of capital stock if we intend to conform with the agreed definition of sustainable development. This extended-capital stock constitute not only man-made capital but also natural capital, human capital, or even social capital. Economics find that measuring those capital stocks is easier than directly measuring welfare.

Sustainable development could be strong or weak. Even from this capital basis there are two different view of sustainable development i.e. the concept of weak and strong sustainability. Weak sustainability rule states that as long as total stock of capital is non-declining i.e. it does not matter, for example, whether stock of natural capital is declining as long as increasing man-made capital can offset its decline, then sustainability is assured. In other form, weak sustainability rule has been also known as "Hartwick Rule" (following Hartwick, 1977) or "constant capital rule". On the other hand, strong sustainability rule insists that beside total capital stock (K) should be set non-declining, some other form of capital such as natural capital (K_N) should also be kept intact. Table 1 from Pearce (forthcoming) summarizes the difference between weak and strong sustainability rule. Our option of adapting either rule lies on how we believe in substitutability among forms of capital

Green accounting measures 'weak' sustainability. One the main purpose of green accounting, is to devise aggregate economic indicator that could improve the existing conventional economic aggregates. In so doing, we have to sum many form of capitals (or its change/depletion), after converting them by the same unit of valuation (monetary unit, dollar or rupiahs), we then in principle adopt the principle of (perfect) substitutability among forms of capital (such as natural and man-made capitals). Applying green accounting in such fashion, implicitly place ourselves into a distinct school of thought i.e. weak sustainability rule as opposed to strong sustainability rule.

Table 1. Weak and strong sustainability rules

Form of sustainability	Requirement
WEAK	$\Delta K/\Delta t > 0$ where $K = K_M + K_N + K_H + K_S$ WS requires that capital depreciation on any form of capital must be at least offset by capital appreciation on other forms of capital. There must be 'reinvestment of rents'. The proceeds of capital depreciation must not be consumed. Forms of capital are assumed to be substitutable at the margin.
STRONG: Environmental	$\Delta K/\Delta t > 0$ and $\Delta K_N/\Delta t > 0$
Social	$\Delta K/\Delta t > 0$ and $\Delta K_S/\Delta t > 0$ SS requires the same rule as WS but in addition requires that the stock of the 'targeted' capital stock should also not decline. Hence the elasticity of substitution between the critical capital stock and other forms of capital is assumed to be zero.

Source: Table 3.5 in Pearce (forthcoming)

3. Green Accounting as Adjustment to macroeconomic Aggregates

Green GDP (or sometimes called Green NDP, or Eco-Domestic Product) is the most popular adjusted macroeconomic aggregate under green accounting framework. It is actually conventional GDP minus all form of capital depreciations (man-made, natural, or human capital). Under a standard UN SEEA (System of Environmental and Economic Accounting) framework (United Nations, 1993), Eco-Domestic Product is defined as conventional GDP minus human-made capital depreciation (depreciation of fixed assets) and imputed environmental cost (Alisjahbana and Yusuf, 2002b). Table 1 shows our earlier studies (Alisjahbana and Yusuf, 2002b) of estimating Green GDP from a framework of SEEA. As conventional GDP and also its growth (economic growth) has been the most popular standard conventional indicator to measure macroeconomic performance of an economy, adjusting this indicator and creating Green GDP is of the most appealing motivation. This could be one of main reason why Green GDP starts to become a popular indicator of green macroeconomic aggregates.

As we defined sustainability as a path of non-declining welfare, then whether or not Green GDP is the proper measure, is simply to ask whether or not Green GDP could tells that we are in that kind of path. However, we have to bear in mind that Green GDP has a theoretical framework (Atkinson et al, 1997) under which it is derived from a result of a model of a dynamic optimization problem in which a representative economic agent maximize the sum of present value of welfare stream overtime under certain constrained condition including the dependence of the economy on exhaustible resources (see Atkinson et al, 1997, for detail). The (present value) optimality condition derived from this model become the basic construction of the optimal measure of economic welfare i.e. Green GDP. Green GDP, then, measure 'optimal' economic welfare at certain period, it measure the true measure of income that guarantee maximum sum of present value of welfare over time. Optimality however does not mean sustainability, the former does not dictate the latter. We learn from the optimal growth theory under exhaustible resources, optimization problem with a positive utility discount rate imply that welfare could be declining i.e. non-sustainable. Theoretical framework of Green GDP does not say that it could measure directly sustainable development.

Table 2.
Eco Domestic Product (Green GDP) of Indonesia, 1990 and 1995

	1990	Pct of GDP	1995	Pct of GDP	Annual growth
Gross Domestic Product	210,866,000	100.0	454,514,000	100.0	7.8%
Depreciation of fixed assets	9,783,900	4.6	19,189,600	4.2	5.8%
Net Domestic Product	201,082,100	95.4	435,324,400	95.8	7.9%
Imputed environmental costs	11,818,452	5.6	23,561,351	5.2	6.2%
Degradation of natural resources caused by residuals	3,074,137	1.5	8,422,325	1.9	13.1%
Destruction of ecosystem	1,157,562	0.5	6,623,532	1.5	31.1%
Depletion of resources	7,586,753	3.6	8,515,494	1.9	-5.4%
Eco-Domestic Product	189,263,648	89.8	411,763,049	90.6	8.0%

Source: Alisjahbana and Yusuf, 2002

To help illustrate the use and interpretation of Green GDP, table 1 (from one of our earlier studies of Green Accounting, Alisjahbana and Yusuf, 2000b) provides the following information: Indonesian Eco-Domestic Product (EDP or Green GDP) in 1995 was Rp 411,763 billion, 90.6% of (conventional) GDP, and grew with annual growth rate of 8.0%, compared to (conventional) economic growth of 7.8% from 1990. What this information can tell us, and what does it have to do with sustainability?

Having EDP in addition to GDP means we can have information on how big is our output or income net of depreciation of our natural capital (imputed environmental costs). This is, surely, a very valuable information in itself. While NDP (GDP minus fixed assets deprecation) could only tells our output net of man-made capital depreciation, subtraction of imputed environmental costs extends the coverage of capital. The lower the green GDP (in rupiahs and in ratio to GDP) relative to conventional GDP, the worse the "true" performance of the economy. In this regards, by greening (conventional) GDP, Green Accounting has improved the standard economic indicator.

Green GDP has been associated with sustainable development. Vincent and Castaneda (1997), for example, specifically suggest that Green GDP could predict the impact of natural resources depletion on a country's long-run consumption possibilities by checking whether the trend in Green GDP is upward or downward. This trend, however, could not tell directly whether or not the economy is on the path of non-declining welfare, neither the relative size of Green GDP. The incapability of Green GDP to straightforwardly indicate (weak) sustainability is among others because it fail to consider the "constant capital rule". The relative size of Green GDP could be low, but when we have higher capital accumulation of other form (e.g. investment in infrastructure), sustainability may not be at risk. The economy, for example, is simply applying the 'Hartwick Rule', making a substitution among forms of capital, or investing all rents from natural resource to assure sustainability. Table 2 does not have information on man-made capital accumulation (positive change), so we could not tell whether or not Indonesian economy in 1990 or in 1995 was accumulating or running down its (broadly defined) capital stock.

In addition to the size of economy's output, the rate of GDP growth, or economic growth has been actually the most widely-cited economic aggregate indicator, thus one then turn to growth of EDP as a better measure. The higher the

growth of Green GDP relative to the (conventional) economic growth, the better the true performance of an economy. From table 1, we could see that growth of EDP (8%) is higher than growth of GDP (7.8%). The rate at which economy grow is faster than at which natural capital depreciate: a good news, but again for similar reasons, it could not tell straightforwardly that Indonesian economy is on sustainable path. We discuss the interpretation of Green GDP growth in the following separate sections using a simple formal growth accounting.

4. Growth of Green GDP and a Simple Analysis of Growth Accounting

For simplicity, lets define Green GDP (Y^G) as conventional GDP (Y) minus resource depletion (R)[1] or

$$Y^G = Y - R \tag{1}$$

Without explicitly shown (for convenience), each of the variable is a function of time (t). Growth of Green GDP (gY^G) then could be written as[2]

$$gY^G = \frac{Y}{Y - R} gY - \frac{R}{Y - R} gR \tag{2}$$

where gY is growth rate of GDP, and gR is growth rate of resource depletion. We could multiply equation (2) by Y/Y, and lets define r = R/Y which could be interpreted as relative resource dependence (initial ratio of resource depletion to GDP). This leads to[3]

[1] or we could use NDP (Net Domestic Product) instead of GDP for more applicable meaning.
[2] Taking the logarithm to both sides of equation (1), then differenting it with respect to t gives $d\ln(Y^G)/dt = d\ln(Y - R)/dt$, or
$(dY^G/dt)(1/Y^G) = [d(Y - R)/dt](1/(Y - R)] = [(dY/dt) - (dR/dt)]/(Y - R)$ ... (1a). If we define growth of Green GDP as $gY^G = (dY^G/dt)(1/Y^G)$, growth rate of GDP as $gY = (dY/dt)(1/Y)$, and growth rate of resource depletion as $gR = (dR/dt)(1/R)$, then we could write equation (1a) above as $gY^G = (gY \cdot Y - gR \cdot R)/(Y - R)$, which leads to equation (2).
[3] Equation (2) becomes $gY^G = [(Y/Y)/(Y/Y - R/Y)]gY - [(R/Y)/(Y/Y - R/Y]gR$, or
$gY^G = [1/(1 - r)]gY - [r/(1 - r)]gR$ which then gives equation (3).

$$gY^G = \frac{gY - r \cdot gR}{1 - r} \tag{3}$$

which tells that growth of green GDP is a function of three variables: growth of GDP, growth or resource depletion, and relative resource dependence, or $gY^G(gY, gR, r)$. It is increasing on gY and decreasing on gR. As illustration, if we input information from table 2, letting NDP as Y, and imputed environmental cost as R, Indonesian growth rate of Green GDP from 1990 to 1995 is gYG(7.9%,6.2%,5.6%) = 8.0%. Growth rate of Green GDP will be higher the higher the economic growth and the lower the resource depletion growth. To find out the effect of increasing r on the growth rate of green GDP (gY^G). We could differentiate equation (3) with respect to r, which gives[4]

$$\frac{dgY^G}{dr} = \frac{gY - gR}{(1 - r)^2} \tag{4}$$

From this we can have the following three special cases:

Case 1: gY = gR, then $dgY^G/dr = 0$. gY^G is independent on r.
Case 2: gY > gR, then $dgY^G/dr > 0$. gY^G is increasing function of r.
Case 3: gY < gR, then $dgY^G/dr < 0$. gY^G is decreasing function of r.

We could actually draw some interesting implication from the above very simple growth accounting. Growth of Green GDP has been seen as a better measure of economic performance of an economy compared to (conventional) economic growth, because the former has already account for resource depletion, for example. But this is not necessarily the case. First, from equation (3), growth of Green GDP could be exactly equal to growth of GDP, so long as the growth of resource depletion is equal to the growth of GDP, or if gY = gR, however high, then gY^G = gY. Thus an economy could simply rapidly depleting its natural resource with very high gR, a behavior which might be seen as non-sustainable, but its growth rate of Green GDP would still be similar to its economic growth (gY). In other words, an economy could

[4] $dgY^G/dr = [-gR(1 - r) - (gY - rgR)(-1)]/(1-r)^2$ that gives equation (4).

rapidly use up its natural resource, have a higher economic growth, but its growth of Green GDP (which many people may see as a better indicator of economic performance) is also high (similar to its economic growth). Thus simply comparing growth of Green GDP to growth of conventional GDP does not tells us much about sustainability. Secondly from case 1 given above, the possible equality between conventional economic growth and growth of Green GDP is independent on r, on whether or not the economy in question, is heavily resource dependent. We may call this "growth equality bias" of Green GDP growth.

Those misleading interpretation of Green GDP growth has also been pointed out by Hamilton (1994) which says that if resource depletion (R) is constant each year and growth of GDP is positive then green GDP will grow faster than GDP no matter how big R is. A constant proportion of R to GDP (r) will make growth of Green GDP is similar to that of GDP. So, green GDP could not tell us precisely and practically (especially for policy maker) whether or not a country is sustainable

Some people may see that the ratio of resource depletion to GDP (r) is also associated with sustainable development. An economy with high r, heavily dependent on natural resources, other things constant, may be seen to be less sustainable (although in some case not necessarily be so) because of the nature of exhaustibility of the resource. Thus in comparing economic performance across regions, for example, people may expect that some regions with much higher r, to be less sustainable than others. Using growth of Green GDP (gY^G) as the indicator for the comparison, would possibly, mislead interpretation. Consider two regions, for example West Java (with insignificant natural resource or low r) and East Kalimantan (a heavily resource dependent or high r). Suppose that both regions have similar economic performance in terms of its conventional economic growth (gY). Let's say that the rate at which, they deplete their natural resource (gR) is also similar, but for both regions their economic growth (gY) is higher than their growth rate of resource depletion (gR). This is actually the case 2, given above. As gY^G is increasing function of r, then we will have growth of Green GDP (gY^G) of East Kalimantan to be higher than that of West Java, a contradiction with people's expectation.

Now, suppose that the previous case apply to two resource-abundance regions, let's say, East Kalimantan and Riau (both are oil-dependent province), and both province experience equal economic growth (gY) and equal growth rate of resource depletion (gR), with their economic growth is higher than their depletion growth (case

2). The only difference is their initial ratio of resource depletion to GDP (r) in which case, for example, that r of East Kalimantan is much higher that r of Riau. This could means that the size of resource depletion of East Kalimantan has already been bigger, a sign of non-sustainable situation. But from case 2, East Kalimantan actually will look better than Riau in its level of Green GDP growth. Again an illustration of misleading interpretation of Growth of Green GDP as indicator of sustainability. We may call this "resource-dependence bias" of Green GDP growth, a bias that is caused by differing initial ratio of resource depletion to GDP (r). A numerical illustration is provided in box 1.

Box 1: Numerical illustration of 'resource dependence' bias of Green GDP growth

Two regions (or provinces), East Kalimantan (k) and Riau (r), are endowed with the same amount of oil reserves (exhaustible resource), $S_k = S_r = 100$ (to show that both regions are equally resource-abundant). However at initial period, East Kalimantan has already depleted half of its reserve, $R_k = 50$, but Riau has only use up a quarter of it, $R_r = 25$. Suppose that their initial GDP (Y) is equal, $Y_k = Y_r = 75$, then their resource depletion to GDP ratio $r_k = 50/75 = 2/3 > r_r = 25/50 = ½$.

The two province have similar economic growth, $gY_k = gY_r = 5\%$, and also equal resource depletion growth $gR_k = gR_r = 2.5\%$. From equation (3), East Kalimantan's growth of Green GDP, gY^G (0.05, 0.025, 2/3) = 10%, and Riau's growth of Green GDP, gY^G (0.05, 0.025, ½) = 6.3%. Green GDP growth of East Kalimantan is higher than that of Riau .

Although East Kalimantan's economy behaves more resource-intensively by using up much more of their reserves, as far as Green GDP growth is concerned, the economic performance of the region, unexpectedly, looks better.

The illustration of those two biases is the examples of drawbacks of Green GDP (and its growth) as indicator to measure sustainable development. Green GDP and its growth as an improved indicators do have a lot of advantages, but this illustration tells that without caution, misleading interpretation could easily occur. As ease of interpretation is supposed to be a condition for a good indicator has, growth of Green GDP seems to not the case. This drawback arises, actually, because this indicator has not been kept consistent with the proper definition of sustainable development (non-declining welfare) and thus the link between this indicator to conditions for sustainable development is a little bit vague.

5. SEEA, Green GDP, Genuine Savings and Change in Wealth Per Capita

The system of Integrated Environmental and Economic Accounting (SEEA) is an accounting framework that is geared towards alternative macro indicators of environmentally adjusted and sustainable income and product. It was developed by UNSTAT extending the standard SNA by linking the economy to the environment (See UN, 1993, for comprehensive discussion, and Alisjahbana and Yusuf, 2002, for the example of its application to Indonesia). Green GDP, by design, has been one of the output of SEEA. However, recently, other adjusted macroeconomic aggregate has already gain widespread recognition, i.e. genuine savings and change in wealth per capita[5]. Green GDP, genuine savings, and changes in wealth per capita, now has been considered the three most popular indicator of weak sustainability.

First introduced by Pearce et. al (1993) and extended more formally by Hamilton (1997) genuine saving is defined as that level of saving in the economy over and above the sum of all the (more broadly measured) capital deprecations in the economy. Intuitively, genuine saving is therefore investment in produced assets and human capital, less the value of depletion of natural resources and the value of accumulation of pollutant. If a nation's genuine saving is positive, then there is an addition to its capital base, and likewise if it is negative there is reduction in its capital stock. Persistent negative genuine saving means development is not on a sustainable path, i.e. well-being could be declining. However, since our concern is "per capita" well-being, genuine saving could only tell us whether or not total well-being, and not per capita well-being is declining. Hamilton (2000), then proposed change in wealth per capita from which to account for population growth. From the definition in table 1, genuine saving is simply the net-change of broadly defined capital stock or $\Delta K/\Delta t$, where $K = K_M + K_N + K_H + K_S$, whereas change in wealth per capita is simply $\Delta(K/P)/\Delta t$, where P is Population. Thus these two indicators consistent with the condition of non-declining capital stock, a condition to achieve a path of non-declining welfare, our definition of sustainable development. The ability of genuine savings and change in wealth per capita to indicate whether or not an economy is on sustainable path, has been formally shown, for example, by Hamilton (1999).

[5] Genuine saving is annually calculated and published by the World Bank in its annual World Development Indicators.

Basic information for calculating genuine saving and change in wealth per capita, more or less, are already available from the SEEA matrix. Information of Green GDP is directly shown i.e. value added net of use produced fixed assets (man-made capital depreciation) and imputed environmental costs. Because all form of capital depreciation (depreciation of man-made capital and imputed environmental costs) are all available from SEEA matrix, we could in principle calculate Genuine Saving (simply by subtracting those depreciations from gross saving which is available from other standard national account) immediately from SEEA matrix (the value of gross saving or investment is also available from SEEA i.e. addition to man-made capital, gross fixed capital formation or investment). The other advantage of SEEA matrix is the availability of information of the value of capital stock. These are available from the sub-matrix non-financial assets account in which assets is divided into produced (man-made) and non-produced assets. SEEA matrix provide the value of the opening and closing stock of each of those assets including natural capital. Therefore, the value of total (broadly defined) capital or wealth could easily be calculated and therefore the indicator of Change in Wealth Per Capita.

6. Concluding Remarks

Economics had rather define sustainable development as a path of "non-declining welfare" and use "constant capital rule" as the condition to achieve that. This, implicitly, is 'weak' sustainability rule, the same rule that implicitly inherent in green accounting. Such definition of and the condition for sustainable development could be used as a clear basis to develop and apply relevant indicators of sustainable development. Green GDP, Genuine Savings, and Change in Wealth per Capita, have been the three important indicators of (weakly) sustainable development. Because those are actually built from existing conventional national account, all of the indicator, then are under the framework of green accounting.

The inability to provide straightforward and direct indication of sustainability has been one disadvantage of Green GDP over Genuine Savings and Change in Wealth per Capita. Comparing economic performance of various economies such as across province or districts, which now is considered important in the era of decentralization, using Green GDP (and its growth) has been shown to be possibly misleading. However, having a comprehensive (an periodic) standard SEEA,

calculating genuine saving and changes in wealth per capita, in addition, to Green GDP, could be carried out with additional little effort, and thus we could have better additional measures of sustainable development.

Finally, to what extent green accounting can properly measure sustainable development, not only depend on how well we maintain the between link the indicators with clearly-defined concept of sustainable development, and cautious interpretation of those indicators, but also depend on many other issues. Those which we think to be important among others are the issue on what is covered and what is not in the indicators, as we are aware that sustainable development is a very broad concept. In this regards, data and methodological limitation could become one critical constraint in developing, and applying the better measure of sustainable development.

References

Alisjahbana, Armida, Arief Anshory Yusuf, and Budiono, 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.

Alisjahbana, A. and Arief Anshory Yusuf, 2002. Green National Account Measurement for Indonesia: Trial Estimates of the 1990 and 1995 SEEA in "Indonesia's Sustainable Development in a Decentralisation Era" (eds. Budy P. Resosudarmo et al), Indonesian Regional Science Association (IRSA)

_____, 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.

_____, 2000c, "Indonesia's Genuine Savings Rates and Sustainable Development". Paper presented at The 7th Convention Of The East Asian Economic Association 17-18 November 2000, Singapore.

Biro Pusat Statistik, 1996, "Trial Estimates of the Indonesian System of Integrated Environmental and Economic Accounting: 1990-93", a research report prepared by Biro Pusat Statistik, 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.

_____, 2001, "Measuring Sustainable Development". Prepared for OECD Round Table on Sustainable Development. May 31, 2001.

Hamilton, Kirk, (1994), Green Adjustments to GNP, *Resources Policy*,. 20,3, September, pp. 155-168.

Hamilton, Kirk, and Ernst Lutz, 1996, "Green National Accounts: Policy Uses and Empirical Experience." *Environment Department Paper Number 39. World Bank*, Environment Department, Vice Presidency for Environmentally Sustainable Development. Washington DC.

Hamilton, Kirk and Michael Ward, 1997, "Greening the National Accounts: Valuation Issues and Policy Uses", in Uno, K. and P. Bartelmus, *Environmental Accounting in Theory and Practice*, Kluwer: London.

Hamilton, Kirk, Giles Atkinson, and David W. Pearce, 1998, "Savings Rules and Sustainability: Selected Extensions," presented to the World Congress on Environment and Resource Economics, Venice, June 25-27.

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

Hamilton, Kirk and John A. Dixon, 2000, "Measuring The Wealth Of Nations. Frameworks To Measure Sustainable Development". pp 39-50 In *OECD Proceedings: Frameworks to Measure Sustainable Development*, An OECD Expert Workshop, September 2-3, 1999, Paris, France. Paris, France: OECD.

Pearce, D.W., forthcoming, "Environment and Economic Development"

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

Pezzey, John C.V and Michael A. Toman, 2003, "Progress and Problems in the Economics of Sustainability', pp. 165-231 in T. Tietenberg and H. Folmer, eds., *International yearbook of Environmental and Resorce Economics 2002/03*, Cheltenham: Edward Elgar.

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

United Nations, 1993, Integrated Environmental and Economic Accounting (interim version), Studies in Methods: Handbook of National Accounting, Series F, no. 61, New York.

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.