ASEAN Economic Bulletin Vol. 21, No. 3 (2004), pp. 290–307 ISSN 0217-4472

Assessing Indonesia's Sustainable Development

Long-Run Trend, Impact of the Crisis, and Adjustment during the Recovery Period

Armida Salsiah Alisjahbana and Arief Anshory Yusuf

We adopt the definition of sustainable development as "non-declining welfare per capita", with genuine savings and change in wealth per capita as indicators of "weak sustainability". The results suggest that the overall trend of the Indonesian economy during the past twenty years has not been on a sustainable path. Despite this, the degree of sustainability had been on an improving trend, due to the restructuring of the economy away from the oil and gas sector, and towards greater reliance on secondary and tertiary economic activities. However, forest resource depletion and environmental degradation from water and air pollution have rapidly become a growing problem. The economic crisis had adversely affected the positive trend in sustainability, through a combination of reduced savings rate and increases in natural resource depletion.

I. Introduction

The "miracle" of rapid economic growth in many East Asian countries, including Indonesia, had been widely perceived as the norm, until the 1997–98 financial and economic crises. Some have argued that the miraculous economic performance had not been properly measured, such as not taking into account the high rate of natural resource depletion and environmental degradation that accompanied the process. This raises the question whether the East Asian economies have developed in a sustainable manner, and how the economic crisis has affected the economic sustainability of these countries. Answers to such questions are of high importance to countries like Indonesia. As the economic and social costs of the crises are enormous, assessing its consequences on broader issues of sustainable development, and on environmental costs in particular, will provide lessons learned for the present and future generations. The objective of this article is to provide answers to the above question, by assessing the sustainability of Indonesia's long-run economic development, both before and after the crisis.

Following this introduction, Section II outlines the conceptual framework used to determine sustainable development. Section III outlines the methodology and data used in the computation of indicators for sustainable development (i.e. genuine savings and change in wealth per capita). Discussion of the results in Section IV is divided into three subsections, based on: (i) the overall long-run trend in sustainability; (ii) sustainability before the crisis; and (iii) the impact of the crisis on sustainability during the adjustment period. Section V concludes with some policy implications.

II. The Conceptual Framework

One of the most universally quoted definitions of sustainable development is the one cited by the World Commission on Environment and Development, also known as the Brundtland Commission, which defines it as:

> Economic and social development that meets the needs of the current generation without undermining the ability of future generations to meet their own needs (WCED 1987).

Following the publication of the Brundtland report, there has been a rapid escalation of alternative definitions of sustainable development, and lists are provided by several authors (Pezzey 1989; Pearce, Barbier, and Markandya 1990; and Rees 1989). Mitlin (1992) notes that, in general, the definitions involve two main components: (i) the meaning of development (i.e. what are the main goals of development: economic growth, basic needs, rights, etc.); and (ii) the conditions necessary for sustainability.

Economics has its own interpretation of this definition, and restates it in a more compact form, that is: sustainable development is defined as non-declining welfare per capita. As long as the future generation is as well off as the current one, then development is sustainable. Measurable and applicable sustainable development indicators have to be able to show this. The practical problem with this definition is how to measure welfare?

To overcome the problem in measuring welfare directly, economics proposes the concept of "capital basis for sustainable development". Capital stock indicates the ability of an economy to produce output, and thereby generate well being. It is the productive capacity of an economy that improves the welfare of its people. Therefore, if the economy can sustain productive capacity, then the economy can sustain its peoples' well-being. The capital basis for sustainable development translates into what is called the "constant capital rule".[1] Non-declining welfare per capita can be guaranteed by a non-declining capital stock. A non-declining capital stock would mean non-declining well-being per capita. Therefore, in order to determine whether an economy is on a sustainable development path, we only need to know the path of its capital stock over time.

The capital basis for sustainable development raises two opposing arguments: the concept of weak sustainability (WS) and strong sustainability (SS). The weak sustainability rule states that as long as the total stock of capital (K) is non-declining, it does not matter. For example, even if the stock of natural capital (K_N) is declining, as long as increases in man-made capital (K_M) can offset its decline, then sustainability is assured. On the other hand, the strong sustainability rule insists that besides the total capital stock (K) should be non-declining, some other form of capital, such as K_N, should also be non-declining.

Genuine savings, and change in wealth per capita, are indicators of sustainable development based on weak sustainability. Genuine savings is defined as the level of saving in the economy, over and above the sum of all capital depreciations (i.e. depreciation of K_M, K_N, K_H, and K_S). Intuitively, genuine savings is investment in produced assets and human capital, less the value of the depletion of natural resources, and the value of accumulation of pollutants. If genuine savings is positive, the nation must be adding to its capital base, and when it is negative, the nation is running down its capital stock. Persistent negative genuine savings means development is not on a sustainable path. However, as mentioned before, since our concern is "per capita" well-being, genuine savings can only tell us whether or not total well-being is declining, but not per capita well-being. The latter is captured through the change in wealth per capita, as developed by Hamilton (2000*a*).

III. Methodology and Data

III.1 Measuring Genuine Savings

This section discusses the step-by-step methodology used, including a description of the data sources used in estimating genuine savings over the period 1980–2000. An empirical estimation of genuine savings is obtained through the following eight equations:

$$GS = S - D^K - D^{NR} - D^R - ED \quad (1)$$

$$S = Y - C \quad (2)$$

$$C = C^P + C^G - [\, C^G_{ED} + C^G_H + C^G_{RD} \,] \quad (3)$$

$$ED = ED^L + ED^G \quad (4)$$

$$D^{NR} = \sum_i r_i q_i \quad (5)$$

$$D^R = \sum_j s_j (h_j - g_j) \quad (6)$$

$$ED^L = \sum_m \sum_n ac_{mn} \cdot p_{mn} \cdot Q_n \quad (7)$$

$$ED^G = mc \cdot CO_2 \quad (8)$$

Where:

GS = Genuine Savings

Y = Gross National Product (GNP)

S = Gross (conventional) savings

C = (Adjusted) consumption expenditure

C^P = Private/household consumption expenditure

C^G = Government consumption (current government spending)

C^G_{ED} = Current government spending on education

C^G_H = Current government spending on health

C^G_{RD} = Current government spending on research and development

D^K = Depreciation of man-made (produced) capital stock

D^{NR} = Depreciation of non-renewable natural resources

D^R = Depreciation of renewable natural resources

ED = Environmental degradation

ED^L = Environmental degradation from local pollution

ED^G = Environmental degradation from global pollution

i = 1,2,3,… (type of non-renewable natural resource)

r_i = Unit rent of non-renewable resource i

q_i = Quantity of non-renewable resource i extracted

j = 1,2,3,… (type of renewable natural resource)

s_j = Unit rent of renewable resource j

h_j = Quantity of renewable resource j harvested

g_j = Natural growth of renewable resource j

m = 1,2,3, … (type of pollutant, i.e. NO_2, SO_2, …. etc.)

n = 1,2,3, … (sub-sector of manufacturing sector)

ac_{mn} = Unit cost of emission abatement of pollutant m in manufacturing sector n (abatement cost)

p_{mn} = Volume of pollutant m emitted per unit of output produced by manufacturing sector n (pollution intensity)

Q_n = Output of manufacturing sector n

mc = Marginal social cost of CO_2 emission

CO_2 = Volume of CO_2 emitted

Gross Savings and Adjusted Consumption. Equation (1) states that genuine savings (GS) is the "true" rate of saving, calculated by subtracting: depreciation of produced or man-made stock of capital (D^K), depreciation of non-renewable natural resource (D^{NR}), depreciation of renewable natural resource (D^R) and environmental degradation (ED), from gross saving (S). Depreciation of non-renewable and renewable natural resources is sometimes called "resource depletion" or "resource rent". Gross saving (S) is calculated by subtracting from Gross National Product (Y), adjusted consumption expenditure (C). Data for GNP and unadjusted (conventional) consumption expenditure, i.e. private/household consumption expenditure (C^P) and current total government spending (C^G), was obtained from Asian Development Bank's macroeconomic database.

In order to measure "true" saving, we have to re-identify what constitutes "true" consumption and "true" investment. In conventional national accounts, in many cases expenditure on education — such as school or university tuition — spent by household sectors, current government spending on education, spending for improving health standards, spending to support research and development activities are counted as current expenditure or consumption. Assigning those kinds of expenditure as "consumption type" and not as "investment type" will simply underestimate true savings or investment, because these types of spending obviously increase the future productive capacity of an economy. Types of consumption spending that we reclassified in this study are current expenditures on education (C^G_{ED}), health (C^G_H), and R&D (C^G_{RD}) spent by government sector.[2] Household consumption of these types of expenditures was not reclassified because we do not have adequate time-series data for the household/private sectors.[3] Equation (3) formally states how to reclassify standard consumption into adjusted consumption.

Depreciation of Non-renewable Natural Resources. Equation (5) shows how to calculate the value of depreciation or depletion of non-renewable natural resources. We included ten categories of non-renewable natural resources: crude oil, natural gas, coal, bauxite, nickel ore, gold, silver, iron sand, copper, and tin.[4] The data of extracted quantity of each sub-soil resources (q_i) was obtained from "Oil and Gas Mining Statistics" and "Non Oil and Gas Mining Statistics", both published annually by the Indonesian Central Board of Statistics (BPS).

We used the "net price method" to measure the depletion of sub-soil resources, by simply multiplying the quantity of extraction (q_i), or the change in stock of sub-soil resources, with its unit rent (r_i). The application of the net price method was based mainly on the Hotelling rent assumption. Unit rent for each resource (r_i) is calculated by subtracting the unit cost[5] of extraction from its price. Because resources extracted are sold to different markets (for example, domestic and international markets) with different prices, we had to calculate the weighted average price for each of the resources.

Annual data for unit costs is hard to find. For the years in which the unit cost could not be calculated, we applied the assumption of real constant cost of production, by adjusting for change in the wholesale price index. The actual data for unit costs of some resources was only available for the years 1990 to 2000, from the BPS publication, *Integrated Environmental and Economic Accounting, 1990–2000*. The cost structure covers primary costs, intermediate costs, and exploration costs. Unit rent for each of the sub-soil resources was obtained by subtracting the unit cost from each price. Multiplying this unit rent (r_i) with the volume of depletion of each of the sub-soil resources (q_i) produces the depletion cost, or rent of its respective resources (equation (5))[6]. We used different methods to estimate the unit rent for iron sands and copper, since the extraction cost of these types of resources are not covered in the BPS publication. For these resources, the unit rent was calculated, following Hamilton (1998), by assigning a proportion of unit rent from our own calculated price (0.58 for iron sands, and 0.49 for copper).

Depreciation of Renewable Natural Resources. Equation (6) shows that instead of multiplying unit rent with quantity of resources harvested, we multiplied it with its net depletion or quantity harvested (h_j), minus natural growth (g_j). For forest resources, this net depletion is simply called "excess felling". Excess felling is defined as the volume of round wood produced in excess of its sustainable growth. Several strong assumptions and simplifications were made to arrive at the estimation of sustainable growth of round wood. We assumed that natural growth is proportional to the stock of standing timber. Data for stock of standing timber is available for the years 1990 to 2000 from a BPS publication.[7] The data for the years before 1990 was estimated using trend regressions.[8] Data for natural growth is also available for the same years (1990 to 2000), with the average proportion from the standing stock of 0.0036. We used this proportion to estimate the natural growth of round wood for the years 1980 to 1989.

Annual data on the volume of round wood production is available from BPS and the Ministry of Forestry. However, it is widely believed that this official data underestimates the true rate of production due to factors such as illegal logging and shifting cultivation. We therefore used round wood production data from the FAOSTAT database on industrial round wood production. It was found that the rate of round wood depletion from this data was greater than the rate cited in the official sources. The average world export price (calculated from FAOSTAT database[9]) was used to estimate round wood unit rent. Based on an ITFMP study, the round wood unit rent is estimated to be 72.41 per cent of its price (ITFMP 1999). Unit rent of round wood for each respective year was calculated as the unit rent percentage of price, multiplied by the price in each respective year.

Environmental Degradation. Equation (7) shows how to calculate the value of environmental degradation due to emissions of several "local-type" pollutants. Air and water pollution originates from fixed sources (for example, industrial sources, which are mainly factories, and household sources) as well as from mobile sources (for example, the transportation sector, such as motor vehicles and aircraft). In this study, only pollution from industrial sources was estimated. For the specific type of pollutant, the volume of emission depends on the pollution intensity (volume of pollution load per unit of output), and composition of the industry.

The conventional pollutants produced by manufacturing sectors, as residuals to air, included in this study (subscript m) were: Nitrogen Dioxide (NO_2), Sulfur Dioxide (SO_2), Carbon Monoxide (CO), Volatile Organic Compound (VOC), Particulate, Fine particulate (PM10), and Toxic air. The conventional pollutants emitted to water included: Biochemical Oxygen Demand (BOD), Total Suspended Solid (TSS), and Toxic water. Pollution intensity for each type of pollutant used in this study was based on the World Bank's *Indonesia, Environment and Development* (World Bank 1994). It is an estimate of pollution intensity by World Bank IPPS (Industrial Pollution Projection System), adjusted for the Indonesian condition.[10] The adjustments made were in separating out the manufacturing sector into processing and assembly types of activities (subscript n).

Output data was obtained from an Input-Output table, and annual survey of large and medium manufacturing sectors, for the years 1980 to 2000. Using a two-digit industrial classification, we separated the manufacturing sector into assembly and processing categories, and multiplied their output with their pollution intensity to obtain the volume of emission for each pollutant type. Assuming a constant pollution intensity throughout the 1980–2000 period, the annual pollution intensity was estimated by adjusting it with each respective year's wholesale price index.

To arrive at the value of environmental degradation (ED^{L}), we applied a maintenance cost approach, i.e. the total cost needed to maintain a certain level of pollutant emission. For each type of pollutant, the maintenance cost approach was applied by multiplying the pollution load with each industrial sub-sector (using the two-digit ISIC) with its abatement cost coefficient (varied by pollutant types and industrial sub-sectors). The abatement cost coefficient was obtained from the World Bank's IPPS. Assuming real constant abatement costs, the annual abatement cost coefficient was adjusted using each year's wholesale price index.

Finally, equation (8) shows how to calculate the value of environmental degradation from emission of "global type" pollutants, comprising CO_2. The methodology used in the World Bank's estimate of Genuine Savings was adopted to measure the cost of global damage from CO_2 emissions (Hamilton and Clemens 1999). It is assumed that global damage is charged to emitting countries, on the assumption that the property rights to a clean environment lies with the polluters.

III.2 Measuring the Change in Wealth Per Capita

Previous discussions suggest that when the constant population growth assumption does not hold, genuine savings are no longer a proper measure of sustainability. A change in wealth per capita could correct this weakness. We estimated change in wealth per capita over the period 1980 to 2000 by following Hamilton (2000*a*):

$$\dot{k} = \frac{d}{dt}\left(\frac{K}{N}\right) = \frac{K_t}{N_t}\left(\frac{\Delta K_t}{K_t} - n_t\right) \qquad (9)$$

where

$\dot{k}$ = Change in wealth per capita at year t

K_t = Total wealth at year t

N_t = Number of population at year t

$\frac{K_t}{N_t}$ = Wealth per capita at year t

ΔK_t = Change in wealth at year t (or genuine saving)

n_t = Population growth at year t

The most difficult part in applying equation (9), is in obtaining the total value of wealth (K_t). Currently, there are several methods and studies in wealth estimation, such as individually estimating every component of a nation's wealth (Kunte et al. 1998), or by estimating it indirectly, by calculating the present value of per capita consumption (Hamilton 2000*a*).

In this study, we used our own estimates of wealth, based on our previous study of green accounting. In Alisjahbana and Yusuf (2000*a*), we constructed an SEEA for the year 1990 and 1995 that required us to calculate the value of non-financial assets (i.e. natural assets). However, this wealth estimate is limited to two years, and only covers selected components of wealth. Table A1 (in the appendix) shows the basis for the wealth estimation (K_t). In order to obtain the time series for K_t, we applied adjusted Perpetual Inventory Method (PIM) that accounts for the revaluation of the change in stock prices.

IV. Results and Discussion

The results for the genuine savings rate are shown in Figure 1, while the change in wealth per capita is provided in Figure 2. Figures 3 and 4 show components of the genuine savings rate, in terms of resource depletion and environmental degradation.

IV.1 Sustainability over the Long-Run (1980 to 2000)

The conceptual framework and the methodology discussed in the previous section suggests that positive genuine savings and/or a change in wealth per capita (for a certain period of time)

FIGURE 1
Gross Savings, Adjusted Gross Savings, Total Capital Depreciation,and Genuine Savings, 1980 – 2000
(As a percentage of GNP)

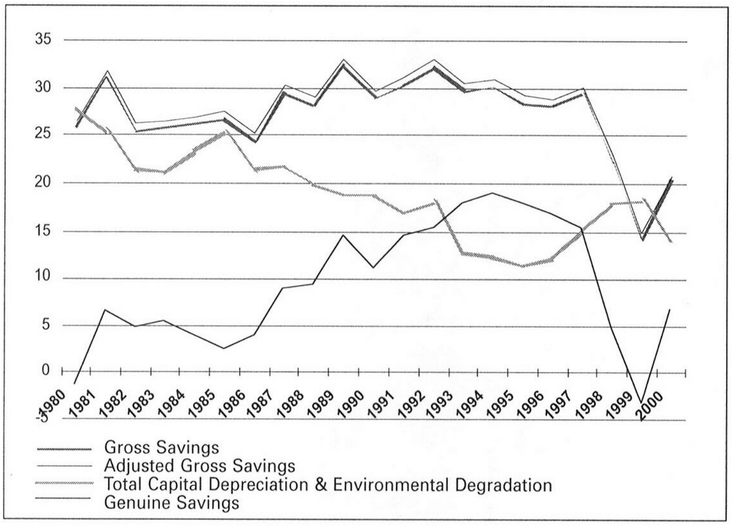


FIGURE 2
Genuine Savings and Change in Wealth Per Capita
(Constant 1995 Price)

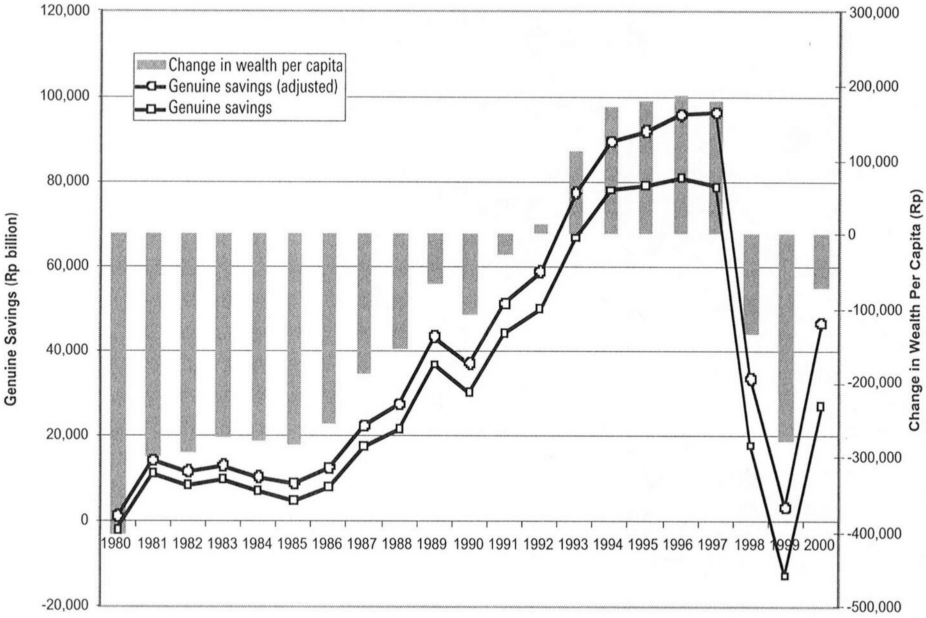


FIGURE 3
Depreciation of Man-made and Natural Capital
(As a percentage of GNP)

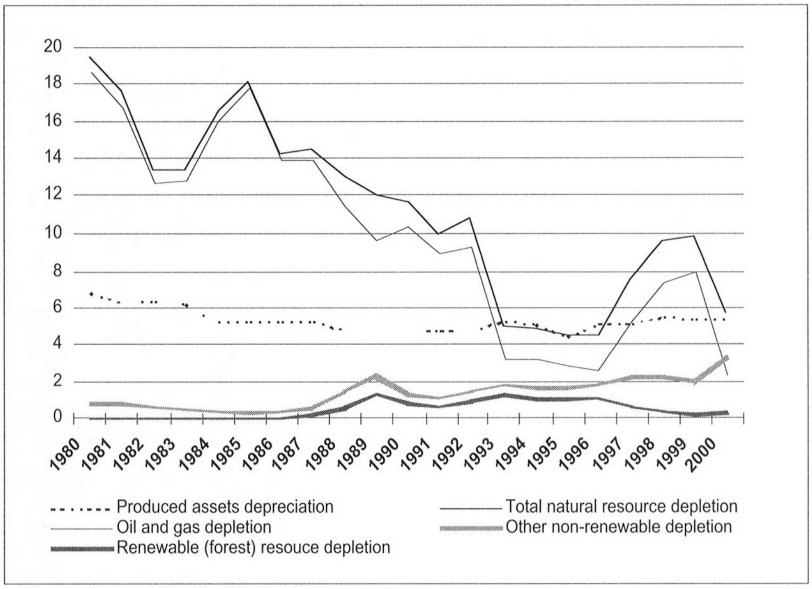
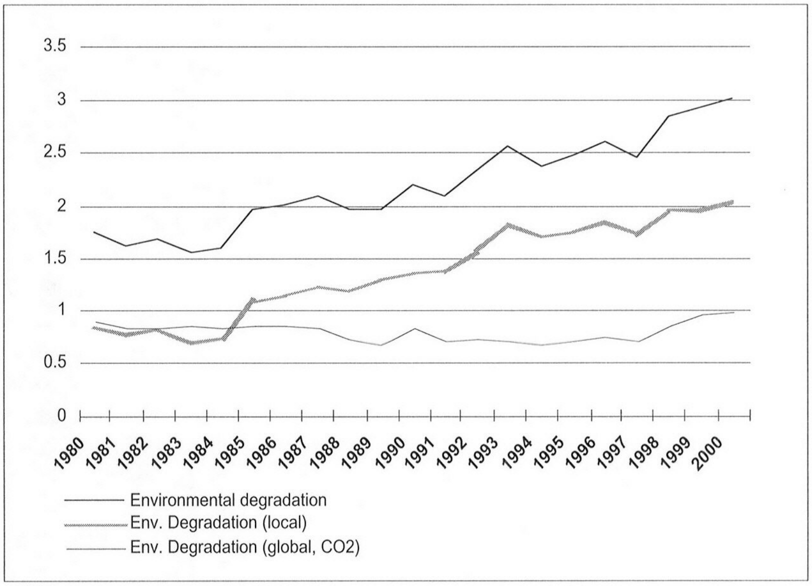


FIGURE 4
Environmental Degradation
(As a percentage of GNP)



could inform whether the economy is on a sustainable economic path. These are the advantages of genuine savings and change in wealth per capita over other indicators of sustainable development.

Interestingly, the general pattern of the two indicators (both the genuine savings rate and the change in wealth per capita) could suggest different conclusions. Over the period 1980–2000, Indonesia only experienced two years of a negative genuine saving rate: once in a normal year (1980), and once during the crisis (1999).[11] Based on the genuine savings indicator, the Indonesian economy is sustainable during the 1980–2000 period. However, the over-time pattern of change in wealth per capita suggests differently. As a positive change in wealth per capita only occurred in six years of these two decades, we conclude that the Indonesian economy in general (i.e. over the twenty years) was not sustainable. As has been explained previously, change in wealth per capita is a better measure of sustainability, since the concept takes into account population growth in the overall sustainability measurement.

As the above calculation was conducted with some data and methodological limitations, then the conclusiveness of the results will likely depend on several aspects. First, we have not yet been able to include some other important components of assets into our calculation. For example, non-timber benefits of forests, which many people think have been depleted significantly, or pollution from non-industrial sources, such as transportation and households, and many others that could not be calculated because of data and methodological limitations. Had these exclusions been incorporated into our calculation it could have further driven down the sustainability indicators, and the conclusion of unsustainability would have been strengthened. Second, the results are based on the concept of "weak sustainability", and on the assumption of perfect substitutability between man-made and natural capital. Since our results do not meet this weak sustainability criteria, it is clear that they would also not meet the (more demanding) strong sustainability criteria either.

However, some cautionary comments should be noted. We do not, for example, incorporate the value of human capital into our calculated changes in wealth per capita (due to methodological limitations), and we also do not include the discovery of natural resources (because of data limitations), as positive changes in wealth. These could drive up our result indicators, and could possibly weaken our conclusion on the unsustainability of the Indonesian economy.

IV.2 The Trend of Sustainable Development in the Pre-crisis Period (1980–97)

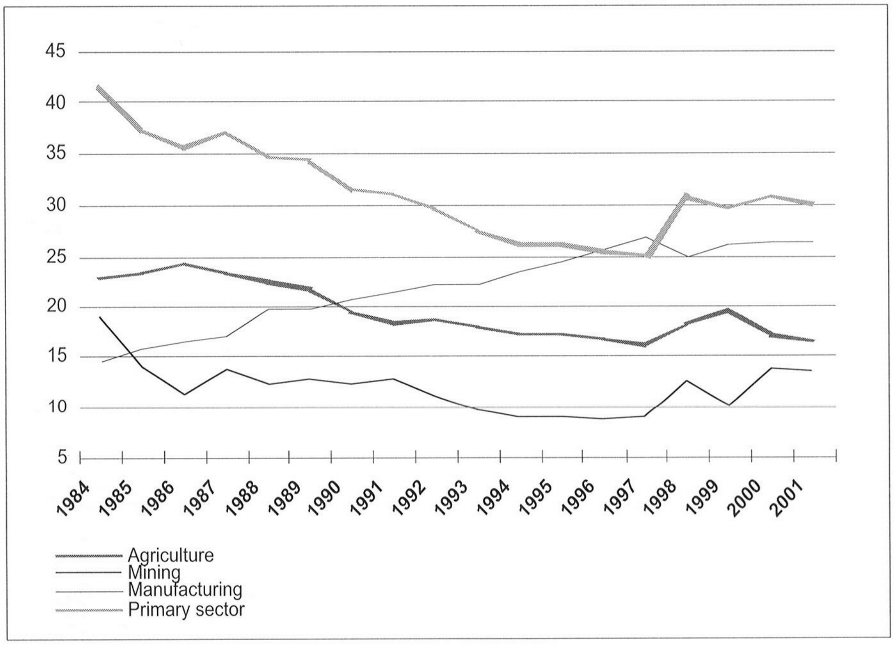
There are some general trends from both indicators that should be noted. Both the genuine savings rate and change in wealth per capita have shown an improvement over time, with the exception of the economic crisis period. Had this trend continued, then there could be some room for optimism in the context of Indonesia's sustainable development. If we divided the last two decades into two distinct periods — the 1980s and the 1990s — we could argue that the Indonesian economy had not been on a sustainable path during the 1980s, but had experienced economic sustainability during the 1990s (especially when we counterfactually assumed no crisis occurred towards the end of the 1990s).

The general improving trend in sustainability indicators over time can be explained further by looking at their components (see Figures 3 and 4). First, the conventional savings rate had been relatively stable. This "traditional measure" of economic sustainability indicates that gross national savings had been relatively constant over the period 1980–97, ranging from 26.24 per cent of GNP to 33.12 per cent. Second, the depreciation of man-made capital has been invariant over time, at a rate of 5 per cent of GNP. Third, total environmental degradation (both local and global environmental degradation) increased slightly over time, despite its insignificant magnitude (around 1.5 to 3 per cent of GNP). Finally, total resource depletion exhibits an obvious decreasing trend over the period, from almost 20 per cent of GNP in 1980, to only slightly less than 6 per cent in 1997.

Looking at the trend of natural resource depletion (see Figure 1), it is very obvious that the decline has been mostly due to declining oil and gas depletion, as a percentage of GNP. As the Indonesian economy had been restructuring away from a high degree of dependence on the oil and gas sector, it has moved towards a more sustainable path. Figure 5 shows the significance of this structural change, and its implication for sustainable development. The figure clearly shows that up to the year 1997, a declining share of the primary sector's value-added (agriculture and mining) had been accompanied by an increasing value-added share by the manufacturing sector. Not only has the economic policy to promote the non-oil and gas sector helped to achieve a higher rate of economic growth, it has also put the economy on a more sustainable development path. However, this structural shift is not the only explanation. The general trend of the economy towards a more sustainable path between 1980 and 1997 might have also been affected by various other events and policies over this same period. First, the shift in Indonesia's industrialization policy, from import-substitution in the 1970s, to an export-oriented industrialization strategy in the second-half of the 1980s. Second, a different attitude towards foreign direct investment, from being very restrictive in the late 1970s, to one that has been more liberal since 1986. Third, the financial deregulation that occurred in October 1988, which significantly increased saving rates.

On the other hand, it should be noted that minerals (excluding oil and gas), forest resource depletion (as shown in Figure 3) and environmental degradation (as shown in Figure 4) have consistently shown an increasing long-run trend. If this trend continues, then we have to anticipate the future implications. As Indonesia is a country with abundant natural resources, once these resources are heavily depleted, it will have adverse consequences for sustainable development. The same is true for the impact of a more dominant industrial sector within the economy, with the ensuing pollution problems.

FIGURE 5
Share of Sectoral Value-Added to GDP
(In percentage terms)



IV.3 Sustainable Development and Impact of the Crisis (1997–2000)

If we highlight the period of the economic crisis, and the adjustment period that followed, we can clearly observe the impact of the economic crisis on sustainability. From the first year of the economic crisis (1997), the general trend — which had occurred for the preceding sixteen years — of improving sustainability indicators, was halted. But more importantly, both indicators of sustainability dropped significantly. Although the genuine savings rate was only negative once, in 1999, the change in wealth per capita was consistently negative throughout the crisis period (of 1998, 1999, and 2000). Such a pattern clearly indicates economic unsustainability.

How has the economic crisis led to unsustainable development? The answers can be found by disentangling the sustainable development indicators into their individual components. The fall in sustainable development indicators is a result of two forces at work. First, the sharp drop in the conventional savings rate; and secondly the significant increase in natural resources depletion, mostly in the form of oil and gas depletion. Both factors have adversely affected sustainable development.

The impact of the change in savings on sustainability is substantial, and since man-made capital comprises the largest share of total wealth, its fluctuation over time would have a substantial impact on sustainability. Compared to the 1980s, in the late 1990s the accumulation of man-made capital (i.e. physical investment) had become a much more important part of the accumulation of total wealth. Savings are very important in the context of sustainable development, because they are the source of investment, or an addition to total man-made capital. When savings decrease, this will substantially reduce the capacity to maintain total wealth, and hence affect sustainability. A sharp decline in the saving rates was recorded, from around 30 per cent of GNP in 1997, to only 15 per cent in 1999. Figure A1 (see the appendix) illustrates that this decline occurred in every component of savings: private saving (other domestic saving), government saving, and foreign saving (in the form of capital outflows). This clearly destroyed the capacity to accumulate man-made capital — an important component of total wealth. The lowest point of the saving rate, in 1998, 1999, and 2000, are thought to be the cause of a negative change in wealth per capita over the three-year period.

There is common agreement in the literature on savings behavior that economic growth is the most important variable (Gulati and Thimann 1997). A casual look at the scatter plot of saving rates and economic growth for Indonesia (see Figure A2 in the appendix) reveals that the savings rate can be very sensitive to economic growth. When the economic crisis caused the lowest economic growth in Indonesian history, a sharp drop in the savings rate was inevitable. However, not many people realized how this had adversely impacted on sustainable development.

The second force that drove down sustainability indicators during the crisis period was the rise in resource depletion, mainly from the oil and gas sector. Non-oil and gas resource rent also experienced substantial increases during the crisis period, although to a lesser degree (see Figure 3). Since the depletion rate is measured as a percentage of GNP, this raises an interesting question. How could the economic crisis of the late 1990s have affected such a notable change in Indonesia's economy, by affecting the behavior of such specific sectors as the mining sector?

Figure 3 suggests that the crisis that started in 1997 had raised rent from the oil and gas sector, from 2.6 per cent of GNP in 1996 to almost 8 per cent in 1999 (an almost fourfold increase within three years). This, in turn, contributed significantly to the rise of total resource rent, from around 4 per cent of GNP in 1996 to almost 10 per cent in 1999; very inconsistent with the long-run trend. Consequently, this sharp rise was responsible for negative genuine savings in 1999, and the negative change in wealth per capita in 1998, 1999, and 2000. In short, rapid increases in the resource rent per GNP, due to the economic crisis, had reduced the sustainability of the Indonesian economy. This interesting phenomenon raises the question whether the economic crisis changed the behaviour of the natural resources sector in the economy. Empirically, this occurred in Indonesia during the crisis, as shown in Figure 5. The figure suggests that the share of the mining and agriculture sectors' value-added rose during the crisis, and these together constituted a notable increase in the total share of the primary sector's value-added, from 25 per cent in 1997 to almost 31 per cent in 1998. Conversely, the share of the manufacturing sector's value-added dropped from 27 per cent in 1997 to 25 per cent in 1998.

There are several links that could relate the economic crisis to resource depletion or environmental degradation. The literature on the links between poverty and the environment argues that in a situation of open access resources, poor people tend to deplete resources more rapidly, because poor people usually have a lower personal discount rate. Unemployment and poverty increased during the crisis, and accordingly the rate of natural resource depletion (for example forest depletion) also rose. Environmental degradation could also be driven by an increasing poverty incidence, because in a period of economic hardship, asset (including natural assets) liquidation can be viewed as an inevitable answer.

The indication that the Indonesian economy was more resource-intensive during the economic crisis can be explained through the relationship between natural resource depletion for export and currency depreciation (Dauvergne 1999). The Indonesian economic crisis was accompanied — and also triggered — by a sharp depreciation of the rupiah. This in turn increased the exploitation and export of natural resources because production costs were mainly incurred in local currency, but earnings from exporting the commodities were generated in foreign currency. As Dauvergne (1999) has observed:

> Mining exploitation has apparently increased during the crisis, including by small miners who are exceptionally difficult to supervise. The Indonesian government awarded 50 contracts in February 1998 to mine gold, coal, diamonds, and nickel, bringing the total number of mining contracts in Indonesia to 269 (Sunderlin 1998:7). The government is now encouraging foreign investment in the mining sector to try and maximize its foreign currency earnings....

The calculation of resource rents reveals that most of the increases in resource rent during the crisis were due to sharp increases in the value of unit rent. The rapid depreciation of the rupiah is thought to be responsible for this rise. Thus, this strengthens our argument that the economic crisis in Indonesia negatively affected sustainable development, the transmission of which was through the effect of the currency depreciation on resource rents.

As we have passed the height of the economic crisis, and Indonesia is on the path to economic recovery, the savings rate is expected to improve, resource depletion is expected to slow down, and hence contribute to an improvement in overall economic sustainability. The lower savings rate was mainly due to lower economic growth during the crisis, but the Indonesian economy is improving, and the local currency has stabilized. Taking an optimistic stance, we would expect that with the economy now in recovery mode, Indonesia's sustainable development can return to its long-run trend of improvement.

V. Concluding Remarks

The overall trend in sustainability indicators shows that the Indonesian economy has not been on a sustainable path during the last twenty years. Despite this, sustainability had been on an improving trend during the 1980 and 1990s, until just prior to the economic crisis. The improvement in the long-run trend of sustainability was due to the restructuring of the economy, away from the oil and gas sector, and towards more reliance on secondary and tertiary activities. Economic policies in the 1980s and 1990s that had accelerated structural change also had a beneficial effect on sustainable development.

Although the share of the oil and gas sector in the Indonesian economy had been on a decline, with its positive effect on sustainability, another development has been an increasing trend in non-oil and gas mineral extraction, the unsustainable practice of forest depletion, and an increasing share of environmental degradation due to industrial pollution. Policies related to natural resources management could be specifically used to maintain an optimal resource extraction path, with such examples as: proper regulation of property rights, royalties, concessions, regulation and zoning of natural resource management, and commitment for critical environmental expenditures. It has been shown that economic growth has a profound and positive effect on a country's path to sustainable development. Overall macroeconomic stability has to be achieved to attain higher growth in a sustainable manner. Policies that would facilitate a rise in the conventional savings rate should be prioritized, aside from measures to improve economic performance, and growth itself.

APPENDIX

TABLE A1
The Stock and Accumulation of Man-Made and Non-Produced Natural Assets, 1995
(In million rupiahs)

Type of assets	*Opening stocks*	*Use of products*	*Consumption of fixed assets*	*Imputed environmental costs*	*Adjustments relating to accumulation*	*Other adjustments*	*Closing stocks*
Produced assets	2,466,700,968	151,608,118	(43,484,328)	(6,623,532)	797,470	137,311,624	2,706,310,320
Man-made assets	1,008,920,000	151,608,118	(43,484,328)			123,587,824	1,240,631,614
Cultivated Forests	1,457,780,968			(6,623,532)	797,470	13,723,800	1,465,678,706
Teak	9,318,732			—	529,100	462,700	10,310,532
Deep-forest	1,448,462,236			(6,623,532)	268,369	13,261,100	1,455,368,174
Non-produced natural assets	1,618,688,849			(16,937,819)	36,980,577	202,474,056	1,841,205,663
Air				(6,825,420)	6,825,420		
Fixed				(6,189,076)	6,189,076		
Mobile				(636,343)	636,343		
Water				(1,596,906)	1,596,906		
Land use	921,459,949				7,617,392	103,663,156	1,032,740,497
Developed land	298,930,375				7,883,056	35,418,882	342,232,313
Agricultural land	366,554,787				2,953,297	39,065,861	408,573,945
Conservation	35,479,300				(3,028,041)	3,746,209	36,197,468
Forest and other land	220,495,488				(190,920)	25,432,203	245,736,771
Subsoil resources	697,228,900			(8,515,494)	20,940,859	98,810,900	808,465,166
Oil	198,524,000			(6,639,879)	274,439	33,833,300	225,991,860
Gas	430,133,300			(1,862,200)	21,021,166	50,125,600	499,417,866
Coal	63,330,900			(92)	(608,867)	10,761,200	73,483,141
Bauxite	671,300			(0)	(4,990)	(21,900)	644,410
Tin	4,569,400			(13,321)	259,111	4,112,700	8,927,889
TOTAL	4,085,389,818	151,608,118	(43,484,328)	(23,561,351)	37,778,046	339,785,680	4,547,515,983

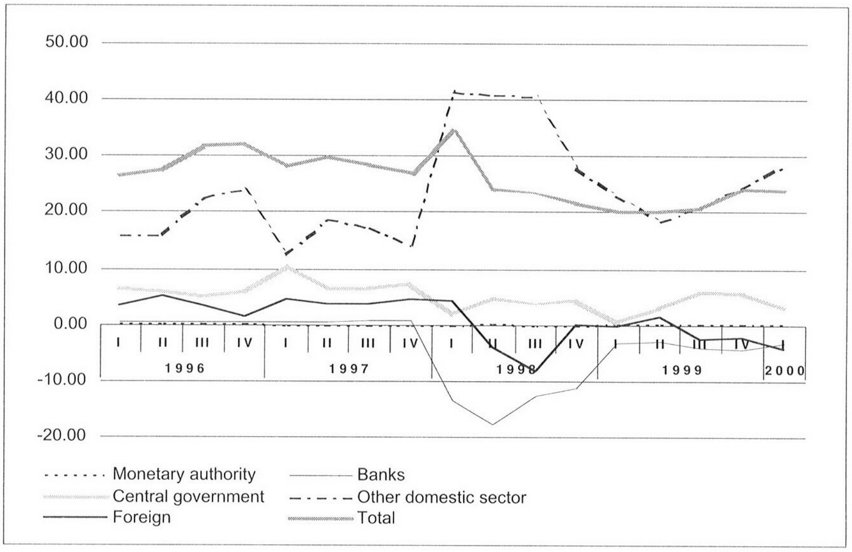
SOURCE: Alisjahbana and Yusuf (2002*a*).

TABLE A2
Pollution Intensities: Processing versus Assembly
(In pounds per million rupiah of output value, 1989)

Pollutants	*Assembly*	*Processing*	*Ratio Processing/ Assembly*
"New" Pollutants			
Volatile Organic Compounds (Air)	9.609	9.495	1.0
Lead (Air)	0.00048	0.00289	6.0
Toxic Release (All Media)	4.806	13.085	2.7
Bio-accumulative Metal (All Media)	0.254	0.987	3.9
"Traditional" Air Pollutants			
Fine Particulate (Air)	0.679	3.037	4.5
Sulfur Dioxide (Air)	7.394	24.03	3.3
Total Particulate (Air)	2.518	15.39	6.1
Nitrogen Dioxide (Air)	4.138	17.50	4.2
Carbon Monoxide (Air)	7.193	17.39	2.4
"Traditional" Water Pollutants			
Biochemical Oxygen Demand (Water)	7.006	5.458	0.8
Suspended Solids (Water)	2.632	36.27	13.8

SOURCE: World Bank, "Indonesia: Environment and Development", 1994.

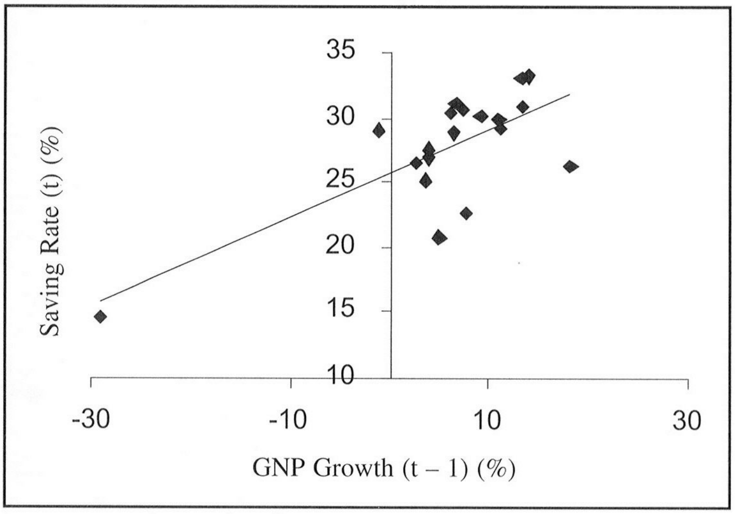
FIGURE A1
Development of Savings, by Component, during the Crisis



SOURCE: Badan Pusat Statistik, various years.

FIGURE A2

Economic Growth and Saving Rate (1980 – 2000)



NOTES

Financial support for this research was provided by the East Asian Development Network Individual Research Award 2001–2002, and is gratefully acknowledged. An earlier version of this article was presented at the East Asian Development Network (EADN) Annual Forum 2003, October 2003, in Singapore. The authors would like to thank Professor Wisarn Pupphavesa of the National Institute for Development Administration in Thailand, and Professor Prema-chandra Athukorala of the Australian National University, who kindly provided constructive comments on the paper presented at the EADN forum.

1. See Hamilton and Lutz (1996).
2. In our previous estimation of genuine saving (see Alisjahbana and Yusuf 2000*c*), only current government spending on education was reclassified. The data is also not clear on whether capital expenditure is also included. Simply reclassifying total government spending as investment will "double-count" investment, because government capital expenditure has been classified as investment in the first place. In this study, we searched original data from the Ministry of Finance to obtain disaggregated current government spending over time, which has enabled us to add current expenditure on health and R&D with greater certainty.
3. We collected this data from annual publications of the Ministry of Finance, such as the Financial Notes and Draft State Budget (Nota Keuangan dan Rancangan Anggaran Pendapatan Belanja Negara) from 1980 to 2000. Since data for the budget year 1989/1990 was not available, we used the estimated trend value for this year.
4. Our previous studies (Alisjahbana and Yusuf 2000*c*) only included oil, gas, coal, bauxite and tin.
5. Ideally, we should use marginal cost, instead of unit cost. However, data on marginal cost of extraction is very hard to find. The use of average cost or unit cost tends to over-estimate the resource rent if the exhaustion time is long (e.g. see Vincent and Castaneda 1997).
6. Since the extraction cost of iron sands and copper are not covered in BPS publication, we followed Hamilton (1999) by assigning a proportion of unit rent from our own calculated price, i.e. 0.58 for iron sands, and 0.49 for copper.
7. *Integrated Environmental and Economic Accounting, 1990–1993*; *1994–1996*; *1996–2000*.
8. We estimated the trend equation: Stock = a + bYEAR, with R-squared of 0.97.
9. The FAOSTAT database can be accessed from <http://apps.fao.org>.
10. IPPS documentation can be downloaded from <http://www.worldbank.org/nipr/work_paper/>.
11. If change in wealth per capita has to be comparable with genuine savings, then we have to compare it to the adjusted genuine savings rate, which has always been positive over time.

REFERENCES

Alisjahbana, Armida S. and Arief Anshory Yusuf. "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, 2000*a*.

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

———. "Indonesia's Genuine Savings Rates and Sustainable Development". Seventh Convention of The East Asian Economic Association, Singapore, 17–18 November 2000*c*.

Asian Development Bank. "Asian Economic Monitor 2002". <http://aric.adb.org>. 2002.

Baharumshah, Ahmad Zubaidi, Marwan A. Thanoon, and Salim Rashid. "Saving Dynamics in the Asian Countries". *Journal of Asian Economics* 204 (2002): 1–19.

Baharumshah, Ahmad Zubaidi and Marwan A. Thanoon. "Foreign Capitals, Savings and Economic Growth: A Dynamic Panel Study on the East Asian Countries". Mimeographed, Department of Economics, Universiti Putra Malaysia, n.d.

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

Dasgupta, Partha, and K-G Maler. "Net National Product, Wealth and Social Well-Being". *Environment and Development Economics* 5, no. 1 and 2 (2000): 69–93.

Dauvergne, Peter. *The Environment in Times of Crisis: Asia and Donors after the 1997 Financial Crisis*. Canberra: Australian Agency for International Development of the Department of Foreign Affairs and Trade (AusAID), 1999.

Everett, Glyn, and A. Wilks. "The World Bank's Genuine Savings Indicator: A Useful Measure of Sustainability?". Bretton Woods Project, 1999.

Freeman, A.M. *The Measurement of Environmental and Resource Values: Theory and Methods*. Washington, D.C.: Resources for the Future, 1994.

Gulati, Anuradha Dayal and Christian Thimann. "Saving in Southeast Asia and Latin America Compared: Searching for Policy Lessons". IMF Working Paper WP/97/110. Washington, D.C.: International Monetary Fund, 1997.

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

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

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

——— and Ernst Lutz. "Green National Accounts: Policy Uses and Empirical Experience". Environment Department Paper No. 39. Washington, D.C.: World Bank, 1996.

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

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

——— and Michael Clemens. "Genuine Savings Rates in Developing Countries". *World Bank Economic Review* 13 (1999): 333–56.

——— and John A. Dixon. "Measuring the Wealth of Nations. Frameworks to Measure Sustainable Development". In *OECD Proceedings: Frameworks to Measure Sustainable Development*, pp 39–50. An OECD Expert Workshop, Paris, 2–3 September 1999. Paris: OECD, 2000.

Kunte, Arundhati, Kirk Hamilton, John Dixon, and Michael Clemens. "Estimating National Wealth: Methodology and Results, Indicators and Environmental Valuation". Mimeographed, The World Bank, January 1998.

Masson, Paul R., Tamim Bayoumi, and Hossein Samiei. "International Evidence on the Determinants of Private Saving". *The World Bank Economic Review* 12, no. 3 (1998): 483–501.

Mitlin, D. "Sustainable Development: A Guide to the Literature". *Environment and Urbanization* 4, no. 1 (1992): 111–24.

Obst, Carl. "The Measurement of Sustainable Development". In *OECD Proceedings: Frameworks to Measure Sustainable Development*, pp. 7–19. An OECD Expert Workshop, Paris, 2–3 September 1999. Paris: OECD, 2000.

Pearce, David W., 2000, "The Policy Relevance and Uses of Aggregate Indicators: Genuine Savings". In *OECD Proceedings: Frameworks to Measure Sustainable Development*, pp. 79–82. An OECD Expert Workshop, Paris, 2–3 September 1999. Paris: OECD, 2000.

—— and Giles D. Atkinson. "Capital Theory and the Measurement of Sustainable Development". *Ecological Economics* 8 (1993): 103–108.

Pearce D., E. Barbier and A. Markandya. *Sustainable Development: Economics and Environment in the Third World.* Edward Elgar Publishing/Earthscan Publications, 1990.

Pezzey J. "Economic Analysis of Sustainable Growth and Sustainable Development". Environment Department Working Paper No. 15. Washington, D.C.: World Bank, 1989.

Rees, W. E. "Defining 'Sustainable Development'". CHS Research Bulletin. Vancouver: Center for Human Settlements, University of British Columbia, 1989.

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

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

Vincent, J and B. Castaneda. "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, 1997.

World Bank. *Indonesia, Environment and Development: Challenges for the Future.* Report no. 12083-IND. Washington, D.C.: World Bank, 1994.

——. *World Development Indicators.* 2001.

World Commission on Environment and Development (WCED). *Our Common Future.* Oxford: Oxford University Press, 1987.

Armida Salsiah Alisjahbana is a senior lecturer and researcher in the Department of Economics and Development Studies, Padjadjaran University, Bandung, Indonesia. She currently holds the position of Head at the Center for Economics and Development Studies.

Arief Anshory Yusuf is a lecturer and researcher in the Department of Economics and Development Studies, Padjadjaran University, Bandung, Indonesia.