©The Pakistan Development Review
46 : 4 Part II (Winter 2007) pp. 579–596

Sustainable Income, Employment, and Income Distribution in Indonesia

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I. INTRODUCTION

Production and consumption activities in any economy have a direct impact on the environment. Although increased economic activity and population growth in developing countries continue to exert enormous pressure on their natural environments, the role of the environment is neglected in the estimation of national income. Such neglect at the macroeconomic level is at least in part, an important cause of environmental degradation in developing countries.

Since the United Nations Conference on Environment and Development in 1992 at Rio and even as early as middle of the 1980s, a substantial literature had developed on methods to integrate the environment into the economic development process. The main assertion in this literature is that natural resources represent a form of capital that is analogous to the stock of manufactured capital. Sustainable income can be determined by allocating a portion of income to allow for the deprecation of natural capital [Ahmed, El Serafy, and Lutz (1989) and Solow (1992)].

Indonesia had average real GDP growth rates of more than five percent per year up to the early 1990s [World Bank (1994)]. But income inequality (measured by the Gini coefficient) has been high. Although inequality continues to be quite high, especially between rural and urban populations, Indonesia has been successful in poverty alleviation up to mid 1990s. In 1976 almost 40 percent of its population was below the poverty line, which in 1993 decreased to less than 14 percent [Todaro (1994)]. Income distributional consequences of economic growth would continue to be one of the main policy issues in Indonesia. This is due to its large population size, presence of different ethnic and religious groups, large diversity between rural and urban groups, variety of natural resources scattered over the country, huge distances and the effects of a far-flung archipelago [Akita, Lukman, and Yamada (1999)].

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Author's Note: This paper is part of my doctoral research. Facilities and support provided by the Graduate School of Environment, Macquarie University, is deeply appreciated, with the usual disclaimers. Support provided by Dr Sinden of the University of New England, Armidale, NSW, Dr Thampapillai of GSE Macquarie University, Mr Oudomlith of Macquarie University library, and Dr Ahmed of the Department of the Environment and Heritage, NSW Government, Australia, is also acknowledged with gratitude.

Before the financial crisis of 1997, Indonesia had been successful in achieving persistent high economic growth over a long period of time. But this economic growth may have been at the cost of environmental degradation. Like any other rapidly growing economy, Indonesia's environment has been under pressure mainly due to massive deforestation, intensive agriculture and intensive use of energy [Repetto (1988)]. Rapid industrialisation, urbanisation, lack of attention to environmental conservation and rising population has triggered many environmental problems. Repetto, *et al.* (1989) used deforestation, mineral oil depletion and soil erosion to value the natural resources for Indonesia. They estimated sustainable GDP by deducting the depreciation of forest, mineral oil and soil from the GDP. During the fourteen years between 1971 and 1984, the GDP growth was on average at 7 percent, whereas the Repetto's sustainable GDP showed an average growth rate of 4 percent. The 3 percent gap in these growth rates was the environmental cost of economic development [Ahmed (2000)].

In their study Repetto, *et al.* (1989) also assert that the growth rates of the agricultural sector of Indonesia represent a significant overstatement. Intensive agriculture is practiced on fertile islands of Java, Bali and Madura where almost three fourths of the Indonesian population lives. Here farmers grow maize, cassava and other crops on hillsides [Hardjono (1991)]. This leads to soil erosion at an estimated average of 60 tons per hectare per year [Repetto (1990)]. The consequences of soil erosion are loss of soil fertility, lost nutrients, and increased downstream sedimentation. By ignoring these environmental costs, growth in agriculture is overstated in the national income accounts of Indonesia.

The study implies that if national income accounting system of the economy is deficient in highlighting the gap in estimated income and sustainable income then there is ample room for improvement in this system. Indonesia along with other developing countries, which are highly dependent on their natural resources, therefore, needs to develop a national accounting system where the concept of natural resource asset depletion is incorporated into their national income accounts [Repetto (1990)].

In this study we estimate sustainable income for Indonesia and explore the linkages between environmental depreciation, income distribution and employment. The paper is structured as follows: Section II discusses depreciation allowances for natural environment. Section III describes the model used to apply the depreciation allowances and estimate the sustainable income. Section IV discuses the results with particular reference to the relationship between the income distribution and the labour market, and finally, Section V concludes this discussion.

II. DEPRECIATION ALLOWANCE FOR NATURAL ENVIRONMENT

Thampapillai and Uhlin (1996, 1997) use total expenditure on energy consumption in an economy as a proxy for the environmental depreciation allowance. They justify this proxy on the premise that energy is a basic input in all production processes. At the same time, production and consumption of energy particularly from fossil fuels, results in pollution that could be related to depletion of the ozone layer, global warming and changes in weather patterns. Further, carbon is the main pollutant produced by the burning of fossil fuel. In 1992, out of the 50 countries worldwide with highest industrial emissions of carbon dioxide, Indonesia was ranked at twenty third [World Resources Institute (1996-97)]. So far, there are many attempts [Pearce (1993); Repetto, Cruz, and Solorzano (1991); Tongeren, *et al.* (1991)], but no universally acceptable method, to value depreciation of natural resources at the macro level and so a proxy must be used.

To estimate the value of the environmental capital depreciation (C_{EM}) a proxy measure more suited to environmental conditions of Indonesia is used here. In addition to the value of total energy consumption, we include estimates of the economic value of losses of agricultural soil productivity and of forest cover [Ahmed and Mallick (1997)]. The choice of these three items, namely energy consumption, loss of soil productivity and depletion of forests rests on the assumption that the stock of environmental capital is confined to air-sheds, soils and forests. This is because air quality, soil erosion and deforestation have been cited as dominant environmental concerns in Indonesia.

One should note that the treatment here differs from that of Repetto with reference to energy resources. Repetto, *et al.* (1989) considered Indonesia's stock of energy resources as wealth and hence defined the depletion value of energy resources by recourse to the concept of user costs. In the analysis that is reported here, the cost of domestic energy consumption is taken as a proxy for the depreciation of Indonesia's air-shed and we refrain from dealing with the depletion of energy resources.

A logical measure of the loss in agricultural productivity is, of course, the value of lost agricultural output. Fertiliser is, conventionally, applied to restore the loss in land productivity. The cost of total fertiliser consumption in the economy is therefore used here to represent loss of agricultural productivity.

Agricultural resource degradation is one of the major concerns when analysing natural resource depletion. Considering its size compared to the other two proxies, fertiliser is a very small component of the C_{EM} as it is difficult to empirically prove assumptions of agricultural resource degradation. One of the reasons for this is rapid technical change and input substitutions. Fertiliser is a single input, there are quite a few inputs used for agricultural products. Adding costs of other inputs may fine tune agricultural land degradation poxy and might make it more accurate.

This is mainly to illustrate that under normal circumstances with gradually depleting soil productivity, fertiliser is a reasonable measure of depleting soil productivity. In some cases land productivity might be totally degraded, but fertiliser as a proxy might not be able to represent that. Example is water logged land. Use of fertiliser as proxy in that region will not represent the true financial cost of degradation or the cost of rectifying such a problem.

Under alternative farming methods some farmers use no manufactured or synthetic fertilisers. Although they have various recycle/compost based inputs to enhance soil productivity, using synthetic fertiliser as a proxy for such a region will also not represent the actual depletion of soil productivity. These alternative farming systems represent low artificial input systems where farm soil productivity might not be depleting and in some cases might actually be improving. In national income accounts both type of farm systems would be treated equally i.e. on the basis of their output [Lawn and Sanders (1997)].

The major impacts of deforestation include the loss of native flora and fauna, and the loss of habitat of native animals. These are indeed difficult to value. But there is a direct relationship between loss of forest cover and loss of biodiversity. To put an economic value on the change in forest cover, a proportion of the annual forest output is used as a proxy. This proportion is assumed to be average value of annual net deforestation.

Thus C_{EM} is defined here as:

$$C_{EM} = C_{EM1} + C_{EM2} + C_{EM3} \quad \ldots \quad (1)$$

where C_{EM1} = Energy Consumption, C_{EM2} = Loss of Agricultural Productivity, C_{EM3} = Loss of Forest Cover.

III. A SIMPLE FRAMEWORK FOR THE DETERMINATION OF SUSTAINABLE INCOME

In the traditional system of national accounts, the distinction between Gross National Product (GNP) and Net National Product (NNP) is due to the deduction of a depreciation allowance for manufactured capital. Similarly, from the viewpoint of environmentally sustainable income, there is a similar need to subtract from NNP a deprecation allowance for natural capital [Lutz and Serafy (1989)]. The term C_{EM} represents this depreciation allowance. That is,

$$Y_S = NNP - C_{EM} \quad \ldots \quad (2)$$

where Y_S is sustainable income and C_{EM} is the allowance for depreciation of environmental capital. Provided C_{EM} is accurately estimated, Y_S will be a true measure of sustainable income. Because the estimates of NNP are not readily available for Indonesia, $(GDP - C_{EM})$ is used here as a measure of Y_S. Thampapillai and Uhlin (1996, 1997) argue that C_{EM} as a function of national income has an exponential form:

$$C_{EM} = e^{\gamma(\phi+\beta Y)} \quad \ldots \quad (3)$$

where γ is a measure of the proportion of environmental capital depreciation in national income ϕ is all components of GDP excluding consumption but including the autonomous component of consumption, β is marginal propensity to consume, and Y is the income measure of national output. In such a context, the variable component consumption (C) that is responsive to changes in income is simply defined as βY.

In a simple formulation where GDP is defined as $(\phi+\beta Y)$, the standard Keynesian equilibrium that neglects sustainability is defined as:

$$Y^* = \phi/(1-\beta) \quad \ldots \quad (4)$$

Given the exponential formulation for CEM, the value of sustainable equilibrium (Y^*_S) needs to be computationally determined by eliciting the value of Y that renders the LHS = RHS for the following expression:

$$Y_S = \phi + \beta Y - e^{\gamma(\phi+\beta Y)} \qquad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (5)$$

The values of sustainable and full employment equilibrium incomes are shown in Table 1 along with the values of C_{EM} and its components for the period 1980–2005.

Table 1

The GDP and Sustainable Income for Indonesia

Years	GDP	C_{EM1} Energy	C_{EM2} Fertiliser	C_{EM3} Forest	C_{EM} Total	Sustainable Income
1980	79	5.9	0.2	3.6	9.6	69
1981	85	6.2	0.2	3.5	9.9	75
1982	88	6.7	0.2	3.5	10.4	77
1983	96	7.1	0.2	3.7	11.0	85
1984	105	7.0	0.3	3.8	11.1	94
1985	112	7.4	0.3	3.8	11.4	100
1986	119	7.7	0.3	3.9	11.9	107
1987	125	7.6	0.3	4.1	12.0	113
1988	132	7.8	0.3	4.2	12.4	120
1989	144	9.2	0.3	4.3	13.8	131
1990	157	9.4	0.3	4.3	14.0	143
1991	171	10.6	0.3	4.4	15.4	156
1992	184	13.4	0.4	4.4	18.2	165
1993	197	14.7	0.4	4.5	19.6	177
1994	210	14.7	0.4	4.5	19.6	190
1995	225	14.7	0.4	4.6	19.7	206
1996	240	14.7	0.4	4.6	19.7	220
1997	251	14.8	0.4	4.7	19.8	232
1998	219	12.8	0.3	4.1	17.2	202
1999	219	12.8	0.3	4.1	17.2	202
2000	223	13.1	0.3	4.1	17.5	206
2001	228	13.3	0.3	4.1	17.8	210
2002	234	13.6	0.4	4.2	18.1	216
2003	241	13.9	0.4	4.2	18.4	223
2004	251	14.1	0.4	4.2	18.7	232
2005	261	14.4	0.4	4.3	19.0	242
Average		**11.1**	**0.3**	**4.1**	**15.5**	

Source: Economic and Social Commission for Asia and Pacific (ESCAP), *Statistical Yearbook for Asia and Pacific* (1989 and 1994) *United Nations, Statistical Yearbook for Asia and the Pacific*, New York, USA, (1997) *United Nations Energy Statistics-Yearbook* (Various Issues) The World Bank, World Development Indicators (1998) *Central Bureau of Statistics*, Indonesia, Gross Domestic Products

Statistics, Selected Tables (1998) Dow Jones, *Economic Indicators, Far Eastern Economic Review* 162:51 (1999).
Constant 1987 Price—Trillion Rupiah.

Economists have traditionally employed the Cobb-Douglas (C-D) function to explain aggregate production in terms of capital and labour. A C-D function that displays constant returns to scale has been justified by several authors, for example Dornbusch, *et al.* (1995) and Branson and Litvack (1981). That is,

$$Y = \alpha K^{1-\lambda} L^{\lambda} \quad \ldots \quad (6)$$

where Y is GDP, α is a country specific constant, L is work force and K is capital stock. Following standard production theory, λ is the elasticity of substitution of labour for capital, and $1-\lambda$ is elasticity of substitution of capital for labour.

To apply the C-D function, data from national income accounts were used to estimate λ. Given the properties of the C-D function, λ is also the share of national income accruing to labour and $(1-\lambda)$ is the share of national income accruing to capital [Dornbusch and Fischer (1994)]. Hence λ is estimated for each year as follows:

$$\lambda = [\text{Sum of all wages in national income}] / [\text{national income (GDP)}] \quad \ldots \quad (7)$$

The full employment level of income in the economy (Y_F) was estimated by substituting the size of the total labour force in the economy into Equation (6), as follows:

$$Y_F = \alpha K^{1-\lambda} L_F^{\lambda} \quad \ldots \quad (8)$$

The amount of labour force that would be employed at the sustainable income level (L_S) was also estimated by substituting the value of sustainable equilibrium income that is determined from Equation (5) into Equation (6) as:

$$L_S = [Y^*_S/\alpha K^{(1-\lambda)}]^{1/\lambda} \quad \ldots \quad (9)$$

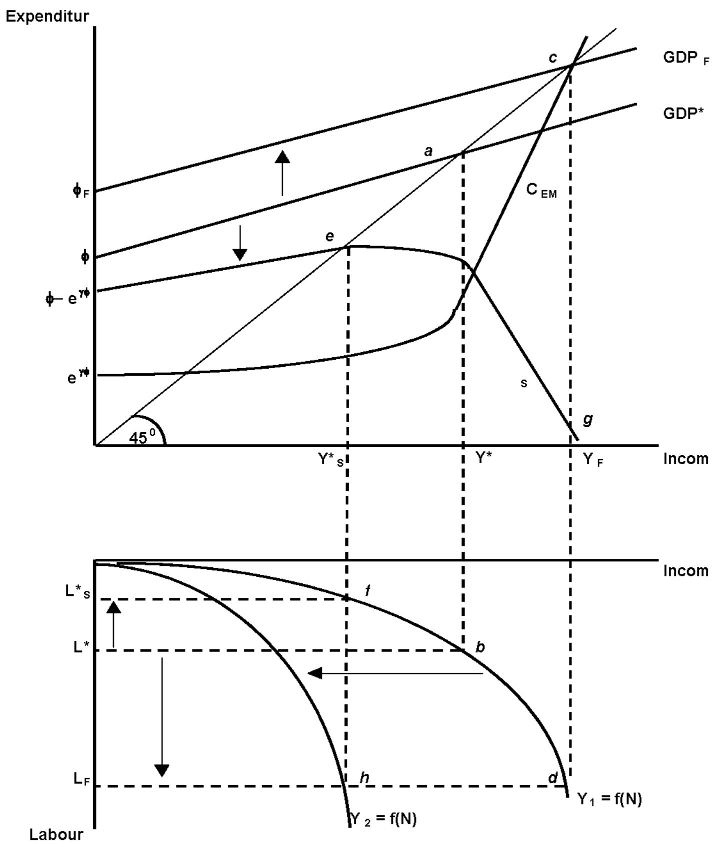
Table 2 illustrates Y^*, Y^*_S and Y_F for each year, estimated by applying Equations (4), (5) and (8). Coefficients like ϕ, β and γ were directly estimated from the national accounts. For example, the description given above, [$\phi = I+G-X-M$], [$\beta = C/Y$] and [$\gamma = (lnC_{EM})/Y$], where, I, G, X and M are respectively investment, government expenditure, exports and imports. Table 2 also illustrates the levels of employment that corresponds with the three income levels Y^*, Y^*_S and Y_F, namely L^*, L_F and L^*_S for each year.

Mallick, Sinden, and Thampapillai (2000) present a hypothetical relationship between sustainable income and employment as shown in Figure 1. If L_F were to represent the level of full employment, then the economy should generate an income level of Y_F. In this hypothetical context, the conflict between the goals of sustainability and employment becomes evident. That is, if a sustainable income policy were to be pursued, the economy has to contend with an unemployment level of (L_F-L^*_S).

Alternatively, if the sustainability goal is ignored and full employment is pursued, the economy would aspire to raising income up to Y_F at a higher environmental cost. The C_{EM} line in the top panel of Figure 1 represents this cost.

Table 2

Fig. 1. Gross Domestic Product and Production Function



Source: Mallick, Sinden, and Thampapillai (2000).

In Mallick, Sinden, and Thampapillai (2000), the methodology was applied to the Australian economy. The major outcome was that to achieve both sustainability and full employment, overall consumption needed to be reduced. The remaining net balance going towards investment in natural resource management. As Indonesia is still classified by World Bank as a lower middle income country with a relatively large low-income population, this approach requires some adaptation. This is because as illustrated below, the level of wages that result from reconciling employment and sustainability could be far too low for a substantive section of the population.

If we assume self-reliance (as oppose to international loans and grants) then the amount set aside for C_{EM} will need to be taken from the income within this economy and it will be spent on restoring and maintaining natural resources. Similarly, funds needed for creating additional employment to absorb the total labour force need to be generated internally also. Hence, both sustainability and full employment need to be achieved through domestic resources.

Within the confines of this simple conceptual framework, three policy options can be considered for reconciling sustainability and employment goals in Indonesia. These are:

- Capture the allocation of funds for C_{EM} from high income earners of the population
- Distribute the burden of funding C_{EM} among all income groups according to the Lorenz curve for the economy
- Population belonging to the lowest ten percent of the income distribution is exempted from covering financial expenses for C_{EM}.

To involve top income group in natural resource management, the government has two options, one is to tax these income groups to increase government revenue and then increase government spending to achieve both sustainability and full employment. And the other option is to create such investment incentives so that the top income groups of the population invest in both sustainability and full employment within the country.

The Lorenz curve and the Gini Coefficient are indicators of the spread of income distribution in a country. For Indonesia in 1996, the Gini Coefficient was 0.34. With top 40 percent of the population investing in natural resources the Gini Coefficient changes to 0.31. If top 30 percent of the population provides for the C_{EM} amount then the Gini Coefficient changes to 0.30. Provided that the population in the top 20 percent of the income bracket is willing to invest in natural resource management, the Gini Coefficient does reduce to 0.29. The focus is on top 20 percent of the income groups as the change in Gini Coefficient is most significant compared with the spread of C_{EM} to a larger population. They would need to invest the amount of C_{EM} in the short run but in the long run the financial returns to investment in environment would take place thereby compensating them for any short run contraction of financial liquidity. Investing in environmental technology could shift the C_{EM} function to the left, and hence reduce the distance between Y_F and Y^*_S and thereby reduce the conflict. Examples of these investments include cost effective methods of waste treatment, recycling, non-pollutive methods of energy production such as solar panels, bio-fuels, land and off-shore wind panels.

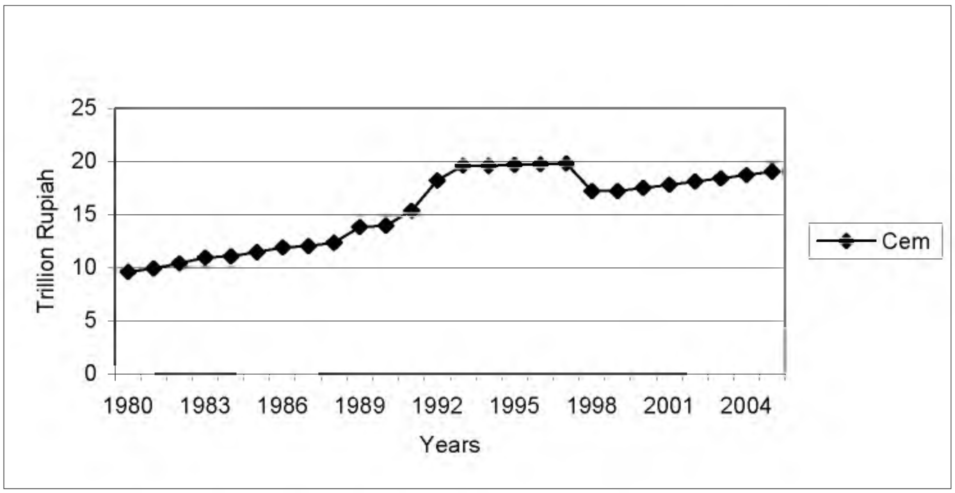
Alternative to focusing only on the top 20 percent of the income groups, another policy option is that the burden of funding C_{EM} could be distributed among all income groups according to the Lorenz curve for the economy. Under this methodology, no single income group is targeted for additional burden to support C_{EM}. As the burden is proportional therefore, income distribution is unchanged in the short run.

Another policy option is that the population belonging to the lowest ten percent of the income distribution is exempted from covering financial expenses for C_{EM}. This is a more realistic extension to the above policy option as on average about ten percent of the population lives in chronic poverty of below US$1 a day [World Bank (2001)]. The goal in the economy is to use natural resources in a sustainable way and to provide employment to total labour force in the economy. The bottom ten percent of the income group owns not more than four percent of the total resources in the economy. This means that the population owning ninety six percent of the resources in the economy would be funding C_{EM}.

IV. RESULTS AND DISCUSSION

The environmental capital depreciation allowance C_{EM} for Indonesia is shown in Figure 2. Actual and sustainable income for Indonesia and all components of the C_{EM} are presented in Table 1. All values are in constant 1987 prices and in trillion Rupiah. In 1980 the C_{EM} was about 12 percent of the actual GDP, it declined to 10 percent in 1985, by 1990 it had further declined to 9 percent of the GDP and by 1995 to just below 9 percent. This decline is due to the difference in the growth rates. The growth rate of GDP is higher than the growth rate of the components of the C_{EM}; hence reducing the size of C_{EM} compared to the GDP. With regards to the future growth rate of Indonesia, an assumption is made that by year 2005 Indonesia would achieve the growth rate of about 4 percent per year.

Fig. 2. C_{EM} for Indonesia



From Table 2, it is evident that there is a widening gap between the income that is required to guarantee full employment (Y_F) and actual income (Y^*) in Indonesia. The comparison between these two types of income shows that the gap ($Y_F - Y^*$) has grown from one trillion in 1980 to seven trillion in 1996 and is forecasted to be twenty eight trillion in year 2005. Of particular importance are the income gaps between actual income and sustainable income ($Y^* - Y^*_S$) and between full employment income and sustainable income ($Y_F - Y^*_S$). The trends of both of these income gaps display a divergent trend. Associated with this widening income gap is a growth in the rate of unemployment during this time period. The increase in unemployment can be clearly seen in Table 2. This increase was from 1 million people being unemployed in 1980 to 3 million people being unemployed in 1996 and the forecast is that about 15 million people could be unemployed in year 2005.

If we consider the relationship between labour forces rather the income, we observe the following two types of unemployment:

$(L_F - L^*_S)$ = Unemployment when the economy is at a sustainable equilibrium. Here the labour force that would be employed at the sustainable income level is deducted from the total existing labour force in the economy.

$(L_F - L^*)$ = Unemployment when the economy is at an equilibrium which does not account for the environment. This is the actual unemployment in the economy. Here the number of people employed is deducted from the total existing labour force in the economy.

It is clear from Table 2 that $(L_F - L^*_S) > (L_F - L^*)$. This means that the difference between total labour force in the economy and labour at sustainable income levels is greater than the difference between total labour force in the economy and the employment level. Furthermore $(L^* - L^*_S)$ is the extra unemployment generated due to the sustainable equilibrium. This is the difference between the labour employed and the labour employed at sustainable levels.

In Table 2, $(L^* - L^*_S)$ in column 8 and $(L_F - L^*_S)$ in column 10 both increase over time. The fact that the paths of $(L^* - L^*_S)$ and $(L_F - L^*_S)$ do not converge indicates that current policies are unsustainable. Therefore, it is beneficial to explore policies that would reconcile the conflicts between full employment and sustainability.

Mallick, Sinden, and Thampapillai (2000) applied the present methodology to the Australian economy to achieve both full employment and sustainability. In the present study, we focus on different income groups particularly the top 20 percent of the population to fund the process of adjustment through which both full employment and sustainability can be achieved. For more than a decade from early 1980s to early 1990s, the top 20 percent of the population in Indonesia owned 42 percent of the resources, but by middle of 1990s their ownership increased to 45 percent of the resources.

The three main aims here are:

- To measure the level of unemployment if environmental sustainability was the goal,
- To estimate the cost of achieving both sustainability and full employment, and
- To determine which section of the economy would bear that cost?

To achieve sustainability in 1996 for example, 20 Trillion Rupiah needs to be set aside. To achieve full employment, another 7 Trillion Rupiah needs to be set aside (Table 2). Therefore, to achieve both full employment and sustainability, a total of 27 Trillion Rupiah has to be set aside. The total is forecasted to increase to 47 Trillion in year 2005.

The methodology using income distribution is applied to determine who would be in a better position to absorb the burden of additional amount needed to achieve both full employment and sustainability in Indonesia's economy. The government has two options here; one is to tax the population in top income bracket to increase its own income base and then increase spending in the concerned sector, or to create such investment incentives that the private sector invests in both sustainability and full employment. Table 3 presents the structure through which the top 20 percent of the population could contribute towards restoring the natural environment along with creating additional employment in the economy.

Table 3

Income Share of Highest 20 Percent before and after Applying Full Employment and Sustainability Policy in Indonesia

Year	GDP Trillion Rupiah	Before* Own % of GDP	Before* Own GDP Trillion Rupiah	After* Give up Trillion Rupiah	After* Give up % of GDP	After* Own GDP Trillion Rupiah	After* Own % of GDP
1980	79	42	34	11	14	23	29
1981	85	42	36	12	14	24	28
1982	88	42	37	13	14	25	28
1983	96	42	41	13	14	27	29
1984	105	42	44	13	13	31	30
1985	112	42	47	14	12	34	30
1986	119	42	50	15	12	36	30
1987	125	42	53	15	12	38	30
1988	132	42	56	16	12	40	31
1989	144	42	61	17	12	44	30
1990	157	42	67	18	11	49	31
1991	171	42	73	19	11	53	31
1992	184	42	78	23	12	55	30
1993	197	43	86	25	12	61	31
1994	210	43	91	28	13	63	30
1995	225	43	98	28	12	70	31
1996	240	45	109	28	12	81	34
1997	251	45	114	35	14	79	31
1998	219	45	99	36	17	63	29
1999	219	45	99	42	19	58	26
2000	223	45	101	43	19	59	26
2001	228	44	101	44	19	57	25
2002	234	44	104	46	19	59	25
2003	241	44	107	47	20	60	25
2004	251	44	112	49	20	62	25
2005	261	44	116	51	20	65	25
		44			**15**		**29**

Source: Economic and Social Commission for Asia and Pacific (ESCAP), *Statistical Yearbook for Asia and Pacific*, (1989 and 1994). *United Nations, Statistical Yearbook for Asia and the Pacific*, New York, USA, (1997). *United Nations Energy Statistics-yearbook,* (various issues). The World Bank, *World Development Indicators* (1998). Central Bureau of Statistics, Indonesia, *Gross Domestic Products Statistics*, Selected Tables (1998) Dow Jones, *Economic Indicators, Far Eastern Economic Review* 162:51 (1999).

* Before and after applying full employment and sustainability policy.

The gini coefficient is an indicator of spread of income distribution in a country. For Indonesia in 1996 gini coefficient was 0.34. This could improve to 0.29 provided the total amount of C_{EM} for that year came from the top 20 percent income group. Table 4, shows that gini coefficient changes to different levels as top income groups invest in natural resource management by fully funding the C_{EM} expenditure for that year. This investment in natural resources could generate environmentally efficient production technologies and increase environment related employment in the economy. The investment then reduces unemployment and opens a whole new sector for innovative research and related training and education.

Table 4

Investment in Natural Resources by Top 20, 30, and 40 Percent of the Population and Resulting Redistribution of Income and Revised Gini Coefficient for 1996

	Gini Coefficient	**Lowest 20 %**	**Second 20 %**	**Third 20 %**	**Fourth 20 %**	**Highest 20 %**
Actual	0.34	8	11	15	21	45
20%	**Gini Coefficient**	**Lowest 20%**	**Second 20%**	**Third 20%**	**Fourth 20%**	**Highest 20%**
Estimated	0.29	9	12	16	23	40
30%	**Gini Coefficient**	**Lowest 20%**	**Second 20%**	**Third 20%**	**Fourth 20%**	**Highest 20%**
Estimated	0.30	9	12	16	21	42
40%	**Gini Coefficient**	**Lowest 20%**	**Second 20%**	**Third 20%**	**Fourth 20%**	**Highest 20%**
Estimated	0.31	9	12	16	18	44

Second and third policy options are regarding distribution of the burden of funding C_{EM} by all income groups according to their income distribution. The first policy option, where C_{EM} is funded by the top twenty percent of the population would result in a shift in income distribution in favour of the lower income groups. The second policy option is that all income groups fund C_{EM} according to their own percentage ownership of the resources. In this way the overall income distribution in the economy would remain the same. The third policy option is to exempt the bottom ten percent from contributing towards C_{EM}. Table 5, presents data for three years 1980, 1990 and 2000. As bottom ten percent population owns not more than four percent of resources therefore the burden distributed to the remaining ninety five percent of the population is minimal. In this way, the overall income distribution improves only slightly in favour of the lowest income group.

Table 5

Income and CEM Share of all Income Groups in Indonesia
The CEM after the Bottom Ten Percent of the Income Groups Are Exempted

	1980			1990			2000		
Population Group %	% Income	Actual CEM	10% Exmpt	% Income	Actual CEM	10% Exmpt	% Income	Actual CEM	10% Exmpt
5	1	0.10	0.00	2	0.15	0.00	2	0.13	0.00
10	4	0.27	0.00	4	0.45	0.00	4	0.54	0.00
15	7	0.26	0.28	7	0.41	0.45	6	0.48	0.51
20	9	0.25	0.27	9	0.39	0.42	8	0.43	0.47
25	12	0.25	0.27	12	0.38	0.41	11	0.39	0.43
30	14	0.25	0.27	15	0.38	0.41	14	0.37	0.41
35	17	0.27	0.29	18	0.38	0.42	16	0.36	0.40
40	20	0.29	0.31	21	0.40	0.44	19	0.37	0.41
45	23	0.32	0.34	25	0.43	0.46	23	0.39	0.42
50	27	0.35	0.37	29	0.47	0.50	27	0.42	0.45
55	31	0.39	0.41	33	0.52	0.55	31	0.46	0.50
60	36	0.44	0.46	38	0.58	0.62	34	0.52	0.55
65	41	0.50	0.52	43	0.65	0.69	40	0.59	0.62
70	47	0.56	0.58	48	0.74	0.77	45	0.67	0.71
75	53	0.63	0.65	53	0.83	0.86	50	0.77	0.80
80	61	0.71	0.73	58	0.93	0.96	55	0.88	0.91
85	69	0.80	0.82	69	1.04	1.08	66	1.00	1.04
90	78	0.89	0.91	79	1.17	1.20	78	1.13	1.17

95	89	0.99	1.01	90	1.30	1.34	89	1.28	1.32
100	100	1.10	1.12	100	1.45	1.48	100	1.45	1.48

CEM in Trillions (1987 Rupiah).

V. CONCLUSION

In recent years, Indonesia has been experiencing environmental problems which had detrimental consequences for the whole region. Indonesia has also been experiencing economic growth rates unparalleled in any other part of the world, but at the expense of its environment. There are direct financial and health repercussions for Indonesia, Singapore and Malaysia, but it is the people of Indonesia who are actually living in this environment [Cohen (1997)]. It is therefore, of utmost importance that environment and its problems are focused firstly within Indonesia and secondly also at regional levels. There is a need to put a financial value on these problems, and there is a need to divert financial resources to look for solutions. In this paper an attempt is made to come up with a methodology to estimate these values.

In this paper, sustainable income has been estimated as gross domestic product minus an allowance for environmental depreciation. This allowance has been estimated in terms of environmental depreciation and proxy data have been used to value this depreciation. If biodiversity and other services of the forest are to be protected, forest production needs to be managed. Therefore, annual forest harvesting is a useful measure for this aspect of sustainability. Similarly, addition of fertiliser can maintain agricultural output, so the cost of fertiliser application is a useful measure of the replaced production efficiency. If consumption of energy has environmental repercussions, then total expenditure on energy consumption is a useful measure of the required depreciation allowance. Further, it is a useful measure of atmospheric pollution and global warming problems.

The study shows that even with increase in fertiliser consumption, agricultural production has not increased at the same rate. In chapter 7, fertiliser, the proxy for agricultural degradation is 10 percent of total C_{EM}, in the present chapter it is less than 5 percent. Although the other two components of C_{EM}–forest output and energy consumption are much larger, fertiliser as agricultural proxy gives use some insight into the direction of agricultural productivity and land degradation.

Forest output has been decreasing in the 1990s but what had happened in 1980s and earlier has its repercussions in the form of huge forest fires in El Nino years [McBeth (1997) and Poffenberger (1997)]. Energy consumption surged in early 1990s. This was the time when most of the industrialised countries were looking at ways to contract energy consumption in wake of receding global resources. Economist like Krugman (1997), Radelet and Sachs (1997) predicted that Asia, and particularly countries like Indonesia, would come out of the recession of 1997-98 and resume economic growth on an unprecedented pace. What is important now is that this growth is not only economically sustainable but also is equitable and ecologically sustainable. A link therefore has to be established between present world market values and true environmental cost of commodities. Absences of environmental markets has resulted in the environmental degradation that Indonesia is experiencing [Gillis, *et al.* (1992)].

If sustainability needs to be enforced in its true sense, then the Government of Indonesia has to decide between two options. The first is: pay for the gap in income due to the goals of sustainability and full employment and then pass on the burden to the economy. The second is; induce the population to invest in natural resource management, and hence achieve both full employment and sustainability.

We have observed in the income distribution section that to achieve both sustainability and full employment there is a need to divert investment towards employment creation and maintenance and restoration of the natural environment. The policy options include focus on funding C_{EM} through various methods involving different income groups. One of the options is to involve top twenty percent of the population that own about forty five percent of the resources in Indonesia to contribute towards this financial allocation. The other option is to distribute the burden of funding C_{EM} according to appropriate allocation to each income group. In this way no particular income group has extra weight to carry with regards to C_{EM}. Another option is to exempt the population belonging to the lowest ten percent of the income groups to contribute towards C_{EM}. It is on government's discretion to directly involve each income group in contributing towards employment creation and maintenance of the natural environment. Similarly, the government could levy tax on them to increase its own income base, so that it can increase its expenditure on natural resource management and employment creation.

To reduce C_{EM} there is a need to make production technology more resource efficient, so that less environmental resources are used. Efforts will have to be concentrated on improving all levels of production technology. Processes that use natural resources for energy purposes will need special attention. Most of these resources used presently are non-renewable. Major alteration is needed in all production processes so that they rely more on alternative energy resources that are renewable or abundant. At present use of these non-renewable natural energy sources is a major cause of pollution problems. They have serious, long-term effects, which are now becoming evident through global warming and changes in climate patterns.

If the production technology uses natural capital more efficiently, then perhaps it will use human capital more efficiently also. This will mean that a larger portion of the population will be able to contribute significantly towards economic activity. With this happening, the gap between actual employment and full employment could reduce.

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