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INTERNATIONAL CONSULTING DIVISION

CHEMONICS

FINAL REPORT

IMPLICATIONS OF NATURAL RESOURCE AND ENVIRONMENTAL MANAGEMENT FOR INDONESIA'S LONG-TERM DEVELOPMENT PLAN

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Prepared by:

Alan Strout (Team Leader)
Henry Peskin
Gary Costello

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2000 M St., N.W.
Suite 200
Washington, D.C. 20036

Tel: (202) 466-5340 or 293-1176
Fax: (202) 331-8202
ITT Telex: 1440361 CHNC UT

Table of Contents

1. Introductory Comments
Alan Strout 1

2. Environmental Accounting in Indonesia: Towards a Comprehensive System
Henry Peskin 9

3. Notes on the Coordination Function of Environmental and Natural Resource Accounting Systems
Henry Peskin 21

4. Notes on the Meaning of "Sustainability" and Its Implications for Indonesian Development Planning and Policy
Henry Peskin 23

5. Towards a Planning Model for Sustainable Development
Alan Strout 31

6. A Planning Model for Sustainable Development and Implications for Indonesian Planning
Alan Strout 35

7. Elements of a Sustainable Development Strategy for Indonesia
Alan Strout 47

8. Notes on Economic Sustainability (with bibliography)
Gary Costello 51

9. Forecasting Economic Growth and Environmental Change in Indonesia, 1990-2020
Alan Strout 61

10. Growth and Structural Change in Indonesia, 1990-2020: Implications for Employment, Urbanization, and the Environment
Alan Strout 77

1. INTRODUCTORY COMMENTS

Background

In November 1990, Indonesia's National Planning Agency (BAPPENAS) requested the assistance of a small team of short-term advisors under the newly-approved Natural Resource Management project. Chemonics International was selected to supply and support the advisors, but the Gulf War delayed execution of an actual contract until the end of March, 1991.

Three advisors were engaged on the project. They conducted a limited amount of research and writing in the United States, and then worked in Jakarta as follows:

Alan M. Strout, senior resource economist, long-term planner, and team leader: April 24-June 17, 1991
Henry M. Peskin, senior environmental and resource economist: May 2-9, 1991
M. Gary Costello, resource economist and policy analyst: April 27-May 21, 1991

Two Indonesian resource economists had hoped to assist with the team's studies. Because of the uncertainty over whether the contract would move forward and the long delay before this uncertainty could be resolved, both Indonesian economists found they had to accept other assignments. Despite their continued interest in the project, they could not be available when finally needed. By that time, it was too late to recruit suitable replacements.

The team produced a number of papers while in Indonesia, most of which are included in this final report. Not included are a series of working memoranda written by team members. Some follow-up writing, including the present summary report, was completed after team members had left Indonesia. In addition to the main concerns of the team, one member (Costello) worked extensively on a separate but related project: a paper on biodiversity that had been requested by BAPPENAS.

The original terms of reference had envisioned two teams. One would help define the concept of "sustainable economic development" in the Indonesian context and "conduct a limited evaluation of planning approaches used for the current five-year plan." The second team was to "provide a brief overview of the current patterns of natural resource use and environmental management," and identify related policy and program issues of importance to the next 25-year plan.

By the time the Chemonics team arrived in Jakarta, however, the needs of BAPPENAS had changed. Concern had shifted to specifying and implementing a new national system for natural resource and environmental accounting and defining a conceptual model of development sustainability for use by Indonesian planners. Longer-run program and policy issues, supposed to have been the purview of the second team, were by this time of lesser immediate interest.

A principal consequence of this shift was that the Chemonics advisors operated as a single team rather than two, and produced a series of short papers for immediate use on economic accounting and sustainability. There was little need afterwards for the synthesis paper called for in the original terms of reference to review and integrate the efforts of two teams. The team's final report is thus a review and overall summary of work accomplished with specific reference to the several papers already delivered to the Indonesian government.

Although by now of less immediate interest to BAPPENAS, two papers on longer-run planning issues were prepared by Dr. Alan Strout. These two papers reached a number of conclusions about environmental and resource matters. They are included in this final report, and are summarized briefly below.

Principal Reports and Papers Prepared by the Chemonics Team
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Natural Resource and Environmental Accounting in Indonesia

Henry M. Peskin, *Environmental Accounting in Indonesia: Towards a Comprehensive System.*

Henry M. Peskin, *Notes on the Coordination Function of Environmental and Natural Resource Accounting Systems.*

Sustainable Development in Indonesia

Henry M. Peskin, *Notes on the Meaning of "Sustainability" and Its Implications for Indonesian Development Planning and Policy.*

Alan Strout, *Towards a Planning Model for Sustainable Development.*

Alan Strout, *A Planning Model for Sustainable Development and Implications for Indonesian Planning.*

Alan Strout, *Elements of a Sustainable Development Strategy for Indonesia.*

Gary Costello, *Notes on Economic Sustainability*, with bibliography.

Longer-run Environmental and Macroeconomic Planning Issues for Indonesia

Alan M. Strout, *Forecasting Economic Growth and Environmental Change in Indonesia, 1990-2020.*

Alan M. Strout, *Growth and Structural Change in Indonesia, 1990-2020: Implications for Employment, Urbanization and the Environment.* Also annex tables on *Alternative Projections of Structural Change, Indonesia, 1990, 2000, and 2020.*

Natural Resource and Environmental Accounting in Indonesia
A decision to undertake a national program of natural resource and environmental accounting was made several years ago by the Government of Indonesia, and initial data collection and methodological study were begun. Two principal issues remained to be resolved: deciding upon the most effective institutional support structure for a national effort; and agreeing on the additional resources and data requirements needed for a fully developed national system.

Henry Peskin held extensive discussions in Jakarta on the second of these two issues, describing his own work in the area and emphasizing the close, desirable, and logical connections between the new field of environmental accounting and more conventional neoclassical economics. From these discussions a consensus emerged that several ministries would support the environmental accounting program, that leadership would be shared by the Ministry of Population and the Environment and the National Planning Agency, and that an expanded data collection effort was warranted, in part along the lines suggested by Dr. Peskin.

The first of the two Peskin papers listed above describes a comprehensive environmental accounting system applicable to Indonesia, and lists a number of references. The second, single-page paper discusses an important but sometimes overlooked use of an environmental accounting system, namely that of improving day-to-day government decisions affecting the environment.

In early June 1991, Alan Strout spoke with a number of individuals whose support would be important to an expanded work program. His notes on the discussions were then to be used as background for a more detailed paper on implementing an expanded program of environmental accounting. The paper itself was to be prepared later by USAID staff.

Sustainable Development in Indonesia
The concept of "sustainability" as applied to development has been widely discussed over a number of years in Indonesia, but it was not clear to the Chemonics team whether one important issue had been fully resolved. This was the extent to which sustainability should be thought of as applicable to individual assets or to a collection of assets. That is, would sustainability in the Indonesian context be interpreted as applying *individually* to most if not all of the country's natural assets (and certainly to all of those that are to some extent "renewable") or whether sustainability was to apply only to a larger set or group of assets, thus permitting tradeoffs among individual assets or even subsets of assets within the larger set.

In a broader sense, this latter position can be extended to cover the choice, discussed in Henry Peskin's *Notes on the Meaning of "Sustainability,"* between sustaining the environment or sustaining income. As Peskin comments in his *Notes*, the general agreement on the desirability of "sustainability" can obscure important differences about the precise meaning of the term. The different interpretations of sustainability, Dr. Peskin points out, "imply very different policies with very different sets of required policy instruments."

In addition to the question of interpretation, it developed that BAPPENAS was more interested in arriving at a conceptual model of sustainability than in conducting a policy analysis of how sustainability fits into the current planning process. Any formal model of sustainability of course requires an answer to the question of how sustainability is to be defined.

The two planning model papers by Alan Strout describe the elements of a conceptual planning model of possible interest to BAPPENAS. The two papers were written together and cover the same material. One is shorter and intended to be more easily read. The longer of the two contains more explanatory and background material.

Dr. Strout's papers essentially answered the question of definition as follows. It should be the task of the new environmental accounting system to identify all elements of natural resource use and environmental impact of importance to Indonesia and which are *not* currently included in the national income accounts at socially desirable values (or in many cases are not included at any value at all). It should be the task of the new accounting system, furthermore, to arrive at socially desirable values for the missing or wrongly valued elements, employing a mixture of economic analysis and, where necessary, political consensus.

The new set of socially valued natural resource, environmental, and perhaps quality-of-life factors can then be incorporated into an expanded set of national income accounts. These accounts, as described by Henry Peskin, would include both positive and negative benefits and social costs. The revalued and expanded depreciation accounts, including especially natural resource depletion, would permit a far more complete and accurate annual measure of *net* national product (NNP). An expanded and revalued measure of NNP that grew at or above the rate of Indonesia's population growth would constitute a necessary and sufficient indicator of sustainable development.

The sustainability model proposed by Dr. Strout is essentially an expanded version of the usual economic model in which gross domestic product derives from a series of physical and organizational inputs. The expanded model incorporates national resources (and "environment" as a natural resource) explicitly as inputs. The inputs both contribute to aggregate output and are (often) negatively affected by the output's production (or consumption) process and thus subtract from the net value of domestic product.

Two more points about the model may be noted. First, the depreciation of natural resources is used to reduce gross domestic product to arrive at net domestic and net national product. Depreciation and natural resource depletion, no matter how measured, will not affect directly the estimated total gross domestic product (GDP), gross national product (GNP), or the recorded rate of GDP (or GNP) growth. Depreciation and depletion only affect the perceived level and growth rate of the *net* product.

Secondly, the model explicitly defines sustainable development in terms of the per capita level of the newly expanded and revalued net product. If properly valued

NNP per capita remains constant or expands, the country is said to be on the path of sustainable development. This definition permits wide latitude for tradeoffs among the various inputs (including their physical augmentation or reduction) which contribute to net national product. This in turn means that if Indonesia should place a very high priority on maintaining, for example, a certain amount of natural tropical hardwood forests, that objective could be achieved in one of two ways. Restrictions could be introduced outside of the sustainability model which simply prevented exploitation of tropical hardwoods below a certain level. This in effect would place an infinitely high price on further reductions to the tropical forest.

Alternatively, a very high but less than infinite value could be placed on tropical hardwoods within the formal sustainability model. The value could become even greater as tropical hardwood forests diminish. This approach would have the effect of possibly permitting further hardwood exploitation while making it more and more difficult, if not ultimately impossible, to find tradeoffs in which expansion of other activities (for example agriculture) or new benefits elsewhere would offset the loss of the high value forests.

Defining sustainability and specifying a model of sustainable development still leaves open a number of implementation issues. Strout's third paper, *Elements of a Sustainable Development Strategy for Indonesia*, discusses a number of these implementation concerns under the headings of political commitment, tactics, organization, and scorekeeping.

Finally, Gary Costello reviewed for the team a number of concepts of sustainability appearing in English-language reports of special interest to Indonesia. His *Notes* summarize relevant material from a 1991 Asian Development Bank paper on sustainable development as well as papers on sustainability by Dixon and Fallon (1988), Barbier (1988), and Pearce (1987). Costello's *Notes* also include a more extensive bibliography on sustainable economic development.

Longer-run Environmental and Macroeconomic Planning Issues

Alan Strout's two papers on longer-term growth and structural change explore some common but poorly understood problems of economic forecasting over long time periods. The results of his analysis are then used to throw light on longer-term natural resource depletion and potential environmental loading. In addition and in response to the interests of the BAPPENAS deputy chairman for human and natural resource development, the second paper looks into longer-term employment issues and into one aspect of income inequality.

The nature of the long-run forecasting problem is seen in the fact that over, say, a 30-year period, a country will change far more dramatically than might seem to follow from its rate of GDP growth as conventionally measured. The fault lies in the usual GDP growth measurements, which rely upon revaluing all output in a single set of base year prices. This method, imposed as a means of eliminating the effects of general inflation, does not give adequate weight to the shifts in *relative* prices among sectors which inevitably accompany long-term growth.

When these relative price changes are allowed for and GDP is defined to reflect more accurately a country's newly emerging and/or revalued activities (as opposed to a basket of goods and services at constant base year prices), a much better picture emerges of that country's actual growth and change. It is this alternative picture of change, reflected in what Dr. Strout terms a "variable price growth rate," that is applicable to intercountry comparisons, to the issue of how fast one country is "catching up" with currently wealthier nations, and to questions of improved social welfare.

It is worth noting that the World Bank has apparently reached a similar conclusion. Beginning with its 1991 *World Development Report* and its 1991 *World Tables*, long-term GNP growth rates are estimated from linked estimates employing three different base periods. Though not resulting in differences as great as those found when using Alan Strout's continuous-rebasing method, the new World Bank technique does explicitly recognize the importance of changes in intersectoral relative prices.

This alternative view of economic growth leads to several important observations. First, under a "medium growth" set of assumptions (that is, with per capita GDP growth in *constant* base year prices of 5.5 to 4.5 percent between 1990 and 2020), Indonesia's per capita income in 2020 would be only US $2,500 measured in Indonesia's own, constant 1988 prices. However, per capita GDP in 2020 would be above US $6,200 when measured in the 1988 prices of a comparable, more developed country. This would place Indonesia in 2020 roughly where Greece and Spain were in 1988, and at almost half the 1988 level of Italy and Belgium.

The same medium growth assumptions would suggest that Indonesia's use of natural resources might be far greater than suggested by a lower, constant price growth prospect. This would be equally true for potential environmental damages, or "loading." On the other hand, this alternative view of growth suggests a faster set of structural changes, including that of agricultural modernization and the shift to sharply reduced numbers of agricultural workers. These structural changes could in turn lead, at least on the island of Java, to sharp improvements by 2020 in intersectoral income equality.

The potential environmental impact under a medium growth assumption may be dramatized using results from the two-region, four-sector model presented in the second of Dr. Strout's two papers. By 2020, according to this model, the island of Java might have a level of industrial product per unit of land area, with all of the attendant possibilities for air, river, and coastal waters pollution and for fresh water consumption, *equal to or greater* than found today in the most heavily industrialized countries of Europe.

The full potential would not be realized for two reasons. First, there will inevitably be technological and other improvements to Indonesia's capital stock between now and 2020. Secondly, pollution control and clean-up measures are already being put in place and will undoubtedly be strengthened over the years. The sheer density on a heavily industrialized Java of factories, warehouses, autobahns,

workers' housing developments, urban congestion, and urban solid and liquid waste, on the other hand, would be more difficult if not impossible to avoid.

Even under the lower economic growth rate investigated in the earlier paper, Dr. Strout concludes that Indonesia's demand for forest products might begin to pass sustainable supply in as few as 10-15 years. By the year 2020, demand for commercial energy might exceed by five times the country's total commercial energy production in 1986.

Although a number of policy conclusions seem warranted, the two papers are preliminary and tentative in the sense that they rely heavily upon much earlier, cross-country studies of structural change and growth. (Note, too, that the second of the two planning issues papers, completed at the end of July 1991, draws upon national accounts and population data that had not been earlier available and hence differs in some minor respects from the April paper.) What should be abundantly clear from the papers is that there are important advantages and disadvantages to achieving either a low or medium growth rate. The growth impacts over a 25-30 year period, it is argued, may in fact be considerably greater than might be commonly supposed. As a consequence the economic growth target will be one of the more critical policy variables in any longer-run economic, natural resource, or environmental plan.

2. ENVIRONMENTAL ACCOUNTING IN INDONESIA: TOWARDS A COMPREHENSIVE SYSTEM

Introduction

With the publication of *Wasting Assets* by Robert Repetto and his associates at the World Resources Institute, Indonesia acquired the unique position of being the first developing country where resource accounting was used to adjust the conventional measure of gross domestic product (GDP) to reflect the degradation of its natural resource base. As important as this pioneering effort was in focusing the world's attention on the need for resource accounting, especially in the third world, the formulation of Indonesian economic and environmental policy over the next 25 years will require a more sophisticated and comprehensive accounting system. The purpose of this report is to recommend the development of such a system and to suggest steps leading to its practical implementation.

The recommendation assumes that the system should fulfill the conventional requirements of the accounting process; that it should reflect the services of *all* environmental assets (including natural resources); and that it should treat both environmental wealth and reproducible wealth in a consistent manner. Accordingly, the report begins with a brief discussion of what the accounting process can contribute to the formulation of economic and environmental policy. It then discusses the limitations of the Repetto approach in terms of its ability to fulfill not only the conventional requirements of accounting but also its own stated objectives.

The alternative approach is described briefly since detailed descriptions are available in the published literature. Relatively more attention is placed on how the system can contribute to the policy process. The report outlines of the system's data needs and the likely steps that will lead to its implementation in Indonesia.

Purposes of Accounting

With respect to its objectives, national accounting and business accounting share similar purposes. The process of accounting serves the needs of business in two principal ways. First, it generates sets of summary statistics whose purpose is to provide a retrospective measure of how well the business performed during the accounting period. Thus, there is a clear *scorekeeping* role for accounting. Second, the accounting process generates a vast amount of information that is used to guide the day-to-day operations of the business. In other words, there is a clear *management* role for the accounting process. These two functions may be valued quite differently by business. For example, while "profits" may, at times, be a questionable performance measure due to, say, weak data on depreciation, this fact may be of minor importance to a business that focuses on day-to-day operations. That is, scorekeeping may be considered far less important than management. National accounting serves the same dual roles, and countries, like businesses, may value these roles quite differently.

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The importance of this observation is that the choice of strategies to modify national accounts to reflect the services of the environment may depend on the relative importance one places on the scorekeeping role as opposed to the management role for the accounting process. Moreover, when one compares systems, they should not be looked upon necessarily as different means to attain the same objectives, but rather as different means to attain often different objectives.[1] The Dutch, for example, appear especially interested in adjusting gross national product (GNP, a performance measure) for the costs required to meet environmental standards. The physical resource accounting by the Norwegians, on the other hand, serves certain model-building needs, a management function. The physical accounts do not allow for any adjustments to GNP, a deficiency which is not of particular concern to the Norwegians.

The premise of this report is that if resource and environmental accounting is to serve the needs of Indonesia over the next 25 years, the accounting system should address both conventional roles for accounting. However, because of the emphasis the nation places on planning and governmental policy interventions in both the environmental and economic areas, the management function may be more important than the scorekeeping function.

Recognition of the dual role of accounting is important in view of the fact that the most contentious and difficult changes to the accounts will be those that lead to "improved" measures of economic and social performance. Because there is simply no general consensus on valuation techniques, any "adjusted" GNP measure will be open to criticism. Nevertheless, the overall accounting effort could still be judged as successful if the management functions are well served. Indeed, the accounting approach suggested below is certain to generate data which, if past experience is any indicator, are highly likely to serve the management needs of policy formulation. The ability of this or any other accounting effort to generate universally accepted improvements in Indonesian GDP is far more questionable.

The Repetto Approach

The accounting adjustments suggested by Robert Repetto to reflect natural resource degradation are known worldwide. His recommendations are especially influential in Indonesia, since Indonesian data were used in the first published implementation.[2] Therefore, it might be questioned, especially in Indonesia, why it is necessary to move beyond the Repetto approach. In order to appreciate the need for an alternative system, it is important to understand the economic underpinnings of the Repetto approach and its inherently limited focus. The approach cannot provide the full complement of information that will shed light on environmental/economic interactions and on policies that may affect these interactions; moreover, the underlying assumptions may inhibit the attainment of even its more limited objectives.

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[1] See Peskin (1990) for a survey of different approaches to resource and environmental accounting in industrialized nations.

[2] Repetto, et al. (1989).

At the outset, it is important to understand that the Repetto approach focuses primarily on the scorekeeping function of accounting. Its basic purpose is to adjust GDP for the degradation of natural resources. Moreover, the resources in question are those that generate services that have clearly market-determined values such as commercial timber, petroleum, and farm products. Environmental resources such as air- or watersheds, and the effects of their degradation, are not covered.

The intended purpose of the approach is to treat natural resources as if they were like other economic capital. The object is to reduce GDP by an estimate of the depreciation of this natural capital.[3]

While it is commonly thought that depreciation is a measure of the *physical* decline in capital, both economists and business accountants define depreciation to mean the change in the economic value of capital over time. Indeed, one important reason that there is a decline in economic value is a decline in physical value; yet economic depreciation can also occur when there is no physical decline, but only a decline in the value of services generated by the capital.

At an initial time period, the value of capital is given by the following expression:

$$PV = \int_0^T e^{-rt} R(t) dt \tag{1}$$

where r is the market rate of interest; $R(t)$ is the net value of the return on services generated by the capital; and T is the capital lifetime. In Repetto's forestry analyses, $R(t)$ is the economic "rent" over time associated with cut timber, defined as the difference between sales value and costs of production.[4] Presumably, depreciation could be calculated by estimating Equation (1) in successive time periods and differencing the result. However, to do so it is necessary to forecast future values of $R(t)$, to know the capital (or forest) lifetime, and to estimate or assume the market interest rate.

Repetto greatly reduces the estimation burden by assuming that $R(t)$ increases over time at the market rate of interest—in particular that:

$$R(t) = R_0 e^{rt} \tag{2}$$

This assumption could be fully justified in a purely competitive economy on the grounds that profit maximization and free entry will assure that all economic pursuits will have a return equal to a common market rate of interest.

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[3]It is not clear why GDP should be so adjusted. One could argue that to maintain comparability with the treatment of the depreciation of reproducible capital, NDP (net product) and not GDP should be adjusted.

[4]This may exceed true economic rent to the extent that there are monopoly profits.

Not withstanding the fact that the assumption may be highly questionable in a world with public ownership of resources and many other sources of market imperfection, the assumption produces extremely attractive results as can be seen by substituting Equation (2) into Equation (1):

$$PV = \int_0^T e^{-rt} R_0 e^{rt} dt = \int_0^T R_0 dt = R_0 T \tag{3}$$

The interest rate ceases to have any effect on capital value. Moreover, since capital value one time period later is simply:

$$PV_1 = \int_0^{T-1} R_0 dt = R_0 (T-1) \tag{4}$$

Depreciation over the first year is simply R_0 or, for commercial forests, the rental value of the first year's cut. This result would be quite attractive to most accountants since it frees them from the need to estimate lifetime, let alone the expected stream of services over this lifetime.

While the Repetto simplifications may be attractive, one should not lose sight of the fact that the simplifications come at a price. There are three key deficiencies that make the approach questionable as the basis for an accounting system that can support economic and environmental policy. In the first place, as already noted, natural assets are only depreciated to the extent that they generate services with commercial value. Nonmarket, environmental services are ignored. Thus, the depreciation of assets, such as forests, which generate both commercial and nonmarket services, will be underestimated. Secondly, the focus is only on depreciation adjustments to the conventional accounts—that is, adjustments to the measurement of capital. No adjustments are made for the fact that the conventional accounts also neglect the current services of the environment and damages to those services due to pollution. Finally, even if one were only interested in accounting for the commercial value of natural resource depreciation, it is likely that the Repetto approach greatly overestimates this depreciation for long-lived assets. This last assertion may require some amplification.

Suppose we replace the assumption embodied in Equation (2) with the assumption that returns, $R(t)$, remain constant over time, equal to R. Direct integration of Equation (1) leads to the following expression for depreciation as a function of T or lifetime:

$$D = \frac{R}{r} e^{-rT}$$

While "Repetto depreciation" remains constant at level R, economic depreciation (that is, depreciation calculated by direct application of Equation (1) declines

exponentially as lifetime increases. For all lifetimes in excess of a value equal to $-r/ln(r)$, or about 16 days at $r = 0.10$, true economic depreciation is smaller—and for moderately large T, much smaller.

The Neoclassical Economic Accounting Alternative

We now propose an alternative way of introducing the natural environment into national economic accounting systems. As this approach has been described in a number of publications,[5] only its essential features will be outlined here.

The approach begins with the premise that regardless of how intrinsically valuable the environment may be, its *economic* value depends on how society values the services generated by the environment. Like the marketed capital services of, say, machines, this social valuation depends on supply and demand. Thus, from an economic point of view, the services of the environment may have no value if they are in excess supply or if there is no demand.

The proposed accounting approach attempts to identify these services according to those sectors of the economy that may demand them. The identified services are then valued in terms of how much the sectors would be willing to pay to maintain their consumption.

The accounting system identifies three classes of services: waste disposal input services to businesses and to households; negative damages to businesses and households due to the consumption of the waste disposal services; and direct final demand services to households or to society as a whole. These direct services include aesthetic services, recreation services, ecological services, etc.

In actual implementation of the framework, businesses have been disaggregated by standard industrial classification (i.e., by establishments and not by enterprises). Further, all sectors including households and governments are disaggregated by geographical location. These disaggregations serve two practical purposes. First, they make it easier to estimate waste disposal service, damage, and direct final consumption values. The valuation estimates rely heavily on existing studies drawn from the benefit-cost literature and most of these studies are highly geographical and sector specific. Second, the disaggregation permits the data to be used for analyses of the distributional implications of policy.[6]

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[5]See, for example, Peskin (1989a) and Peskin (1989b). An earlier version which adheres to the same principles may be found in Peskin. (1976).

[6]See for example, Gianessi, et. al. (1979).

With respect to each sector or establishment, the environmental services are entered into the conventional economic accounts in a double entry fashion. Specifically, waste disposal services are treated as additional inputs (valued negatively like subsidies as a matter of convention). Negative damages associated with the sector's use of waste disposal services are entered as additional outputs. Also, added to the output side are the direct final demand services. These input and output entries are balanced by another input entry, "net environmental benefit," defined as the sum of services (waste disposal and direct final demand services) less damages.

These additional accounting entries when added to the conventional national economic accounting entries yield a modified gross domestic (or national) product. To obtain a similarly modified net product, it is necessary to deduct a measure of depreciation of environmental and natural resource assets. Such assets may be defined according to their physical attributes (e.g., forests, mineral stocks, lakes, air-sheds, etc.), but it may be more convenient to define these assets according to the services they provide. Thus, we define water-based recreation assets, waste disposal assets, surface transportation assets, etc. Doing so makes it easier to account for the depreciation of environmental assets, such as lakes, which generate many different services (e.g., water supply, waste disposal, recreation), all with different lifetimes. In general, the depreciation of such assets is calculated by estimating the change in their present value over the accounting period.

Figure 1 on the next page displays this modified accounting framework for the consolidated income and product account. Note that entries have been arranged in such a way as to preserve the conventional accounting entries. At least with this framework, the frequently heard argument that modifying the national accounts will destroy their integrity has no relevance.

Implementation Approaches

This section describes the types of data and procedures needed to implement the above framework. The rationale and theoretical justification for the procedures is discussed in Peskin (1989a). The exact data needs are not presented since they likely will be unique to Indonesia. A description of the data used for a recent implementation for the Chesapeake Bay area of the United States will be found in a forthcoming report by the U.S. Environmental Protection Agency.

1. Waste disposal services

Waste disposal services can be conveniently measured by the prospective costs to reduce discharges of residuals to "safe" levels. These *prospective* costs should be distinguished from the *actual* costs that may have been already incurred due to compliance with past regulations. Such actual costs are already reflected in the conventional economic accounts although they are usually not separately identified. However, since past cost experience is extremely useful for estimating prospective costs, those efforts to identify past costs, such as those undertaken in the United States by the Bureau of Economic Analyses, have been very valuable.

Figure 1:MODIFIED NATIONAL INCOME AND PRODUCT ACCOUNTS

INPUT	OUTPUT
Compensation of Employees Proprietor's Income Indirect Taxes Gross Return to Capital	Personal Consumption Investment Inventory Change Exports Imports Government Goods and Services
CHARGES AGAINST GROSS NATIONAL PRODUCT	GROSS NATIONAL PRODUCT
Capital Depreciation (-)	Capital Depreciation (-)
CHARGES AGAINST NET NATIONAL PRODUCT	NET NATIONAL PRODUCT
Nonmarket Household Production	Nonmarket Household Production
Natural Resource Depreciation (-)	Natural Resource Depreciation (-)
CHARGES AGAINST MODIFIED NET NATIONAL PRODUCT	MODIFIED NET NATIONAL PRODUCT
Capital Depreciation (+) Natural Resource Depreciation (+)	Capital Depreciation (+) Natural Resource Depreciation (+)
Environmental Waste Disposal Services (-)	Environmental Damages (-)
a. Air b. Water c. Land	a. Air b. Water c. Land
	Direct Consumption of Environmental Services
	Recreational Esthetic Ecological
Net Environmental Benefit (Disbenefit)	
CHARGES AGAINST MODIFIED GROSS NATIONAL PRODUCT	MODIFIED GROSS NATIONAL PRODUCT

Where cost data are scarce, as is likely in Indonesia, it would be possible to develop rough estimates using the U.S. data. To do so, however, it would be first necessary to estimate waste discharges in Indonesia by discharging sector—industries, governments, and households. The U.S. cost data can then be converted to a per-unit-of-discharge basis and applied to the Indonesian discharge levels. However, Indonesian discharge data may be scarce as well. These, in turn, could be estimated using engineering process information. Encyclopedias of such process information, in the form of flow charts, have been published for many industrial production activities. These charts usually describe all materials entering and leaving the process. Other engineering studies, which similarly describe the generation of residuals, are available for household and agricultural activities. If engineering estimates are not available, another possibility would be to use the U.S. discharge data, normalized to a per-unit-of-output basis.

While estimates based on the above approaches are extremely crude, their publication often stimulates the generation of better data. Moreover, when the crude estimates are compared sector by sector, it may become apparent that many sectors contribute little to the overall consumption of waste disposal services. In such cases, the development of more refined estimates may not be warranted.

2. Environmental damages and direct environmental services

In previous implementations of the accounting framework, environmental damages were drawn from a number of pollution control benefit studies. Duplicating these studies in Indonesia would probably be prohibitively expensive. One could pursue one of two alternative approaches.

First, damages could be estimated by the costs of their elimination. This approach appears to be favored by several European investigators who are skeptical of the benefit estimation techniques widely used in the United States. While this approach is viable, it essentially makes benefit-cost comparisons of pollution control policy meaningless. In terms of our accounting framework, it means that the value of waste disposal services (which are measured by prospective control costs) identically equals the value of associated damages. If there were no direct environmental services to final demand, the use of control costs to measure benefits would also mean that the net environmental benefit term would always equal zero.

A second approach would be to use the information contained in the U.S. studies. In particular, it is usually possible to express damages in per capita terms, in terms of pollutant concentrations, or in terms of pollutant discharges. Thus, if data were available on pollutant concentrations throughout Indonesia (unlikely) or on discharges (more likely, especially if estimated with engineering data), it would be possible to make rough estimates of damages based on extrapolations from the U.S. literature.

This second approach may be the only viable one (in the absence of undertaking new studies) for estimating the value of the direct final demand services the environment provides to households and to society as a whole. Of course, given the great differences in income levels and, perhaps, in tastes, U.S. estimates of recreation benefits and other direct services may be completely irrelevant for Indonesia. On the other hand, many of these direct services are provided to tourists from developed countries. For this group of consumers, the U.S. studies may be more relevant.

3. Environmental and natural resource depreciation

To the extent that the Repetto approach is used for commercial assets, the data requirements are familiar to investigators in Indonesia. Data are required describing physical depletion and, for renewable resources, natural regeneration. The physical data are valued at unit "rents" defined as the difference between average selling price and extraction costs. To the extent that additional data become available that would permit estimates of the time path of demands and, hence, lifetimes, it might be worthwhile to attempt a more sophisticated estimate using the present value formulas described above.

As noted above, the Repetto approach is not viable for noncommercial, environmental assets such as air and water. However, to the extent that the current waste disposal and final demand services of these assets can be estimated over time, depreciation can be estimated by subtracting successive estimates of present values using Equation (1) (or its equivalent "summation" form).[7] In this case, the $R(t)$ is not rental value but rather an estimate of environmental asset services. In previous implementations of this system, future values of these services were estimated often by assuming them to grow in proportion to population.

Illustrative Uses of the System

The implementation of this accounting system leads to the generation of data on pollution damages, the costs of controlling these damages, and measures of the deterioration of environmental assets. The data are detailed and comprehensive in that they cover all economic sectors and are identified by location of those economic activities that interact with the environment.

Although previous implementations of the system in the United States were only meant to be experimental, the data generated did have implications for environmental policy. These findings were published in a number of studies.[8]

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7 $$PV = \sum_{t=0}^{T} \frac{R(t)}{(1+r)^t}$$

[8] A list of these studies may by found in Peskin (1990), Appendix II.

1. Relative importance of industry, agriculture, and "nature"

The comprehensive coverage of pollution sources made it possible to identify the relative contribution of economic sectors to the nation's air and water pollution problems. In particular, the data indicated that of the pollutants targeted in the 1972 Clean Water Act, more than half came from agricultural sources—even though these sources were not subject to discharge regulations. Subsequent revisions to the Water Act did place more emphasis on agriculture.

The accounts also measured pollution from natural sources. These data indicated that in many areas, "nature" is the dominant polluter. In fact, simulation models using the data demonstrated that in large regions of the United States, total regulation of human sources of pollution would have little affect on water quality due to the dominance of natural sources.

2. Analysis of the distributional implications of policy

Because the data on the consumption of environmental services in the accounts were identified by the location of the economic agent affecting the environment or affected by the environment, it was possible to analyze the distribution of environmental asset use, both geographically and (using additional census data) by income class. In addition, the data permitted distributional analyses of regulatory policies that would affect the consumption of waste disposal services.

The general findings were that the more the costs of regulatory policies were placed on polluters (the "polluters pay principle"), the more regressive were the policies.

3. Analyses of the overall benefits and costs of policies

The accounting data on the value of waste disposal services and the value of associated damages can be used to assess the benefit-cost implications of policies designed to alter the consumption of these disposal services. The results of these investigations indicated that the command and control approach adopted in the United States was economically inefficient, due primarily to the fact that uniform levels of control were often called for, even in regions where environmental damages were minor.

It should be noted that these examples illustrate the *managerial* function of accounting and not the *scorekeeping* function. In the United States, adjustments to conventional GNP for environmental degradation were small compared to the high level of GNP. Thus, these adjustments were not very interesting. Similar findings would not be expected in low income, developing countries.

Implementation Lessons

The above system has only been implemented on two occasions, both in the United States. Therefore, the experience may not be entirely relevant for Indonesia. Nevertheless, there are three lessons learned that may be applicable to Indonesia.

1. There are more data than may appear at first.

It is natural to look towards "official" sources for data on pollution levels, damages, industrial discharges, etc. It often happens, however, that many of the official sources actually assemble data from other, nonofficial sources such as trade associations, environmental groups, and academics. By approaching these sources directly, a lot more data can often be uncovered.

This data search activity should be a first step in implementing the accounting system.

2. Data descriptions are not to be trusted.

Although there may be more data than first meets the eye, the data may not be exactly as advertised. For example, a government agency may claim that it has industrial discharge information. Upon inspection, however, it may turn out that the information only covers one or two sectors or it may be classified according to some nonstandard classification scheme.

Thus, an essential second step in the accounting process is to obtain the data and evaluate it first hand.

3. Don't be afraid to publish "bad" results.

It is counterproductive to hold on to the accounting data until it reaches some state of perfection. In the first place, all information has value, even "bad" information. In the second place, as noted at the outset, the purpose of accounting is more than scorekeeping. If one waits for the perfect set of accounts, then one is forgetting the important *management* function of the accounting process. In the third place, often the only stimulant to the production of better data is the publication of poor data. More than once, initial requests for data were met with silence, requiring substitution with engineering estimates. Upon publication of these substitutes, the previously silent sources suddenly saw fit to provide far better information.

Final thought: Is the system too expensive for Indonesia?
Full-scale implementation of the above system could place substantial demands on the data gathering and analytical responses of Indonesia. Therefore, it would probably not be wise to proceed without first undertaking a pilot study somewhat along the lines of the Chesapeake Bay study recently completed by the U.S. Environmental Protection Agency, or the resource accounting project recently initiated in the Philippines. The pilot project would probably best be treated as an unofficial exploratory effort done outside of government bureaus. By so doing, rough estimates could be published without the fear that the public would treat such estimates as official. It would probably be possible to undertake such a project in Indonesia over a 20-month period with two full-time Indonesian university graduates and six months of expert consulting. This time frame assumes the cooperation of those ministries where basic data reside.

Suppose the pilot project suggests the long-term viability of the approach. It is actually possible that in spite of the analytical and data demands, the incremental cost of the full accounting system will be less than for the pilot project. The explanation for this apparent contradiction is that full adoption of the system would largely require a reorganization of existing data collection activities—not necessarily the adoption of new data collection efforts. Much of the work could be done by current government personnel.

Of course, one the main purposes of undertaking a pilot project is to ascertain just what the costs will be. More importantly, the pilot project should give some indication of whether the benefits of the comprehensive accounting approach discussed here is worth these costs.

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3. NOTES ON THE COORDINATION FUNCTION OF ENVIRONMENTAL AND NATURAL RESOURCE ACCOUNTING SYSTEMS

In many countries, including Indonesia, one of the first steps in developing environmental and natural resource policy is to require the preparation of environmental impact assessments (EIS). The basic purpose of such a requirement is to assure that both the proponents of programs and the government in general are made aware of the potential effects the program may have on the environment. Experience has shown, however, that while the EIS process may have helped to eliminate clearly bad projects (from an environmental point of view), it provides little guidance for the rational selection of potentially good projects. The problem is that it is not very easy to compare one EIS with another even qualitatively, let alone quantitatively.

One approach to this problem is to require that all EIS adhere to exactly the same protocols–same coverage, same definitions, same measurement techniques, etc. Indeed, this approach has been tried in the United States, but only within selected bureaucracies, such as the Department of the Interior. Such standardization has not been tried *across* bureaucracies, nor is there any enthusiasm to do so, since most want to maintain their independence in this matter. Bureaus are usually advocates of their own projects; it is understandable that they would like to use EIS to place these projects in the most favorable light.

These political realities suggest a side benefit of centralized resource and environmental accounting systems. They can lead to the development of standardized information that would permit qualitative and quantitative comparisons of the environmental implications of projects originating in different bureaus. This is certainly the case with accounting systems that are monetized (such as the UNSO system, Peskin's neoclassical system, or Repetto's neoclassical approach) but it may also be the case with purely physical systems to the extent that different projects affect the same physical resources.

In practice each bureau would still be required to prepare its own EIS, and each would be permitted to follow its own internal protocols, as currently is the case. However, they also would be required to prepare certain project-relevant pieces of information in a form compatible with the accounting framework. (For the Peskin system, they would be required to provide information on the likely environmental benefits and damages, their best estimates of the monetary values of these benefits and damages, and the costs of mitigating any damages.) Such compatible information provides a lingua franca–a common means of expressing the project's environmental and economic implications throughout the government community.

1. NOTES ON THE MEANING OF "SUSTAINABILITY" AND ITS IMPLICATIONS FOR INDONESIAN DEVELOPMENT PLANNING AND POLICY

Introduction

In the early years of the modern environmental movement, efforts to clean up the environment were justified by the adverse effects of environmental degradation on human health and on the preservation of plant and animal species. More recently, however, the arguments are also reflecting concerns about the effects of environmental and natural resource degradation on the ability of societies to sustain their economic growth. Indeed, it is now hard to find any written materials on the environment that fail to use words like "sustainability" and "sustainable" at least once.

However, as has been pointed out by many commentators, these words are often used without precise definition. Indeed, they are frequently used in more than one way in the same document.

This imprecision may be thought a minor irritation, but there are more serious consequences. In particular, while the loose language may make it appear that there is general agreement on policy objectives among various commentators, the different interpretations of sustainability imply very different policies with very different sets of required policy instruments.

Consequently, if Indonesia wishes to determine the most efficient plan for sustainable growth and development, the nation must decide which interpretation is the more consonant with its overall social objectives.

However, while the different concepts of sustainability imply different policy objectives and policy instruments, they may share similar information needs. These information needs could be largely satisfied by a single, comprehensive accounting system that links economic and environmental data. As is the case with other national data systems—such as the national economic accounts—the environmental/economic data system could support a number of analytical approaches that are consistent with several policy objectives.

Sustaining the Environment versus Sustaining Income

In his *Economic Analysis of Sustainable Growth and Sustainable Development* (1989), John Pezzy quotes 51 definitions of sustainability. When reading these quotes, one is struck by the fact that not only are the terms "sustainable" and "sustainability" used differently by different authors, the terms are often used very differently by the same author, even within a single publication.

Most of the quoted authors seem to share a similar belief in the desirability of

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"income" as an appropriate focus of policy.[1] Where the authors do differ is in terms of *what* should be sustained. There appear to be three points of view. First, there are those who refer to sustaining the *environment*, either in general terms or in terms of specific environmental and natural resources. Second, there are those (primarily, but not exclusively economists) who focus on sustaining the *economy* and who are willing to live with some environmental degradation and natural resource depletion. Third, there are those who share both objectives: sustaining the environment *and* the economy.

As an example of the first point of view, consider the following quote from a paper by Anil Markandya and Professor David Pearce (1988):

> "The basic idea of [sustainable development] is simple in the context of natural resources (excluding exhaustibles) and environments: the use made of these inputs to the development process should be sustainable through time...If we now apply the idea to resources, sustainability ought to mean that a given stock of resources—trees, soil quality, water and so on—should not decline."

The following quotes from Professor Tom Tietenberg (1984) illustrates the objective of sustaining the economy and, in this particular case, economic well being:

> "The sustainability criterion suggests that, at a minimum, future generations should be left no worse off than current generations."

> "...the present value criterion [used to assess the social value of an investment] should be complimented by other criteria, such as sustainability...For example, we might choose to maximize present value subject to the constraint that future generations are not made worse off."

Finally, the following quote from Professor Kerry Turner (1988) illustrates the dual objective of sustaining both the economy and the stock of resources:

> "In principle, such an optimal [sustainable growth] policy would seek to maintain an "acceptable" rate of growth in per capita real incomes without depleting the national capital asset stock or the natural environmental asset stock."

It should be kept in mind that within the three groups of interpretations there are many variations. For example, those whose stated objective is to sustain the economy have a number of alternative ways to express this objective. Some intend it to mean only the maintenance of a base level of (per capita) income, while others intend maintaining a given level of income growth. And by "income," some mean

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[1]The belief that preservation of the environment, *per se*, should be the sole focus of policy (a position that Pezzy refers to as the "deep ecology" view), was not represented in the quoted materials.

money income; others mean *total* income, that is, money income plus any other (nonmarket) contributions to well-being.

Among those who wish to sustain environmental resources, some mean those physical resources that support life (air, water, and land); others mean the living resources themselves (plants and animals); and others intend to sustain all natural resources, regardless of whether or not they are alive.

Underlying Assumptions and Implicit Models

The three interpretations of sustainability and their many variations reflect different models of the way that natural and environmental resources affect economic performance and human well-being.

Probably of most importance are the assumptions concerning the feasibility of reproducible and human resource capital to substitute for environmental and natural resource capital. The assumed degree of substitutability depends not only on the physical characteristics of the various forms of wealth, but also on the assumed production function that links social outputs (in the form of income or utility) and factor inputs (labor and the services of reproducible capital and the environment), as well as the rates of technical progress.

Presumably, those who promote the preservation of certain or all environmental and natural resource assets feel that substitution possibilities are limited or impossible. As a result, certain natural resources are "critical" in the sense that their exhaustion will necessarily mean eventual declines in income and well-being. The set of critical living resources can be quite large if it is further assumed that there is an easily disturbed, delicate balance in ecosystems.

On the other hand, those that focus on maintaining the economy see far greater opportunities for asset substitution—especially substitution of human capital for natural resource capital. While certain natural assets may be critical to sustaining life, such as air and water, they appear to be in excess supply (admittedly often with questionable quality). The issue of sustainability for this group is not the preservation of assets, but whether existing assets—natural, human, and reproducible—can be rationally managed. Poor management could mean unnecessary degradation and misallocations with the result that present incomes and growth rates will not be maintained in the future. With good management, on the other hand, it would be possible—and perhaps even desirable—for a nation to lose its entire stock of a particular natural resource and still enjoy increased levels of growth and well-being.

The assumptions of asset substitutability are related to different views of the outputs and output services generated by environmental and natural resources. Those who argue for sustaining the environment often note the unique goods and services generated by environmental assets; those who focus on sustaining the economy dwell instead on more aggregate measures of these goods and services. Thus, a frequently heard argument for preserving a beautiful river is that it provides the option for future generations to enjoy its special beauty, or that it

provides a unique fishing experience. The more detailed the specification of the output services of an asset, the more unique it appears (and, consequently, the less substitutable it appears). If, on the other hand, only aggregate measures of output services are viewed as important, few assets will appear unique and the set of substitution possibilities will grow. Thus, while the fishing experience provided by a beautiful river may be a great source of enjoyment, there are many other assets--both natural and man-made—that are also potential sources of enjoyment.[2]

Policy, Analytical, Data, and Institutional Implications

These distinctions in the interpretation of "sustainability" are of more than academic interest. Each interpretation implies a different policy, analytical, and institutional path towards the objective of attaining maximum social income and well-being.

If sustainable development means sustaining the environment, it justifies a policy focus on the preservation of specific environmental and natural resources—especially those that are deemed "critical." Analytical support for such policies depends heavily on resource specialists who can determine the relative ecological and economic importance of the resources. Most other economic analysis is directed towards determining the effect of economic activity on the quantity and, especially, the quality of specific environmental and natural resources and to ascertaining the costs of remedial actions. In addition, "feedback" effects and interactions may be recognized as important, but only *within* the set of various natural and environmental resources. As a result, policy analyses tend to be "partial," permitting, for example, deforestation to be studied independently of other economic activities such as agriculture and mining.

If, on the other hand, sustainability means sustaining the economy, economic, environmental, and natural resource policies become totally intertwined. Environmental and resource policy becomes a part of conventional fiscal and monetary policy. Actions affecting the use of environmental and natural resources have to be recognized as actions that also affect short- and long-term economic objectives. Preservation of the environment is no longer sacrosanct. Attainment of long-run social and economic objectives may require the destruction of some portion of the current natural resource base.

Under this view of sustainability, analytical needs are much more extensive. A holistic approach is called for that recognizes the interactions between the state of the environment, the stock of natural resources and environmental assets, and general economic activity. Because of interactions and feedbacks, partial approaches have to be viewed with suspicion. Furthermore, environmental and resource expertise have to be combined with the same degree of economic

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[2]The substitutability and modeling assumptions behind those that call for sustaining both the environment and income are not self evident. If there is an underlying "model," it may not be feasible: That is, it may not always be possible to maintain a particular income or growth level while, at the same time, maintaining a pre-specified level of environmental assets.

expertise that supports conventional economic and development policy.[3]
It is unclear how a shift in focus from one concept of sustainability to another affects the amount of data that have to be collected. Holistic analytical approaches require large amounts of both environmental and conventional economic statistics, while partial approaches may require more detail in the environmental and natural resource data than in the economic statistics.

More important than how much data are required is how they are assembled. Holistic analytical approaches require that the data be integrated. Data describing the quality of the environment or the status of individual resources have to be indexed to permit linkages with data on the economic activities that affect these conditions. Furthermore, if it is analytically convenient to regionalize the data (which is surely going to be the case in a country as diverse as Indonesia), indexing should permit aggregation to national levels since economic effects are not confined to regional boundaries.

The different sustainability concepts also have institutional implications. Bureaucratic compartmentalization, typical in most countries, does not lend itself to holistic analytical approaches. Thus, the objective of sustaining the environment is more compatible with existing institutions than would be the objective of sustaining the economy. However, as evidenced in some countries, such as Norway, adoption of holistic policy formulation and planning is possible with bureaucratic compartmentalization if there is a willingness to share and centralize information.

Implications for Indonesia

There appears to be no official Indonesian definition of sustainable development. As suggested here, rational policy formulation requires a decision on whether the focus of policy should be on sustaining the environment or more generally on sustaining economic activity and growth. The decision will affect the choice of policy instruments, analytical techniques, and perhaps the bureaucratic structure.

If Indonesia chooses to follow the recommendations in the recent World Bank study on Indonesian forests, land, and water (World Bank: 1990), then to be consistent Indonesia should adopt the more holistic view of sustainability. The sustainability view in the World Bank report is clear:

> "Environment and development are intertwined. The sound management of natural resources, including forests, soils, and water is a prerequisite to economic development; and economic development, in turn, is necessary for good environmental management."

While most of the recommendations in the report (many of which echo an earlier UNDP Environmental Sector Review in support of Repelita V) are consistent with

[3]Presumably, policies based on those sustainability concepts that call for sustaining both the environment and the economy would require similar analytical support.

the adoption of the holistic view, it may be that these recommendations do not go far enough. In particular, the World Bank report does not appear to explicitly address the problem of developing consistent economic and environmental planning and policy.

Indonesia should investigate the possibility of developing new institutional arrangements and analytical methods that would lead to joint development of economic and environmental policies. The Norwegian experience may be instructive: consistent economic and environmental policy and simulation models are under development in the Norwegian Central Bureau of Statistics.

To support such modeling, Indonesia should consider another recommendation explicitly made in the UNDP report: the development of integrated environmental-economic accounting systems.[4] These systems essentially extend the scope of the conventional national income accounts to cover the services and depletion of environmental and natural resource assets. The development of such accounts not only generates the data necessary to support environmental/economic models, but also serves to encourage different bureaucracies to transfer data and information in a consistent manner.

Pilot projects to develop such comprehensive accounting systems are underway in several countries including Costa Rica, China, and the Philippines. Indonesia might consider establishing a similar pilot program.[5]

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[4]See Peskin (1988).

[5]The study by Repetto et. al. (1989) represents a modest step in this direction. However, the primary focus of that study was the depletion of marketed, commercial-type resources (such as timber and petroleum). The accounting schemes referred to here—particularly the Philippines study—are far more comprehensive in that they cover all environmental assets and services, regardless of whether they are marketed.

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5. TOWARDS A PLANNING MODEL FOR SUSTAINABLE DEVELOPMENT

The Problem

How can "sustainable development" be defined in operational terms? How can the concept be used for long-term planning in a manner logically consistent with conventional economic planning models but capable of illuminating issues of sustainable as opposed to more conventional economic development? How would planning under the new model differ from that under the conventional growth and development model?

Proposed Solution

One answer to these questions is to build upon the economic growth model already employed by most economists and planners. In this model a number of inputs–most notably labor and capital–are assumed to produce a nation's output. Other inputs of recognized importance but which are less easy to measure are changes in technology and other forms of productivity, including those associated with management improvements and natural resources. The production model finds expression in conventional national income accounting. Domestic inputs are measured as returns to the several factors of production and are exactly equal, in their aggregate, to domestic output as measured by gross domestic product (GDP).

This model can be extended to capture the modern concept of "sustainable development" by adding a series of real but hard-to-measure elements on both the input and output sides of the equation. On the input side the new factors should include, among others, productive services provided by the environment (such as waste disposal), hydrological and other contributions of watershed protection, and the diversity (as opposed to the level) of natural resource stocks and gene pools. New factors on the output side would include various nonmarketed social benefits deriving from the services provided by the natural environment, intergenerational gains and losses, and negative outputs such as environmental damages. Included as a supplement to the standard depreciation accounts would be an explicit allowance for natural resource depletion.

Under the expanded model (and correspondingly expanded national income accounts), attention would turn less to gross output change (GDP) and more to that of net national product (NNP). NNP, it will be recalled, equals GDP less all allowances for depreciation. It can be shown formally, and has been so argued by a number of economists, that when NNP has been "properly" valued, it measures social income in the Hicksian sense of the maximum value that a nation can consume in one period and still be as well off at the end of the period. If well-being is maintained or increased *in per capita terms* over time, it follows that the nation is on a path of sustainable development.

"Proper" measurement means that NNP must include, at shadow or accounting prices, both those goods and services whose scarcity values can and cannot be

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determined in the economic market place. The latter would include goods and services (marketed and nonmarketed) subject to technological, transaction, information, and ecological or environmental constraints. In summary:

> Sustainable development is defined as a long-term increase in net national product equal to or greater than the increase in national population where the NNP has been properly adjusted to account for natural resource depletion as well as a wide variety of socially and environmentally important goods and services not normally valued in financial markets.

Short-run Planning Implications

There follows from this model of sustainable development a number of implications for both short and longer-run planning. First, in the short run, the identification and valuation of factors to be included in an expanded measure of NNP is by no means trivial. A considerable step forward will be to implement a new system of natural resource and environmental accounting to complement the existing national income accounts. To some extent nonmarket valuations can be arrived at through research and analysis, including that on human behavior and public opinion. Certain values may have to be approximated through open debate among large numbers of affected individuals and organizations (including governmental). The debate and eventual consensus building serves as a kind of "market" for the pricing of scarce goods, services, and production factors not bought and sold in the normal financial market place.

Another short-term issue will be to find a series of incentives to encourage desired ("sustainable") social actions when the dictates of the financial market place would otherwise be unfavorable. This is to say that the activity would either be nonviable under normal market conditions or that a market-based decision would result in an inefficient allocation of resources (resulting, for example, from major externalities, public good outcomes, or common property problems). Such market failures provide a clear justification for certain carefully planned subsidies. Some form of open competition among subsidy claimants might even be provided for access to resources placed in an "environmental fund," or a "growth dividend" fund for improvements to the environment and to the quality of life.

There also are a series of investments in quasi-tangible factors whose importance is already recognized under conventional planning models but which might assume even greater importance under a sustainable development model. These especially include certain aspects or contributions to human skills and well-being, to science and technology, and to organizational management.

Longer-term Implications for Planning

The most important long-run issue relating to the sustainable development model is factor and output substitutability. The factor substitutability concept recognizes that in the longer-run, increases and improvements in labor, capital, technology, and management can compensate to some degree for declining stocks of natural resources. The importance of a national economy focus is that it allows for

aggregate sustainability despite the possibility of stock depletion (or "unsustainability") in any individual sector. What is best for the nation may not appear best from the viewpoint of an isolated sector. (These last statements are subject to the limitation that sustainability in that sector has not been designated a national objective in and of itself, as might be the case, say, with national food self-sufficiency.)

The critical factor in judging national sustainability in the face of declining stocks of natural resources becomes whether new assets can be created which equal or exceed the "properly measured" long-run value of the assets lost. Does the present value of the long-run benefit stream from reinvested income, that is, does it equal or exceed the present value of the benefits lost?

Another implication for longer-run planning follows from the first. There is a great need for careful research and analysis of longer-run economic and natural resource management trends, both domestic and foreign. For example, a careful longer-run look will reveal the conflict that will arise within only 15 years between sustainable timber yields and domestic (let along foreign) demand for Indonesia's wood products. In 30 years domestic demand alone could exceed today's sustainable yield from all Indonesian forests by a factor of two. As another illustration of the need for careful analysis, likely future trends indicate that the island of Java could easily turn into one of the more heavily industrialized parts of the globe–along with all the attendant negative side effects of pollution, environmental degradation, and, perhaps, social unrest and violence.

Planning for sustainable development must almost by definition be done in the context of a longer-term plan. The analysis of alternative scenarios associated with such a plan provides the best means for judging whether future development will in fact be sustainable.

Implication for Current Issues

A series of environmental and natural resource problem areas have already been identified in Indonesia. These include sectoral issues such as forestry and coastal and marine fisheries management. There are also cross-sectoral areas of concern such as the resolution of the competition for land, watershed management, air and water pollution control, and urbanization. Most such issues are location specific; uniform, nationwide solutions may not be possible. Many of these problems are already so acute that the need for corrective action is obvious.

In the longer run, however, many of these same issues should be reexamined from the viewpoint of the sustainable development model described. Many aspects of the national sustainable development model are equally applicable at the sub-national and project level. Indirect effects should be identified and measured, possibly involving interactions with other sectors or certain types of factor substitutions which a more comprehensive approach might reveal. It may turn out–as it has in other countries–that less obvious wastes or sources of pollution, for example, are more economically and socially important than the origins first

identified. Lastly, as already noted, what is best to sustain a particular sector may not necessarily be best for the longer-run sustainable development of the nation.

In general, the more comprehensive approach of the sustainable development model differs from conventional analysis in several ways. Most importantly, it seeks to incorporate and integrate socially important and ordinarily unmeasured factors–most significantly the services provided by and damages incurred by the environment–into standard policy assessments rather than limiting judgments to either economic or environmental considerations by themselves.

The distinguishing characteristics of the sustainable development model, in short, follow largely from the definition given earlier and include:

- Explicit consideration and valuation of nonmarket factors.
- Special consideration for distributional, quality-of-life, intergenerational, and other issues of longer-term importance.
- Possibilities for longer-run substitutability and tradeoffs among all factors, market and nonmarket.
- Focus in the first instance on national rather than sectoral sustainability.
- Close association in most cases with specific locations and, in the case of distributional effects, with specific population groups.
- A full accounting compatibility with the national accounts.
- Compatibility in practice, though not necessarily in outcome, with standard economic decision making (that is, with decisions and tradeoffs based upon a comparison of streams of long-run benefits and costs, "properly" measured, weighted and discounted).

Finally, it must be noted that the calculus of sustainable development is still in the process of invention. A proper goal and a good theory do not translate automatically into a framework for generating wise policy prescriptions. Countries throughout the world are wrestling with many of the same environmental and natural resource management issues as Indonesia. Only gradually are they coming up with useful solutions. This means that on the one hand, unlike tax reform for example, there are no ready solutions available from abroad. On the other hand, it means that Indonesia herself can make important contributions to this emerging field.

Next Steps

Two kinds of issues are raised by the notes above. The first kind is substantive: Does the proposed model make sense and seem useful from an economic planning perspective? Are there missing elements? Should certain of the ideas be developed further? The second set of issues are more procedural, relating to consensus building and to implementation. What additional discussions, writings, seminars, etc. might be useful for testing and refining the ideas proposed in these notes? Are there case studies (necessarily limited by current data deficiencies) which might prove useful to, for instance, those who are preparing the forthcoming 25-year development plan? What are the highest priorities for further analytical work among the lines outlines in this draft paper?

6. A PLANNING MODEL FOR SUSTAINABLE DEVELOPMENT AND IMPLICATIONS FOR INDONESIAN PLANNING

Introduction

How can the notion of "sustainable development" be introduced into a long-term plan in a manner which is logically consistent with conventional economic planning models and which illuminates issues of sustainable, as opposed to more conventional economic development? How might this new sustainable development outlook affect planning and decision making?

These notes describe a simple model (or manner of formal thinking) about sustainable development. Later sections discuss the model's implications for several kinds of sustainability (natural resources, financial resources, and political), for both short-run and longer-run planning, and for environmental and natural resource policy issues currently facing Indonesia.

A Simple Model of Sustainable Growth

One standard conception of the economic growth process sees national output (roughly measured by gross domestic product, GDP) deriving from a number of broad inputs. The most easily defined of these are labor and capital. Others, less easily measured, include "land" or natural resources, technology, innovation, management skills, etc. Often in empirical studies the effects of technology and management are subsumed into a residual category, sometimes called in recent literature "total factor productivity." Land and natural resources are usually not included in the simple model because they are too heterogeneous and because their contributions to growth (rents) are difficult to measure and are often quite small. In such cases the contribution of land and natural resources will be a part of total factor productivity.[1]

One important aspect of this simple growth model is that the several inputs are to some extent substitutable for one another. Thus capital can substitute for labor in production, and technology (or factor productivity) can substitute for either capital or labor. Depreciation enters the model as a charge or debit against capital stock, in effect reducing the output growth rate by subtracting from total capital stock the amount of new investment needed to maintain the same value of the capital stock. Note that even if no additions were made to capital stock and, because of capital depreciation, the value of the stock were to decline, the model would permit total output to grow *if* the income contributions of the other inputs, most importantly technology or productivity, could more than make up for the diminishing capital.

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1 See for example the World Bank, *Indonesia: Strategy for Growth and Structural Change*, Report No. 7758-IND, p. 18, Table 1.9, Washington, May 3, 1989. The Bank's analysis attributes an unusually large growth impact in Indonesia to changes in capital stock and very little to the residual category, total factor productivity, or TFP. Including the growth of the natural resource contribution to GDP would remove natural resources from the residual and would increase the implied measure of TFP derived from the residual.

Economists have not regarded this simple model as a complete statement of economic growth, let alone of the more broadly defined concept of "development." Many important elements have been left out, especially on the benefit or output side. For at least thirty years, development economists have been wrestling with such questions as how to properly account for distributional concerns (affecting poverty, income inequalities, disparities in "basic needs," etc.), "intangibles" such as environmental amenities or external costs and similar effects, and whether "employment" should be counted as a specific benefit in addition to or in contrast with the income generated by employment.[2]

In recent years, the growing concern with "quality of life," environmental degradation, and the proper accounting for natural resource depletion have deepened the distrust of the conventional growth model. Distrust has been heightened by the growing reliance throughout the world on market mechanisms to stimulate and direct growth despite the well-known fact that markets cannot price and hence place little or no value on many environmental and quality-of-life factors. Markets may also perform less than satisfactorily when it comes to valuing the "true" social worth of natural resources and the importance of "preserving" today's world for the benefit of future generations. The urge to recognize these factors has been partly met by agreeing that a nation's growth objective should be that of sustainable development. The problem then arises of how to define this new concept.

The difficulty, however, lies less with the conventional model than with how we have succeeded in implementing it. This may be seen in the strong similarity between the Brundtland Commission definition of sustainable development (and one widely used by others since that report) and the definition of income by a neoclassical economist of two generations ago, Sir John Hicks.[3] The Hicksian

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2 Some of the most significant advances in quantifying a number of these factors may be found at the micro level in the literature on social cost-benefit analysis. For an early critique of the inadequacy of national income accounts for development planning, see William K. Knapp, "The Social Costs of Private Enterprise" (Harvard University Press, Cambridge, MA: 1950), cited in Richard Norgaard, "Linkages Between Environmental and National Income Accounting," in Ahmad, Yusuf J., Salah El Serafy, and Ernst Lutz, *Environmental Accounting for Sustainable Development, A UNEP-World Bank Symposium* (World Bank, Washington, D.C.: 1989). The general aim of this latter volume is to explore how environmental intangibles might be captured by a formal system of accounts.

3 In the words of Sir John Hicks: "The purpose of income calculation in practical affairs is to give people an indication of the amount which they can consume without impoverishing themselves. Following out this idea, it would seem that we ought to define a man's income as the maximum value which he can consume during a week, and still expect to be as well off at the end of the week as he was at the beginning. Thus when a person saves he plans to be better off in the future; when he lives beyond his income he plans to be worse off. Remembering that the practical purpose of income is to serve as a guide for prudent conduct, I think it is fairly clear that this is what the central meaning must be. (Sir John Hicks, *Value and Capital*, Oxford University Press, 1946, p.172, quoted in Herman Daly, "Toward a Measure of Sustainable Social Net National Product," in Ahmad, Yusuf J. et al, cited above). Hicks' concept of income is usually described more briefly, as for example in the introductory chapter by Serafy and Lutz in the UNEP-World Bank volume just referred to: "...the maximum value that a person can consume during a time period and still expect to be as well off at the end of the period as at the beginning." Compare this with the essence of the Brundtland Commissions definition of sustainable development: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (World Commission on Environment and Development, *Our Common Future*, Oxford University Press, New York: 1987, p.43).

concept of ordinary income is in fact that of sustainable income.[4] The concept of sustainable income, in turn, is reflected in the "properly computed...real net national product (NNP)" as described by Dasgupta and Maler.[5] These two authors go on to state:

> Real net national product estimates are in bad odor today. It is often thought that they are even in principle incapable of reflecting aggregate intergenerational well-being. This is not correct. Subject to certain technical restrictions, for any conception of the social good, and for any set of technological, transaction, information and ecological constraints, there exists a set of shadow, or accounting prices which, when used in the estimation of national output, will ensure that the index [of real net national product] reflects aggregate well-being.[6]

This is to say that if all scarce factors and needs--natural resource, environmental, and human (including intergenerational)--could somehow be correctly valued to reflect their true scarcities, the values could be combined into a "properly computed" index of real net national product. The inference is that if this "proper" index of aggregate intergenerational well-being (NNP) rises at least as fast as does population, the economy is on the path of sustainable development. This is the definition of sustainable development proposed by these notes.

As further noted by Dasgupta and Maler:

> We are, of course, using the measurement of NNP merely as a prop to hang a number of issues concerning public policy. Appropriate criteria for public investment, and the public screening of private investment are...closely related to the correct way of measuring NNP...An entire set of commodities and services are regarded free in current exercises on these matters even while their accounting prices are positive. This leads to biases in policy. And it leads to biases in the design and installation of new technology, in that they are often unfriendly to environmental resources. Indeed, an entire debate, whether *economic* and *environmental* considerations are in contraposition, is a misplaced one. They *are* when economic calculations are biased. They would be consonant with one another if environmental resources were to be made a part of the furniture of economic thinking.[7]

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4 This fact has prompted Herman Daly to argue that "the term 'sustainable income' ought therefore to be considered a redundancy. The fact that it is not is a measure of how far we have strayed from the central meaning of income and, consequently, of the need for correction." Daly, as cited above, p.8.

5 Dasgupta, Partha, and Karl-Goran Maler, *The Environment and Emerging Development Issues*, World Bank Annual Conference on Development Economics, Washington: April 26 and 27, 1990.

6 Ibid., pp.11-12. The "technical restrictions" mentioned by the authors, as explained in their footnote 8 on page 12, refers to the need for convexity among certain attributes of the system. The convexity condition is "dubious for pollution problems" but can be side-stepped through somewhat cumbersome but feasible estimating techniques. Dasgupta and Maler also point out that because "needs and incomes differ along gender, age, caste, or ethnic lines," many of the accounting prices "will be person or household specific."

7 Ibid., pp. 19-20.

Herman Daly has reached a similar conclusion but proposes a less comprehensive and less theoretically complete solution. He offers two adjustments to the conventional measure of NNP "to make it a closer approximation of Hicks' concept of income and a better guide to prudent behavior." One adjustment is to include the depreciation of "natural capital stocks" along with those created by humankind. The second is to subtract from NNP "defensive expenditures, or regrettable expenditures necessary to defend ourselves from the unwanted side effects of our aggregate production and consumption."[8]

What are the implications for planning of this view of sustainable development? They are that the key to incorporating environmental and other nonmarket-priced considerations into planning for sustainable development is to expand the existing growth model to include all relevant nonpriced resources, services, human needs, and other considerations. This can be achieved in a practical way by following the natural resource and environmental accounting framework proposed by Henry Peskin.[9] Under this scheme standard inputs (largely labor, capital, and market-based resource rents) are supplemented by a series of "below-the-line" factors whose prices are not normally determined in the economic marketplace. These would include services provided by the environment (chiefly waste disposal), watershed management, biodiversity, and the like.

Similarly, outputs (whose conventional elements comprise consumption, investment, and exports) may be expanded to include unpriced, below-the-line environmental and social benefits (and negative benefits, or disbenefits), intergenerational gains and losses, and (at least conceivably) even political gains or costs.

The difficulty of finding values for these previously unpriced inputs and outputs should of course not be underestimated. But once the framework is clear and the missing factors have been identified, then a number of strategies can be employed for arriving at agreed-upon values. Sometimes analogies can be made with goods and services which do have market values. Sometimes human behavior, interview responses, etc., can be used to provide indirect evidence of values of willingness to pay. Sometimes cardinal rankings and rough orders of preference may be helpful. And occasionally the value question may be disposed of through sensitivity analysis to determine the maximum (or minimum) values below (or above) which the unknown value would not have, in fact, any effect on a particular policy decision.[10]

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8 Daly, p.8.

9 Peskin, Henry M., *Environmental Accounting in Indonesia: Towards a Comprehensive System*, May 1991. See also Peskin's two chapters in Ahmad et al.: "Environmental and Nonmarket Accounting in Developing Countries" and "A Proposed Environmental Accounts Framework."

10 See for example Hufschmidt, M., D.E. James, A.D. Meister, B.T. Bower, and J.A. Dixon, *Environment, Natural Resource Systems, and Development: An Economic Evaluation Guide* (Johns Hopkins University Press, Baltimore: 1983); Dixon and Hufschmidt, *Economic Valuation Techniques for the Environment* (Johns Hopkins University Press, Baltimore: 1986); Dixon and Paul Sherman, *Economics of Protected Areas in Developing Countries: General Issues and Examples from Thailand*, report prepared for the Asia and Near East Bureau, USAID/Washington (Environmental and Policy Institute, East-West Center, Honolulu: March 1989); and Pearce, David and R. Kerry Turner, *Economics of Natural Resources and the Environment* (The Johns Hopkins University Press, Baltimore: 1990).

Considerable progress has been made in our ability to carry out such valuation. In a brief review of the question, Richard Norgaard refers to the numerous techniques developed over the past three decades "for estimating the monetary values of resource and environmental services...Economists have tried to ground these techniques in economic theory, have obtained adequate data in some cases, and have established effective econometric procedures. To most economists, environmental and resource valuation is a proven area, one where success appears consistently possible after sufficient effort."[11]

Implications for Resource, Financial and Political Sustainability

There are two important implications for planning the proposed model of sustainability. The first is, as noted already, that to some extent inputs, including natural resource, can be substitutes for one another. The second is that from a national perspective what counts is the nation's sustainable development and not the sustainability of a particular sector.

Take the case of nonrenewable natural resources. Substitutions are often possible to extend the life, sometimes "indefinitely," of resources whose supply is in some sense finite. Examples include improved efficiency of use (management and technology), technological innovation, or the willingness to spend more on poorer sources of supply. Even where supply extensions are more limited, a country may still choose to use up its resources if it is persuaded that the resulting discounted stream of benefits exceeds that from postponing use until later. In the simpler language of Dasgupta and Maler, a decline in the stock of an exhaustible resource is not by itself a cause for concern. "To not reduce their stocks is to not use them at all, and this is unlikely to be the right thing to do."[12]

In the case of renewable natural resources, even in the case of irreversible reductions in the current resource base, one must look at the tradeoff between the present benefits ("properly defined," as discussed above) and those obtainable in the future from the same resources. Another way to pose the question, one less dependent upon the "proper" valuation of all variables, is to ask whether the income from the exploited resource will be reinvested so as produce a long-run benefit stream of a magnitude equivalent to the benefits lost. As one asset is used up, in other words, new assets must be created of equal or greater long-run value (in the sense of their projected stream of benefits). If this can be done, then the country's path of development, at least with respect to using up that particular resource, is sustainable. Once again quoting from Dasgupta and Maler, in the case of renewable natural resources:

> "...we could in principle limit their extraction and use to their natural regeneration rate and thus not allow their stocks to decline. But this too may well be the wrong thing to do, in that there is nothing sacrosanct about the stock *levels* we have inherited from the past. Whether or not policy should be directed at expanding environmental resource bases is something we

11 Norgaard, pp. 54-55.

12 Dasgupta and Maler, p. 10.

should try and *deduce* from considerations of population change, intergenerational well-being, technological possibilities, environmental regeneration rates and the existing resource base. The answer can't be pulled out of the air."[13]

The implications for natural resource sustainability, in short, are that judgments and policies should not be arrived at without considering substitution possibilities (including that of substituting foreign for domestic sources of supply) and the national benefits to be derived from expending rather than saving one's own stocks.

Turning to financial and political sustainability, both have more to do with the mobilization of resources used as inputs to growth and development than with working out sustainable development itself. Both are closely related to the public and private satisfaction and willingness to pay for a certain rate and type of economic and social development. Political sustainability, for example, would seem at an abstract level to be largely a function of the degree of harmony between the government's perceived actions and the peoples' needs and satisfactions.

In another sense, of course, financial and political sustainability is the very stuff of real world, day-to-day policy making. Domestically the two are closely liked by the connection between willingness to pay taxes and taxpayer (voter) satisfaction with the political process. Foreign capital markets and donor contributions may be influenced by similar considerations. On the other hand the level of foreign exchange is chiefly determined by export earnings, in turn reflecting the supply, demand, price, and conditions under which the nation is willing to sell its produce and product abroad.

On a more practical note, the incidence rate of taxes paid in Indonesia appears low by the standards of other countries. It would thus seem that there is no immediate limit on government resources from domestic sources other than the willingness to pay and the ability to collect higher taxes.

The continued availability of foreign exchange is another matter given that over three-quarters of all commodity exports are natural resource-based.[14] The growth of tourism in recent years and of commodity exports not primarily dependent upon natural resources demonstrates that a gradual substitution is occurring between labor-technology-capital on the one hand and natural resources on the other.[15] Nevertheless, any immediate and significant reduction in foreign exchange earnings, say in the name of ensuring a more sustainable extraction rate from a particular sector, could cause considerable short run financial difficulties for the nation. A careful examination of all factors might disclose that full

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13 Ibid.

14 The actual 1989 figure, based on BPS, *Indikator Ekonomi*, Feb. 1991, was 77.9 percent. Oil and gas accounted for 39 percent of total commodity exports and manufactures based on natural resources, including cement and leather goods in addition to tree crops, processed food, wood and paper products, and non-ferrous mineral products, came to 27 percent.

15 Between 1981 and 1989, "other" (non-resource-based) commodity exports increased from under 2 percent of the total to over 22 percent. (BPS, *Indikator Ekonomi*, Feb, 1991).

sustainability of a particular resource base at current levels was not consistent with the most efficient way for achieving sustainable development for the nation as a whole. Some permanent reduction in natural resources stock, in other words, might permit (and in many countries often has permitted) the creation of new assets of even greater longer-run foreign exchange earning value.

It may not be easy to express the notions of substitutability and national (as opposed to sectoral) sustainability in clear and simple enough ways to command wide popular support. In Indonesia there appears to be a groundswell of popular backing for what may be rather vague notions of environmental preservation. Accompanying this in the popular mind may be at least some implicit criticism of the "excesses" of modern, market-based economic development, including but not limited to the lack of well paying employment opportunities for all. This suggests that political sustainability may depend to some extent upon a popular perception that a suitable fraction of the country's benefits from growth are in fact being effectively redirected towards environmental and other "quality of life" concerns.

Implications for Shorter-run Planning, Programming and Budgeting

The proposed sustainable development model depends heavily upon identifying and valuing social benefits and costs which are not captured by the conventional national income accounts. When all such elements have been included along with measures of the economic depreciation (depletion) of natural resource stocks, the changes over time in the redefined net national product will be a strong indication of truly sustainable growth.

Under this model, not only would a series of intangible or nonmarket values be introduced into the national accounts, but these same nonpriced benefits and costs would be estimated for individual projects and incorporated into sectoral and regional plans. Basing decisions upon these new, enlarged data sets will in some cases be quite straight forward. In other cases, the additional information may merely seem to complicate what would otherwise have been a simple decision, based strictly on market-derived calculations.

There is an analogy with the difficulties encountered when basing decisions upon social benefit-cost analysis. Economists define several levels from which a project may be evaluated. The first is that of routine financial analysis, in which all benefits and costs are valued at market prices. The second is from the viewpoint of society as a whole, in which some market prices are adjusted to reflect the "true" factor scarcities for society. The third may examine issues of social justice and interpersonal utility embodied in the actual distribution of benefits and costs to individuals within society. Other layers might be added by some analysts to account for classes of goods or outcomes deemed to be of greater or less merit according to the moral standards of the society.[16]

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16 For a clear exposition of this approach see Hansen, John R., *Guide to Practical Project Appraisal: Social Benefit-Cost Analysis in Developing Countries*, Project Formulation and Evaluation Series No. 3, (The United Nations, New York: 1978), Sales no. E.78.II.3.

The difficulty comes when a project evaluation based upon broader, nonmarket values differs from the more narrow, market-based evaluation. Private business persons will certainly not undertake a project with a high social benefit-cost ratio if its financial benefits do not exceed its financial cost. Even government ministers may be reluctant to undertake socially desirable projects or programs if the narrow financial calculations show that they will operate at a financial loss.

One solution is for a government to recognize explicitly the difference between the private and social calculus and to engage in formal subsidies for socially deserving projects and programs whether undertaken by the private or public sector. A narrower solution is to insist that all proposed projects at least break even in financial terms. Among those that met the minimum financial criterion, a final choice would then be determined by nonmarket, social considerations. The narrower solution will make government or private investors faced with an otherwise "unprofitable" project more comfortable with their investments. The social good, however, may not be as well served as under the subsidy solution.

In the case of decisions made to pursue and enhance "sustainable development," there will obviously have to be considerable debate and probably experimentation–at least when a project or programs will make a negative contribution to NNP as conventionally defined but a positive contribution when NNP is "properly" defined. One step which might help decision making in the short run would be for a government to set aside in advance a fund designed to compensate those within and outside government for their net financial costs in undertaking socially desirable projects.

A second implication of the proposed model is in fact one already recognized under the conventional economic model. This is to pay special attention in the short run to those somewhat intangible factors of particular importance to growth and development in the longer run. Traditionally these include science, technology, management, and improving the quality of the human factor. More recently, there has been an increasing appreciation of the importance for "total factor productivity" of market incentives and discipline. Under a broader definition of net national product, these same factors would have enhanced importance because of their ability to compensate partly for natural resource depletion and environmental degradation.

Another shorter-run implication relates to institutional matters. Normal monetary prices are determined by exchanges in a commodity, service, or financial market. To place a fair and accurate value on intangible, environmental, and similar benefits and costs, services and disservices, one would also like to have some analogy to an economic marketplace. In a rough way this can be accomplished by encouraging the generation of and the exchange of ideas, opinions, and personal feelings among various groups and individuals.

Both generation and exchange have been encouraged by recent moves within Indonesia towards government decentralization, and by the proliferation of NGOs concerned with environmental issues. It remains to question whether any government organizational changes, for instance, might strengthen the voice of the

environmentalists and the quality-of-life supporters in determining the social values to be used in properly adjusting the NNP. Such changes might include greater autonomy and voice for a national parks and protected areas agency, improved analytical capacity in the Ministry of Population and the Environment, and perhaps a BAPPENAS-led forum for the identification and valuation of non-market social goods, services, and costs. (See the section below on current policy issues for Indonesia.)

Implications for Longer-term Planning Issues

The very essence of sustainable development is that planners and policy makers adapt a longer than usual time horizon for their decisions. Many environmental and resource problems may be tolerated in the short run but bring extremely high costs in the longer run. A periodic long-run perspective planning process can be an essential part of developing a longer run perspective.

Two examples will illustrate this point. In recent years Indonesia's forestry sector has been of the greatest interest to environmentalists and to those concerned with the sustainability of Indonesia's renewable resources. By now it seems clear that rising domestic demand and the ongoing foreign exchange need for forest-based exports either has already or will reach unsupportable limits within the near future. This is to say that total demand (including that for exports) will be likely to exceed sustainable supply. This means that Indonesia's stock of forests could thereafter be depleted at an accelerating rate into the foreseeable future.

The solution to this likelihood is by no means clear. Policies should be based upon, as noted earlier, a careful comparison of long-term benefits and costs, broadly defined to include such nonmarket-valued matters as watershed protection, biodiversity, recreation and tourism, global carbon dioxide benefits, esthetic enjoyment, and availability of timber from foreign sources.

What is more clear is that a longer-term plan might well include statements such as "Around the year 2005, Indonesia's currently sustainable timber yield will be exactly equivalent to probable domestic demand, leaving no excess for net exports. By the year 2020, domestic demand could easily exceed twice today's sustainable timber yield."[17] It is likely that these statements would command more attention and calls for appropriate policies than would a far more vague sentence about "future" forestry depletion in a five-year plan.

The second example concerns a less well appreciated possibility, namely the probable impact of the future industrialization of the island of Java. At current

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17 The first of these statements assumes: (1) a relatively modest constant-price growth rate of about 5.5 percent annually between 1985 and 2006; (2) an average population growth rate between those years of 1.7 percent; (3) an annual increase in the domestic consumption of "industrial lumber" equal to about 5 percent; (4) little or no change in relative timber prices; and (5) an annual sustainable production level from all of Indonesia, assuming "improved policies," of 23 million cubic meters. The first four of these assumptions are from Strout, Alan, *Forecasting Economic Growth and Environmental Change in Indonesia, 1990-2000*, April 1991. The sustainable yield estimate is from the World Bank, *Indonesia: Sustainable Development of Forests, Land, Water, a World Bank Country Study* (World Bank, Washington, D.C.: 1990). pp.8-9. For further details see the document by Strout, Table 4, and accompanying text.

rates of manufacturing concentration on Java (about 70 percent of the total for Indonesia) and under the same low-growth assumptions used for the forestry example, Java could be experiencing environmental and pollution problems in another 25 or 30 years similar to those found today in parts of Western and Eastern Europe.[18]

It is hard for today's observers to imagine the great changes and the environmental threats which can take place during 25-30 years of even modest economic development. Witness the changes in the city of Jakarta over the past 25 years. The effectiveness of a longer term plan lies in its ability to capture the shape and magnitude of likely changes and to devise strategies for dealing with these changes. Surely the location of economic activity today and tomorrow will be of great importance for the "sustainability" of tolerable and healthy living conditions in particular locations over the longer-term future. But to forecast accurately the probable effects of alternative location policies will require both a long-term perspective and close attention to nonmarket factors (externalities, both industrial and social) of importance to future well-being.

The implications of the properly valued NNP approach to sustainable development are that the benefits and costs from alternative resource strategies can best be judged (and in fact, it may be argued, can *only* be judged) in the context of overall growth and change in the longer run. Every analytical effort must be made to trace out for the economy as a whole, including both economic and nonmarket effects, the consequences of alternative policies. Quite obviously there is a great need for accurate forecasting, for analysis of global developments and change, for careful risk assessments, and for imaginative sensitivity analysis. Quite obviously, too, when changes are under consideration, there must be a careful examination of intermediate questions such as "How do we get from here to there with the least possible social cost and disruption?"

Finally, it is worth reemphasizing the importance of longer-run national and regional planning to the whole debate over a country's ability to achieve sustainable development. A balanced judgment on sustainability can only be reached after taking long-run change into account, and it is the long-run perspective plan which can best describe and analyze likely change. Similarly, the best prospects for achieving true sustainable development may lie in the prescience and careful logic of the long-term plan.

Implications for Current Policy Issues in Indonesia

There are a series of other sustainability issues of current concern in Indonesia. Some have already been addressed by government policies. Most are still awaiting incorporation into a coherent, long-term sustainable development approach.

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18 Strout.

Some are of such high international interest that successful Indonesian approaches to the issues could be of considerable importance to major trading partners and aid donors. The list of policy areas includes:

- Energy conservation and prospects for some degree of sustainability.
- Land use: resolving current and future conflicts among competing users.
- Parks and protected areas conservation and development.
- Coastal and marine resources management and conservation.
- Watershed management, including dams, resettlement, reforestation, etc.
- Industrial and household pollution control.
- Financing: for example, should a policy decision be made on the best and fairest ways to compensate enterprises, local governments, and individuals for the costs of environmental and quality-of-life improvements that could not otherwise be captured in normal markets?
- Institutions: What is the best method for Indonesia to organize the policy studies, income accounting, forecasting, standards creation, and the enforcement standards related to longer run sustainability? (The creation of BAPEDAL has undoubtedly been an important part of the answer to this question.)

Several comments should be made about these policy areas. First, sustainability problems related to Indonesia's natural resources are in many cases so acute that conservation and related decisions must be made immediately on the basis of the best available knowledge and analysis. It is possible in some cases, however, that these early policies might later need to be modified as the result of more careful analysis based upon the precepts of the sustainability model proposed in this paper. (That is, the analysis should include the possibility of substitutability among factors; a full identification and valuation of nonmarket factors, both costs and benefits; an effort to assess future streams of benefits and costs for many years into the future; and an ultimate judgment reflecting the effect upon national sustainable development). This suggests the desirability of beginning additional, comprehensive studies as soon as possible, employing the more broadly based analysis advocated herein.

Secondly, it is a relatively new task to apply to natural resources and resource-based issues a comprehensive, long-run analysis embodying nonmarket as well as market factors. There are few lessons from elsewhere which can be easily adapted to the Indonesian case. There is just beginning to emerge a body of acceptable theory and tentative consensus on how nonmarket valuations should be attempted. However, there has been to date little practical experience, and much exploratory study and experimentation (learning by doing) are still needed. Countries around the world, in short, are grappling with many of the same issues as Indonesia. Indonesia could well become a leader in this particular field.

Third, the spatial dimension is an important component of all the issues listed. To a large extent the problems can only be analyzed properly on a location-specific or at least a regional or subregional basis. Solutions found for one location may not automatically be appropriate elsewhere.

Finally, one might ask how planning under the proposed sustainable development model might differ from planning under a more conventional approach. Take once more the example of the forestry sector. Conventional economic planning would deal mostly with the best use of forest resources from the perspective of national income growth and would say little or nothing about national sustainability. Conventional forestry planning based on principles of resource conservation and preservation would emphasize the importance of maintaining timber production capacity (yield sustainability). There would also be a considerable but mostly unquantified importance attached to other forest ecological functions and economic contributions. These might include, as noted above, watershed protection, employment generation from collecting and consuming nontimber products, maintenance of biodiversity, recreation, tourism and esthetic enjoyment, and the forest's role as a sink for carbon dioxide.

The broader approach of the sustainable development model, in contrast, would first of all try to identify and value, on a long-term basis, the many nonmarket aspects of the forest. It would seek to measure, in short, by how much the economic and social value of a forest exceeds the sum total of the timber's commercial value. But the broader approach would ask additional questions. What level of forest stock is most compatible with the long-term sustainable development of the country as a whole? Might it be feasible to first draw down the timber stock in support of other social and economic objectives and then permit the stock to rise again in later years? What irreversible losses (say, to biodiversity) might occur in this process, and what value can be placed on the lost services? How does forest yield sustainability contribute to national development in contrast to alternative uses of some forest land, especially for agriculture? How might the composition of the forest stock itself, for example as between natural forests and plantation forests, affect the concept and desirability of forest sustainability? Are there any options open to the country to reduce domestic demand for timber, to more effectively exploit future foreign demand for certain types of forest products, or to increase forest productivity of outputs other than timber?

Many of these same issues would be (and have been) raised in the process of more conventional analysis. However, the sustainability model's explicit consideration of long-run nonmarket values, substitutability among factors, primary focus on national rather than sector sustainability, regard for distribution and intergenerational issues, and other considerations of a longer-run nature would enlarge the scope for debate and hopefully lead to more consistent and coherent policy decisions.

7. ELEMENTS OF A SUSTAINABLE DEVELOPMENT STRATEGY FOR INDONESIA

Introduction

Chapter 5, *Towards a Planning Model for Sustainable Development,*" presents a sustainable development definition and model having potential applicability in Indonesia. Both the definition and the model (an extension of that conventionally used to describe and analyze economic growth) call for the identification and valuation of socially important factors which are not now included in standard national income and product accounts. The most important of the unpriced, nonmarket factors are environmental services and costs and the depreciation of natural resources. Other difficult-to-value factors which belong conceptually in this list are numerous quality-of-life benefits and special weightings of other nonmarket factors included to reflect social and perhaps political objectives. (Examples of the latter would be higher social weights given to poverty alleviation and possibly to certain regional objectives.)

Once the new factors have been identified and valued (admittedly a difficult process), they may be fitted into a conventional set of national income accounts. The result will depict a far more complete and socially responsive picture of development than found in the standard, unadjusted accounts. The adjusted measure of gross national product (GNP) will represent a more satisfactory description of total output in that it will include a series of environmental and quality-of-life services not normally identified or valued. When the depreciation of both manufactured capital and of natural resources is subtracted from adjusted GNP to give adjusted net national product (NNP), the result will be a relatively complete measure of human well-being. If, over time, this adjusted NNP increases as fast or faster than does total population, the country can be said to be following a path of sustainable development.

Questions remain, obviously, of how to move from the definition and model to a sustainable development strategy for Indonesia. The current notes are addressed to four of these implementation issues: commitment, tactics, organization, and score-keeping.

Commitment

An important aspect of political commitment is to make "sustainability" a major developmental goal. By explicitly and publicly attesting to the importance of sustainability, and by emphasizing its significance in every aspect of the planning process, the government sends a clear and vital message throughout its own bureaucracy and to the general public.

The World Bank has pointed out Indonesia's "long-standing commitment to the concepts of environmental protection and sustainable development" going back at least to the GBHN in 1973 "which emphasized that 'exploitation of natural resources should be executed by a comprehensive policy which takes into account

the needs of future generations'."[1] Despite continuing expressions of strong interest in sustainability, Indonesia, according to the Asian Development Bank, in 1990 had yet to take the initial step of making sustainability "an explicit major goal of the country's development plan." An Indonesian study team examining sustainable development for the Asian Development Bank has recommended that "sustainability be declared a fourth element of the existing development trilogy of stability, growth, and equity."[2] There reportedly has since been considerable, mostly favorable, discussion of sustainability as a fourth national objective.among Indonesian economists and planners

Tactics

A series of steps will be needed to turn the *objective* of sustainable development into an *action plan* for sustainable development. The first of these is to agree upon a practical and simple definition or model of sustainable development and upon a means for measuring progress towards the goal of sustainability. The definition offered above is conceptually simple and clear, and it is economically respectable. Because it permits some degree of substitutability among productive factors and outputs, it will not be readily accepted, however, by hardline environmentalists. The proposed sustainability goal, furthermore, is currently less-than-practical because measured progress must rely on data that has yet to be assembled and on values that will be difficult to reach agreement on. The proposed definition nevertheless offers a clear vision of an appropriate and theoretically measurable national goal. Over a number of years (3? 5?), it should be possible to develop and assign values to a suitable set of environmental and natural resource accounts.

A second, shorter-run tactic is to devise a public initiative which (a) demonstrates to the people of Indonesia their government's commitment to the sustainability goal; (b) mobilizes large numbers of people and organizations throughout Indonesia (since sustainable development is in many ways a primarily local issue) in the active pursuit of the goal; and (c) would be impressive enough and practical enough to catch the attention of the international donor community and of those nations participating in the 1992 Rio Conference. As an example, since there is almost certainly a direct conflict at some level between rapid economic growth and environmental sustainability, there could be a public decision to allocate a certain fraction of national product above, say, a "minimum" five percent rate of growth into a separate, "environmental" or "sustainability" part of the national budget.

The new fund, fueled by the nation's growth dividend, would be analogous to the new Global Environmental Fund of the World Bank except that its use would be limited to domestic projects. The domestic fund, in fact, might prove an acceptable vehicle for international contributions. If, in addition, suggestions for fundable projects were to be encouraged from private as well as public organizations, from environmentally concerned NGOs, and from interested individuals, it would serve two additional important functions. The first, of course, would be to promote widespread, grassroots involvement in environmental and related issues, helping

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[1] *Indonesia: Sustainable Development of Forest, Land, and Water; a World Bank Country Study*, World Bank, Washington, D.C.: 1990, p. 136.

[2] *Economic Policies for Sustainable Development*, Asian Development Bank, 1991, p.68.

both to identify potential problems areas and to create a considerable amount of political support. Secondly, it would encourage a widespread public dialogue about the value of certain projects versus competing projects. These debates would help to establish the "social values" needed for adjusting NNP and for measuring progress towards national sustainability.

A second example might derive from a purely Indonesian initiative that is already beginning to be implemented in the area of assigned property values. It is widely understood among economists that many of the current, undesired "externalities" of pollution and other environmental degradation could be ameliorated if air and rivers and coastal waters were no longer regarded as free goods. In fact, the argument runs, often these natural resources are treated as though they were owned by the polluters. This results in a lower social good than if property rights had instead been acquired by those who suffer from the polluters. However, when political and institutional considerations are taken into account, the usual conclusion is that there is probably no practical way to ever establish the property claims of the pollutees over air and water.

But Indonesia has already begun to move in the direction of reassigned property rights through the President's hope to persuade private industries to assign a part of their ownership rights to local populations organized into cooperatives. With this precedent in mind, there might be some interesting possibilities for assigning to local populations rights to the air and water affected by the private (and public?) firms. The legal basis for such an assignment, furthermore, might be easier to establish than for the appropriation of existing ownership rights.

Organization

To pursue implementation tactics most effectively, organizational reform may be needed. If local environmental projects are to be identified and corrective activities are to be undertaken throughout the archipelago, the recent trends towards decentralization must be continued. A national environmental budget to which local groups have at least indirect access would do much in this regard. Developing a new set of national and regional environmental accounts will require not only a great deal of data collection, an effort already underway within the Ministry of Population and the Environment and Biro Pusat Statistik, but much experimentation, model building, and debate among theoreticians. There exist few if any data valuation models to guide Indonesia in this area, and the country, to be a world leader in the field, must work closely with the best minds available, nationally and globally.

It is also possible that some of the more environmentally sensitive agencies within the government might benefit from greater public visibility and increased independence (and accountability), in addition to greater budgetary resources and more skilled personnel. One example might be national park and protected area management and nature conservation, now under the Ministry of Forestry. Organizational change may be necessary to achieve these institutional objectives.

Finally, by its very nature as an encompassing backdrop for many sorts of economic and social activities, environmental concerns often cut across many existing jurisdictions, both geographical and organizational. Examples of these cross-cutting areas include water use on Java, pollution and hazardous waste management, coastal and marine resource management, and urban growth management. The resolution of problems within one of these areas will by necessity involve the cooperation of many agencies and levels of bureaucracy. In the case of coastal and marine resources, for instance, about 28 agencies were represented at the 1987 Jakarta Workshop on Planning for Development of Marine and Coastal Resources. In these circumstances, new resource-specific groups may need to be formed and given sufficient power to ensure the success of a cooperative effort among many operating agencies. In the case of marine and coastal resources once again, the Indonesian Medium-term Planning Support Team concluded:

> As a critical first step in implementation [of the action plan for sustainable development] it is recommended that an interagency coordination mechanism involving key agencies at the national and regional levels of marine and coastal development be established...

And later:

> Above all, marine and coastal activities need to be grouped together as a concept for improving management of cross-cutting activities, rather than for the purpose of creating a distinct administrative entity.[3]

As with marine and coastal resources, it is likely that other cross-sector environmental issues will require the invention and execution of new organizational forms.

Scorekeeping

The proposed sustainability definition and environmental accounting system will, after a number of years of data collection and experimentation, provide an indication of whether Indonesia is or is not on a path of sustainable development. The "national score card" based on the national income and environmental accounts can and should be supplemented by an annual listing of "sustainability" projects started and finished, by sectoral reports of goals and objectives reached, and by the amounts of public and private investments made in environmental and related projects. Until the adjusted measures of net national product can be perfected, the detailed, project and sector-based national scorecard must in fact serve as the principal indicator of sustainable growth.

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[3] *Action Plan for Sustainable Development of Indonesia's Marine and Coastal Resources*, Indonesian Medium-term Planning Support Team, (BAPPENAS/Canada, April 1988, pp. 2 and 2-8)

8. NOTES ON ECONOMIC SUSTAINABILITY

1. Economic Policies for Sustainable Development (ADB, 1991)

Executive Summary: The primary objective of the study is to translate World Conference on Environment and Development (WCED) recommendations into an achievable economic development and environmental protection program relevant to the particular circumstances and urgent needs of that country in the 1990s. Each study examines national economic policies and environmental programs to assess which are supportive of, and which constrain, implementation of WCED recommendations.

The Brundtland Commission defined "sustainable development" as:

> "... a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations."

Some key findings:

- Economic development enhances living standards and thus improves environmental quality, but there are some negative by-products which require urgent attention and effective counter measures.

- The alleviation of poverty produces beneficial effects in terms of sustainable development.

- Public and private expenditures must be realigned to achieve a more sustainable pattern of development.

- Development planning and budgeting must be undertaken in close cooperation with environmental agencies.

- The process of economic transformation in recent years has caused a rapid increase in human pressure on the environment, and radical structural transformation, particularly in terms of industrialization and urbanization.

- Several resource management problems result from rapid economic transformation: abundant resources such as water, land, and air become scarce.

Trends in Seven Participant Developing Member Countries

Population: Country reports make clear that the differences in growth rates are related directly to differences in policy; while there is no contention that policy alone can account for all the differences, there is strong evidence that it is a substantial factor.

Indonesia's growth rate will drop to 1.7 percent between 1988-2000. Nevertheless, by the year 2025 the population will have grown by 100 million, to 282 million.

Labor Force: Despite serious concerns regarding the sustainability of recent development trends, all seven countries participating in the current study have experienced growth rates of GNP which are faster than their rates of population growth. However, it should be pointed out that these accounts fail to allow for the depletion of natural resources and other environmental degradation. Although the judgment cannot be quantified precisely at this stage, it is reasonable to conclude that net income growth, especially if calculated to allow adequately for environmental depletion, has failed to keep up with population growth in countries recording low rates of GDP increase (p. 29).

The data presented in Table 2.11 support the hypothesis that long-term economic growth is closely related to rats of saving and investment. In fact, among the seven DMCs there is a one-to-one rank correlation between the investment rate and the long-term growth rate. Implicit in some of these performance indicators is a suggestion that the efficiency in resource allocation has contributed to the ability of high-performance countries to counter large-scale pressures on their natural and other capital resources. One suspects the correlation would be even closer if data were available to allow for depreciation of capital assets and the depletion of environmental resources.

Poverty: Poverty and environmental degradation are closely associated in almost every instance and are described as two sides of the same coin.

There are a number of relevant tables in this section.

Environmental Trends: The lack of *quantitative* environmental information comparable with the statistics available regarding economic parameters is a major obstacle to integrated economic-cum-environmental planning.

Statistical information on the environment is scarce, often inaccurate, seldom comparable from country to country, and rarely available in a time series covering a sufficient number of years to indicate trends in a reliable way.

Without question one of the most important findings of this study is that while reliable data on conventional economic parameters are plentiful, statistical information on the condition of the environment is scarce and poorly organized (p. 40-41).

WRI citing FAO notes the following rates of deforestation during the 1980s.

Indonesia	0.8%
Malaysia	1.2%
Nepal	4.0%
Pakistan	0.4%
Philippines	1.5%
Sri Lanka	3.5%

Reforestation on an annual basis represents only a small fraction of deforestation.

Moderate to severe threats are reported for 57 percent of the wetland sites in Indonesia. The Philippines has the highest with 69 percent of wetlands endangered.

Overall Development Policies: "All country studies agree that to ensure the pace of development is sustained, it is necessary to make sustainability itself an explicit major goal of the country's economic development plan."

The Indonesian study states: "To give sustainability greater recognition, the study team recommends that sustainability be declared a fourth element of the existing trilogy of stability, growth, and equity."

Some questions which are relevant to the issue of sustainable development include:

- How will proposed actions affect the environment and a country's ability to maintain the pace of development for the benefit of future generations?

- Can negative effects be reduced or eliminated, and if so, at what cost?

- Are negative effects fully compensated for by incremental additions to national capital resulting from the proposed action?

- What alternative actions will yield similar "economic" returns, but with enhanced sustainability?

- What arrangements are in place to monitor results of the policy, project, or program from the point of view of sustainability so that threats to the environment, both foreseen and unforeseen, are detected and dealt with promptly?

Many instances are cited in which government agencies, not to mention organizations in the private sector, work at cross purposes to the detriment of the environment and at considerable cost in terms of efficiency. The most obvious cases involve the exploitation of natural resources as a means to create income, jobs, exports, or regional growth without adequate consideration of environmental and sustainability issues which could negate much of the projected project benefit.

2. Dixon, J. and L. Fallon, *The Concept of Sustainability: Origins, Extensions, and Usefulness for Policy,* East-West Center, Honolulu, Hawaii, July 1988.

The authors favor looking at sustainable development as a concept where resources and the environment are inputs into a complex process that generates the goods and services that enrich our lives. Some key points:

- Sustainability has evolved from a fairly narrow and precise definition into a much broader and very nebulous concept.

- Initially the concept was used in the context of a special class of biologically renewable resources, such as fisheries and forests, to define physical limits of exploitation, i.e., using the incremental flow without reducing the physical stock.

- Recently, the concept was extended to a broader system of resources, such as the ecosystem. Achievement is still measured in physical terms, but now rather than a single impact (on fish, trees) there are a variety of goods and services to be considered. Sustained yield forestry may create problems with soil erosion and water yield: there are tradeoffs among different development alternatives.

- The concept is being broadened further to include some increases in the levels of societal and individual welfare. How does a country pursue it, and how does one measure progress?

- One problem is that the attainment of physical sustainability may work against attainment of sustainable economic growth.

- Sustainable development does not require that any particular economic activity continue indefinitely. It may require that structural changes occur in an economy, and that new economic activities replace old ones.

3. Barbier, E. *The Meaning of Sustainable Development,* paper presented to the Ministry of Environment, January 1988.

Suggests that two interpretations of sustainable development have emerged: (1) a wider concept concerned with sustainable economic, ecological, and social development as adopted by the WCED; and (2) a narrower concept which places emphasis on optimal resource stock and environmental use over time.

Interpretation 2 suggests that "sustainable development involves maximizing the net benefits of economic development, subject to maintaining the services and quality of the natural resources over time," where (1) the real per capita income increases over a long period of time; (2) the number below the poverty line does not increase and the distribution of income does not become more unequal; and (3) the services and the quality of the stock of resources are maintained over time.

Stocks can be allowed to decline in situations where technological change allows for the enhancement of environmental quality and the level of environmental services. Incentives which deplete resources in an unsustainable way should be removed.

Caution: do not assume that an irreversible loss of the natural capital stock is justified if it results in the formation of more man-made capital. Some of the functions of the environment are not replicable by man-made capital. In general, there is a need to recognize the importance of irreversibility resulting from development and the value of any benefits lost through reducing the natural capital stock in such a way that its flow of services is affected.

Appropriate economic indicators of sustainability need to be developed and be based on the proper valuation of the economic consequences of natural resource degradation over time.

"The Government of Indonesia has officially endorsed this more narrowly interpreted view of 'environmentally sustainable' economic development in its planning for Repelita V." To quote President Suharto: "The natural environment is the basic capital for the entire Indonesian nation for ages to come. Like capital it cannot be allowed to diminish. Instead it must be developed so that it becomes larger, in order to be able to support development and prosperity in harmony with the aspirations of the entire nation throughout the ages, from generation to generation."

Tackling the problem of "environmentally sustainable" development is a necessary precondition to understanding the conditions required to achieve overall sustainable development.

4. Pearce, D. *The Meaning and Implications of Sustainable Development*, Paris, 1987.

Sustainable development involves maximizing the net benefits of economic development, subject to maintaining the services and quality of natural resources over time. Following from this, economic development includes increases in real per capita incomes and structural change.

Maintaining the services and quality of the stock of resources implies utilizing renewable resources at rates less than or equal to the natural or managed rate at which they can regenerate, and optimizing the efficiency with which non-renewable resources are used, subject to substitutability between resources and technological progress.

It is important *not* to identify sustainable development with the idea that *no* options should be foreclosed: this would stultify economic growth and development. Sustainable development implies considerable caution in undertaking policy which does impose irreversible costs.

Sustainable development analysis suggests that many developing countries do not make the substitution between ecological and man-made capital, and that more cost effective development could occur by focusing on the development value of natural resources.

At a certain level of resource base utilization, economic development is likely to involve reductions in one or more of the functions of natural environments: economic production inputs, receiver environments for waste products, and as a provider of other ecological services.

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9. FORECASTING ECONOMIC GROWTH AND ENVIRONMENTAL CHANGE IN INDONESIA, 1990-2020

Preview

The following paper is a precursor to a more detailed and thorough treatment on growth and environmental issues to be prepared in Indonesia by June 1, 1991. The current, preliminary piece accompanies a similar preliminary note on sustainable development by Henry M. Peskin. The several themes–namely those of sustainable development, economic growth, natural resource use, and potential environmental issues during the years covered by Indonesia's new 25-year plan–will be combined in the consultants' final report.

This introductory note deals with the problem of measuring economic growth over an extended period. It argues that effective, actual growth, in terms of its impact on welfare, on resource use, and on possible environmental degradation, will likely be much higher than suggested by the target growth rates of the 25-year plan. Some implications of this faster growth rate are inferred, based largely on an earlier study of Indonesian growth prospects by the author. These implications in turn suggest a number of likely environmental issues, as well as matters requiring further investigation.

The paper concludes that, while further studies may shed additional light on important issues and may modify some of the details of the arguments advanced in the current paper, the paper's main themes will survive intact. These are: that Indonesia's gross domestic product (GDP) growth target will be the single most important determinant of the potential for future natural resource and environmental problems; and, because of the way in which GDP growth is conventionally measured, the tradeoffs among economic growth, natural resource exploitation, and environmental degradation may be far more restricted than generally recognized.

Introduction

Four different but complementary approaches can be taken to the problem of forecasting longer-term environmental issues in Indonesia. The first is to inventory those problems areas which are already of public concern and to ask what is likely to happen to each in future years. The second is to closely examine specific plans being proposed for the current Repelita and for the following 25-year period, and to draw out the implications of these plans for environmental change. Of particular importance in this examination and analysis would be the spatial location of planned activity.

Thirdly, environmental issues may be identified by analogy with those already experienced elsewhere in the world. The reference countries in this case would be those judged similar to what Indonesia will be like in 25-30 years. Finally, there is a class of events that have not yet occurred (or which have not yet occurred under modern conditions) but which may have profound environmental consequences.

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These include the consequences, both environmental and economic, of global climate change and, at a more local level, the repercussions of a major volcanic eruption on, say, the island of Java.

For all but the last of these analytical approaches, Indonesia's own economic growth rate will be an important element in assessing probable environmental outcomes. Growth will both determine and will be influenced by concerns for resource and environmental sustainability. The pace and nature of economic growth, in fact, may be the principal "policy variable" for obtaining Indonesia's goals of economic and environmental sustainability.

The Problem of Growth Targets

At the heart of most 25-year plans lies an expectation of how rapidly a country is able to grow economically and of how fast it desires to grow. The two first chapters in the Republic of Korea's first 25-year prospective plan, for example, were an evaluation of Korea's growth potential and a specification of macroeconomic perspectives.[1] In Korea's case the projected growth rate for total gross national product (GNP) was 10.1 percent per year, while that for per capita GNP was 8.4 percent.[2] (Though failing as a fully satisfactory measure of economic growth, GNP or its near twin, GDP, are generally used as a first approximation measure of possible and desired economic change.)

The difficulty with such targets is that over a 25-year period, for instance, the proclaimed rates do not in fact measure what they claim to measure. This is because such GNP or GDP growth is inevitably projected in real terms, and "real" traditionally assumes measurement in constant prices. This sounds logical enough, and indeed the assumption works reasonably well over five or even ten years. But during the course of normal economic development, relative prices change.[3] This means that domestic prices paid for some goods and services rise (or fall) relative to those for other commodities. These relative changes do not reflect systemic and normal price inflation but profound structural changes taking place within the economy.

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1 Korea Development Institute, *Long-term Prospect for Economic and Social Development 1977-91* (Korea Development Institute, Seoul: 1978).

2 Ibid., p. 20, Table II-3.

3 This section draws heavily on the international comparison project work of Irving B. Kravis, Alan Heston, and Robert Summers, all of the University of Pennsylvania, and sponsored largely by the United Nations and the World Bank. See the three volumes published by the Johns Hopkins University Press for the World Bank: *A System of International Comparisons of Gross Product and Purchasing Power* (1975, with Zoltan Kenessey); *International Comparisons of Real Product and Purchasing Power* (1978); and *World Product and Income: International Comparisons of Real Gross Product*, United Nations International Comparisons Project, Phase III (1982). Much country detail is also to be found in journal articles, an early one of which, by the same three authors, was "Real GDP Per Capita for more than 100 Cities," *The Economic Journal*, vol. 88, pp. 215-242 (June 1978). This was followed by a series of articles in *The Review of Income and Wealth*: series 26, no.1 (March 1980); Series 27, no. 4 (December 1981); and, by Robert Summers and Alan Heston, in series 30, no. 2 (June 1984); and series 34, no. 1 (March 1988). The last article, "A New Set of International Comparisons of Real Product and Prices: Estimates for 130 Countries," was accompanied by three computer diskettes containing extensive tables for each of the 130 countries. See also Christopher Clague, "Short cut Estimates of Real Income," *The Review of Income and Wealth*, series 32, no. 3 (September 1986).

As examples of expected and normal price changes, consider the prices of most services, of "nontraded" agricultural goods, and of other commodities which do not or did not previously enter into international trade. The price of the goods and services produced by these sectors are, during the earlier stages of economic development, relatively low when contrasted to those produced by the economic sectors which are involved with international trade. As economic development progresses and as a country's economy becomes more fully integrated and responsive to wage and other influences originating in the "modern," export-sensitive sectors, the prices of these nontraded goods and services will tend to rise relative to those of internationally traded commodities. In one sense a person's welfare is not improved by having to pay Rp. 2000 for a haircut rather that Rp. 200, and in this sense a constant price measure of per capita income is the better measure of improved welfare.

But this is a limited perspective to take. For during the same period of time and for related reasons, many other changes will have occurred and will have affected, hopefully, a growing majority of the population. These include technological change and higher productivity in the previously lagging sectors of trade, services, local manufactures, and agriculture. The higher incomes and purchasing power in these sectors are reflected in the rise in relative prices. The producer of haircuts at Rp. 2000 is better off even though the consumer must now pay more. And of course the consumer is presumably someone who has also benefited from rising wages and productivity in his or her own segment of the economy.

Such changes in relative prices are the reason that the average person in the United States appears at first glance to be 45 times "better off" than the average Indonesian was in 1988.[4] This of course is an exaggeration. But so would be a comparison which simply valued U.S. average consumption in Indonesian prices. The approach of Irving Kravis and his University of Pennsylvania colleagues, on whose studies this section draws heavily,[5] has been to reprice the GDP of each country using a set of hybrid, "international prices." This technique would reduce the ratio of U.S. to Indonesian per capita incomes from about 45:1 to "only" 10:1. Though the use of "Kravis dollars" for this comparison is itself a compromise and does not capture all welfare aspects, the lower ratio is probably a more accurate measure of "average" differences between the two countries.

The next section will discuss the preliminary results of an effort to derive adjusted GDP growth projections for Indonesia to the year 2020. The projections assume an illustrative (conservative) average per capita GDP target of about 3.5 percent per year from 1990 to 2020. Subsequent sections test the implications of alternative ways to measure this GDP growth and will discuss the likely implications of the alternative growth rates on natural resource demand and on environmental pollutants. The final section of the paper identifies a number of likely environmental issues for the proposed 25-year plan. It also reminds the reader of

4 Based on 1988 per capita GNP estimates from the World Bank, *World Development Report 1990*, Appendix Table 1 (World Bank, Washington, D.C.: 1990).

5 See Note 3.

economic projection and related issues which require further analysis and research.

An Adjusted GDP Growth Rate for Indonesia, 1990-2020

So far we have mentioned two real growth rate measures for GDP as conventionally defined: a constant domestic price growth rate and a constant international, or 'Kravis-price" growth rate. Neither of these will capture another aspect of economic growth, namely the rate at which Indonesia "catches up" with countries such as Korea, Japan, and the United States. This requires a GDP measure which implicitly allows for changing relative prices while at the same time eliminating or minimizing the effects of general price inflation.

This result can be achieved for past periods by using a linked index in which the base year for price weights is constantly moved forward in time. For projection purposes, it may be difficult to forecast price changes in sufficient detail to permit using the same technique. A cruder method was used by Korean analysts when preparing the 1977-1991 plan already cited. This method, reputedly derived from work by Balassa and Shimomura in the 1960's, estimates Korean GNP growth in constant U.S. dollars, using the following relationship:

GNP growth rate, US$ = {[1+nominal GNP growth rate]/[(1+Pus)x(1+ex)]-1}

Where *Pus* is the rate of increase in U.S. GNP deflator, and *ex* is the rate of increase in the exchange rate per dollar.[6]

Using this equation and projected changes in U.S. GNP and exchange rate measures, the Koreans estimated that an 8.4 percent target rate of per capita GNP growth, measured in constant 1975 won, would translate into an 11.9 percent annual rate when expressed in 1975 U.S. dollars. Thus, the Republic of Korea would be overtaking the GNP per capita level of the United States at a rate considerably faster than suggested by their target growth rate in constant won.[7] An alternative and possibly less crude (but still mildly heroic) way of measuring this higher, varying price growth rate is to draw upon the international price comparison work of Kravis, Summers, and Heston. The technique requires four steps, all sufficiently complicated that details will not be included in this brief paper.

The first step is to derive an econometric relationship in a base year between a country's GDP per capita in U.S. dollars (that is, in domestic values converted to dollars using the base year dollar exchange rates) and the same country's GDP per capita when measured in international or Kravis dollars. For 1985, for example, the ratio of exchange rate-based estimate of per capita GDP to Kravis dollar estimates would be about .27 for Indonesia and, by definition, 1.0 for the U.S. The

6 Korea Development Institute, p. 12.

7 The Korean authors, having made this important point in the first chapter of their report, dismissed the higher rate (erroneously, for the reasons given in the previous section) as not reflecting a higher rate of living standard improvements. They thus failed to draw the possible implications of the higher GNP growth rate for the other macro aspects of projected future change in the Republic of Korea.

same ratio for other countries would serve as the dependent variable for the needed statistical analysis (a cross-country multiple regression[8]). Once the cross-country relationship is obtained, it can be used to approximate the internationally priced GDP per capita given a country's nominal GDP per capita, and vice versa.

The second step is to project a country's future growth rate in terms of its own base year prices. For the current, illustrative purposes, the economic growth rate projected for Indonesia has been moderately conservative. A per capita GDP growth rate of 4.0 percent per year between 1985 and 2000 is used here, equal to a total GDP growth rate of about 5.9 percent. Between 2000 and 2020, some slackening of these rates to 3.1 percent per year per capita or about 4.7 percent total is assumed.

Population growth must also be projected if one is to move back and forth between per capita and total values of GDP and other measures. For the present paper, a 1985-2000 growth rate has been assumed which averages 1.83 percent per year and a 2000-2020 rate of 1.52 percent per annum.[9]

For the third step, per capita GDP in constant domestic prices must be translated into international or Kravis dollars, both for the base year and for some future year. Published Kravis-type estimates for each country now exist through 1985, expressed in 1980 international prices.[10] Changing these to prices of another base year (the base period 1969/71 was used for the current paper) is one of the complications alluded to above and passed over here.

Projecting, say, the 1985 internationally priced GDP values to a future year can be done by simply assuming the same growth rates as for constant domestic price GDP. This was essentially the technique used earlier by Kravis, Summers, and Heston for extrapolating from a base year. More recently they have decomposed total GDP per capita into several components–private consumption, government, gross capital formation, and net foreign balances–and have estimated change in each of these separately.[11]

For the present paper, the disaggregated approach for interpolations is used, where needed, over the period, 1969-1988. The projections to 2000 and 2020 simply assume the same rates as for per capita GDP in constant domestic prices, namely 4.0 percent and 3.1 percent. These may well be understatements since the disaggregated extrapolation procedure applied to 1975-1985 suggests a Kravis-type growth rate that is higher that the constant domestic price rate.

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8 See for example Kravis and associates, *World Product and Income* (1982, pp.337-341), and Summers and Heston, "Improved International Comparisons of Real Product and Its Composition, 1950-80." *The Review of Income and Wealth*, series 30, no. 2 (June 1984, p.211).

9 Based on the Indonesian population projections to 2005 shown in Biro Pusat Statistik, *Statistik Indonesia* 1988 (BPS, Jakarta: 1989), p.43. The five-year annual growth rates implied by the BPS table and the extrapolations used for the current projections to 2020 were, for successive five-year periods beginning with 1990: 1.8 percent, 1.6 percent, 1.38 percent, 1.25 percent, 1.15 percent, and 1.05 percent, the last being an average for 2015-2020.

10 Summers and Heston, 1988.

11 Summers and Heston, 1984.

The final step is to work backwards from the internationally priced GDP estimates, using the same equation as found in step one, to give per capita GDP in nominal U.S. dollars. These dollars remain those of the original base year, but the new nominal estimate has implicitly allowed for changes in relative prices during the growth process. The new "nominal" rates of growth will be, in general, considerably higher than either of the two constant price growth rates.

The nominal rates express directly the speed at which Indonesia will be catching up (in terms of average per capita income) with currently wealthier nations. This catching-up rate is the correct one to use when drawing conclusions for the future derived from past cross-country statistical analyses.[12]

A comparison of the several alternative growth rates is given in Table 1 on the following page. Actual rupiah or dollar values are not shown because, as already noted, the base year for the current calculations was essentially 1970. Values in 1970 U.S. dollars have little direct meaning for today's readers. Retaining a 1969/71 base period (that is, a 3-year average centered on 1970) for this paper was necessary in order to use material from earlier studies.[13]
For comparative purposes in, say, 1988 prices, per capita GDP in constant domestic prices would be estimated to grow from about $465 in 1985 to $1,540 in 2020; in variable prices, permitting a more direct comparison among countries as of 1988, per capita GDP would grow from about $650 in 1985 to $3200 in 2020. Note that these comparisons are simple multiples of the 1970 dollar figures and thus do not fully reflect the large relative increase in petroleum prices beginning in late 1973. Because the numbers have not been adjusted for oil price increases, they may understate the true "nominal" per capita GDP figure for 2020 (in 1988 U.S. dollars). The estimates suggest, however, that given the conservative growth projected for this illustration, Indonesia's per capita income in 2020 would be similar to that of Portugal or the Republic of Korea in 1988.

A Test of Constant versus Variable Price Growth Rate Measures
How important might be the differences in Table 1 for forecasts of Indonesia's future? If the differences are indeed important, how confident can we be that the variable price real growth rates are so much higher (as shown in the same Table) than constant price growth rates?

The first of these two questions is easily answered by observing that when we wish to compare Indonesia of 1991 with some other country in 1991, we almost always use the respective average incomes for our first comparative measure. The income, usually GDP per capita, must be expressed in a common currency, often U.S. dollars, and these in turn are found by applying 1991 dollar exchange rates. Thus

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12 This assumes that today's cross-country comparisons are based on per capita GDP measures in todays' US$, using today's dollar exchange rates.
13 See Strout, Alan, *Population, Resources, and the Environment in Indonesia's Future*, a study prepared for Resources for the Future under a grant from the Rockefeller Foundation, 1978 (unpublished), chapters 3 and 9; Strout, "Macroeconomic Structure and Energy Demand: Indonesia to the Year 20000"; Appendix A in *Energy Planning for Development in Indonesia*, a report prepared for the Ministry of Mines by Energy/Development International, Setauket, N.Y. December 1980.

to the extent that we try to forecast Indonesia's future through the analysis of the situations in other countries in 1991 (or any other recent year), it becomes imperative to know just how fast Indonesia will "catch up" with the reference country.

Table 1
Annual Growth Rates of Per Capita GDP, 1975-2020, for Indonesia using Alternative Measurement Concepts, %

Measurement of GDP	1975-1985	1985-2000	1985-2020
Constant 1970 rupiah prices	5.0	4.0	3.5
Constant 1980 international prices	5.6	4.0	3.5
Variable prices (nominal)	6.5	5.1	4.7

Source: Author's spreadsheet, IndoDat3 of 4/4/91.

As a matter of fact, a great deal of information has already been compiled on "normal" country characteristics that are associated with certain levels of per capita income, population size, etc. These can be enormously useful in diagnosing a particular county's current situation and in assessing its likely future. But to extrapolate from the situation in one year to the prospects in a later year, especially when the second year is 20 or more years into the future, we must use a GDP growth rate which allows for normal changes in relative prices. A growth rate based on the more usual concept of fixed, base year prices may greatly understate the real rate of growth.

Turning to the question of confidence, we can perform the following experiment. Take cross-country estimates of "normal" country characteristics estimated in the 1960s, for example, and ask how they would apply to Indonesia in, say, 1985 under two separate assumptions. The first assumption is that Indonesia's per capita GDP growth from the base period is estimated using constant price weights. That is, growth rates are used which are similar to those of the first line of Table 1. The second assumption is that the estimate of GDP change uses variable price growth rates analogous to those shown in the bottom line of Table 1.
The 1960s cross-country estimates for the experiment will be those of Chenery and Syrquin (1975), a product of the World Bank research program and widely used since for country analysis throughout the world.[14] We will look in particular at the

14 Chenery, Hollis and Moises Syrquin, *Patterns of Development, 1950-1970*, a World Bank Research Publication (Oxford University Press for the World Bank, London: 1975). The basic data used for this study were compiled in June 1972 and covered 101 countries and the years, where possible, 1950-1970. Values were converted to 1964 U.S. dollars using annual average (largely "official") exchange rates as published in the World Bank Atlas. Statistical analysis centered on the year 1965, and dummy variables were used to capture the effects of changes over time, if any, between 1950 and 1970. The actual equations used for the experiment reported here refer to the authors' "large country" sample and are actually from an earlier report on the project by N.G. Carter, *A Handbook of Expected Values of Structural Characteristics*, World Bank Staff Working

structure of gross domestic product, namely the relative contributions to GDP of primary production (agriculture and mining), industry (manufacturing and construction), transportation and utilities (including communication), and other services.

Ideally, the experiment should be carried out in 1964 or 1965 base prices, but because of unsatisfactory Indonesian GDP estimates for those years, the three years 1969-71 are used as a substitute base. Since the comparisons will be made, essentially, in 1970 U.S. dollars, Indonesia's GDP structure for 1985 must be adjusted to eliminate the effects of the extraordinary oil price changes following 1973.[15] The results are shown in Table 2.

In 1970, average per capita GDP in Indonesia was about $82 in 1970 prices or roughly $69 in the 1964 prices used for the Chenery-Syrquin cross-country calculations. Using 1970 price weights for the GDP components (1964 would have been better, as just indicated, but are not readily available), 1975 and 1985 per capita GDPs in 1964 U.S. dollars would have been estimated at $93 and $138, respectively. The "normal" GDP share for large countries associated with those two income levels are shown in the middle two data columns of Table 2. Thus the estimated shares of agriculture-plus-mining and manufacturing-plus-construction would have been estimated for 1985, respectively, as .358 (that is, as 35.8 percent of total GDP) and .215. Thus when using constant price weights for the GDP projection, the estimated share for agriculture plus mining is slightly larger, and that for manufacturing plus construction is slightly lower than the observed shares when measured in 1985 rupiahs (except for an adjustment to petroleum prices), as shown in the second data column.

When, however, GDP growth is measured in such a way as to allow for expected changes in relative prices, higher per capita estimates are derived, namely $103 for 1975 and $193 for 1985. The difference is relatively small ($10 or 11 percent) over the five-year period, 1970-1975, but greater ($55 per capita, or 40 percent) over the longer, 1970-85 period. The higher estimates of GDP lead to a different set of GDP component shares as shown in the final two columns of Table 2. The latter estimates are in every case closer to the observed shares than are those based upon constant 1970 price weights. Put another way, Indonesia in 1985 had a GDP structure that was much closer to a country with an average per capita GDP of $193 (measured in 1964 U.S. dollars) than to a country whose GDP per capita was $138.

Paper No. 154 (June 1973). They compare closely with the somewhat more rounded coefficients in Chenery and Syrquin (1975), Table S9, p.204. (The Carter paper also gives results in somewhat greater detail with respect to industry classification than does the later Chenery-Syrquin volume.)

15 What one would like to do for this purpose would be to reprice the mining GDP for 1985 using values which would reflect the general rate of inflation between 1970 and 1985 in the absence of the oil price changes. Instead, the adjustment was made using the ratio of the fuel export price index to the manufactures' domestic price index, both from the World Bank, World Tables, 1989-1990.

Table 2
Actual GDP Structure in 1985* and That Projected under Alternative 1970*-1985* GDP growth Rate Assumptions

	GDP Shares After Mining Price Adjustments		"Normal" (Cross-Country-Based, Chenery-Syrquin) GDP Shares			
			Constant Price Weights		Variable Price Weights	
	1975*	1985*	1975*	1985*	1975*	1985*
Agriculture & Mining	.439	.323	.482	.381	.461	.317
Manufactures & Construction	.157	.230	.142	.209	.154	.247
Transport. & Utilities	.055	.071	.058	.064	.060	.071
Services	.348	.374	.322	.350	.328	.369
Memo: Per Capita GDP assumed, 1964 US$			93	138	103	193

*** = mean of 3-years centered on year shown. Source: Author's estimates, spreadsheet IndoDat2, 4/5/91.**

This demonstration is not a completely satisfactory test in that necessary price adjustments have been based upon secondary sources, largely those of the World Bank, and are of necessity somewhat crude. The results do strongly suggest, however, that when using cross-country comparisons for making judgments about Indonesia's future, the analyst should be alert to the problems caused by changing relative prices. More specifically, the results show that the use of constant price weights may substantially underestimate future "real," internationally comparable income levels.

Implications for Resource Use and Environmental Change

The differences found for the 1970-1985 period are paralleled by those for later periods. Using a combination of 1980 and 1983 price weights (needed because of the employment of World Bank GDP data in 1980 prices and Biro Pusat Statistik data in 1983 rupiahs), we have already projected in Table 1 growth rates for 1985-2000 and 2000-2020. For the year 2000, the alternative GDP per capita estimates differ by 63 percent; for 2020 the difference rises to 108 percent. This is to say that year 2020 average GDP per capita based upon the variable price approach is more than twice as large as that found when assuming constant relative prices throughout the period.

When it comes to projecting natural resource use and potential environmental degradation, these differences only begin to tell the story. This is because a country's demand for natural resource-based commodities and many forms of pollution will grow at a faster rate than will GDP, even when measured in variable price terms and when including population growth as an additional explanatory variable.

In their 1977 study, *The Future of the World Economy*, Wassily Leontief and his associates projected to the year 2000 a variety of economic measures for fifteen regions. For the "low income Asia" region, "Scenario X" used an overall GDP growth rate of 6.25 percent annually between 1970 and 2000. Expected population growth was 2.11 percent per year, urban population growth was 3.40 percent, and per capita GDP growth was estimated at 2.97 percent per year.[16]

For many economic activities associated with environmental pressures, the growth rates were higher than even that for total GDP. Thus total manufacturing output was expected to grow at 9.2 percent, chemicals output at 10.75 percent, and non-electrical machinery output at 13.1 percent.

The Leontief world model also used fixed emission coefficients (not reproduced in the published study) to estimate the annual amounts of pollutants produced. Not all major contaminants were included, but the model did estimate the physical amounts of five waterborne pollutants (biological oxygen demand, suspended solids, dissolved solids, phosphates, and nitrogen), one airborne pollutant (particulates), and solid waste.

The growth rates of estimated emissions for "low income Asia" are shown in Table 3 on the following page.[17] In a number of cases the growth rates of pollutant, before abatement measures, grows as fast or faster than estimated GDP. For some water pollutants and for solid waste emissions related to urbanization, the growth rates exceed those of projected urban population but fall below those of total GDP. Other major emissions omitted from the Leontief study, for example carbon dioxide and monoxide, nitrogen oxides, and other industrial wastes, are probably largely related to the growth of industry and thus will ordinarily exceed the growth rate of GDP itself.

Related but more vivid results are found from projections of Indonesia's demand for a number of bulk commodities in the future. These projections rely on a series of cross-country equations, similar to those of Chenery-Syrquin, made by the author for an earlier study of longer-run growth prospects. The dependent variable in each was per capita material consumption in 1969/71, measured in the natural logarithm of the physical units. Principal explanatory variables were per capita GDP, population, and several measures of industrial structure.[18]

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16 See Wassily Leontief and associates, *The Future of the World Economy*, a United Nations study (New York: Oxford University Press, 1977), Annex VI, pp. 96-100. Professors Anne Carter and Peter Petri of Brandeis University and Joseph J. Stern of Harvard were Professor Leontief's principal collaborators in the project.

17 Low income Asia is used for this analysis because Leontief and his associates assumed that few if any pollution abatement measures would be in effect within this region during the period 1970-2000. Pollution results are similar to those for other low income regions and to centrally planned Asia for which a no-abatement assumption was made. For higher income countries with abatement programs in effect, the published results show only net pollutants after the reduction effects of assumed abatement measures.

18 Strout, Alan M., *Population, Resources, and the Environment in Indonesia's Future*, chapter 9. A reference sample of 31 countries was used for this earlier analysis.

Table 3

Anticipated Growth of Total Emissions, Leontief Estimates for Low-Income Asia, 1970-2000, Scenario X

	Emissions in "diverse physical units"				Annual Growth Rate, %
Pollutant	1970	1980	1990	2000	1970-2000
Pesticides	.16	.39	1.95	3.77	11.11
Particulates	.64	1.04	2.47	3.44	5.77
Biological Oxygen	1.38	2.09	5.62	8.79	6.37
Nitrogen (water)	.01	.01	.05	.08	7 ?
Phosphates	.01	.01	.03	.04	5?
Suspended Solids	.35	.63	1.64	3.00	7.42
Dissolved Solids	3.69	5.51	20.92	34.04	7.69
Solid Waste	56.72	96.62	165.19	295.07	5.65
Memo:					
Total GDP, '70 US$					6.28
Population					2.52
Urban Population					4.16
GDP/capita					3.69

Source: Leontief et al., *The Future of the World Economy* (1977), pp. 96-97.

The earlier equations have been applied, using the population and GDP estimates (in 1970 US$) developed for the present paper and already discussed above. Results are shown in Table 4.

The projections of Table 4 are not to be taken as representing precise expectations for the years 2000 and 2020. For one thing, they derive from technological relationships for a much earlier period (1969/71). For another thing, they do not fully reflect special situations which may already exist in Indonesia. They should, however, reflect in approximate terms the nature of expected growth for these classes of commodities and, by inference, the demand for natural resources.

Several important points derive from Table 4. First, the growth rates of expected, "normal" (that is, based on cross-country relationships) demand are in almost all cases greater than the growth rates of total GDP. The few exceptions include refined petroleum products, industrial lumber (which includes sawnwood, sleepers, wood-based panels, and some industrial roundwood), hydraulic cement, and zinc. *Thus, whatever should be the final GDP growth rates used for the forthcoming 25-year plan, the demand growth rate for most natural resource-based bulk materials can be expected to exceed that of total GDP.*

Table 4

Current (1985) and Projected Total Consumption of SelectedBulk Materials, Indonesia, for the Years 2000 and 2020 (In thousand metric tons except for lumber (thousand cubic meters) and electricity (million kilowatt-hours)

			Projected ("Normal") Consumption			
	Actual Consumption		Based on Constant Price Growth Rates		Based on Variable Price Growth Rates	
	1975*	1985*	2000	2020	2000	2020
Forest-based products:						
Industrial lumber	2699	8047	10685	25426	16957	44696
Wood pulp	13	360	701	2381	1471	7198
Paper & paperboard	257	676	1632	5066	3201	12701
Commercial energy (in coal equivalent)	23380	47564	107456	329232	195217	707283
Electricity	4195	29011	39916	147514	90438	426197
Refined Petroleum	13293	23570	31952	86069	55646	196841
Primary metals:						
Crude steel	1348	2509	5127	19923	12139	57548
Aluminum	7	43	65	270	155	894
Lead	3	16	73	357	194	998
Zinc	25	48	47	164	101	467
Copper	8	17	95	438	241	1323
Hydraulic cement	2709	8995	9813	26193	19006	53507
Memo on projection assumptions:						
Population, mil.	133.6	162.9	213.8	289.0	213.8	289.0
GDP/capita, 1970 US$			296	544	483	1129
Total GDP, mil. $			63.2	157.2	103.3	326.3

*** = 3 year averages centered on year shown. Source: Author's estimates, spreadsheet IndoDat2, 4/5/91.**

Secondly, the table gives a graphic illustration of the importance of using a variable price real growth rate when analyzing the impact of targeted GDP increases. As noted earlier, total GDP for 2020 when projected using variable prices exceeds the equivalent constant price measure by a factor of slightly more than 2:1. For crude steel demand in 2020 the difference between the two methods is 2.9:1; for woodpulp, it is 3:1; and for refined copper, also about 3:1. It has already been observed that a number of environmental pollutants are likely to grow at rates

which equal or exceed that of GDP. *Thus there is the strong possibility that the use of a constant price growth rate GDP would considerably understate likely future impacts of economic growth on natural resource demand and on the environment.*

Finally, by comparing "normal" consumption projected for the years 2000 and 2020 with actual current domestic use and production, one sees more clearly the magnitude of future economic demands on resources and the environment. In 1988, for example, the FAO estimates that Indonesia produced 10.2 million cubic meters of sawnwood and sleepers, 6.6 million cubic meters of wood-based panels (including plywood, veneer sheets, particle board, etc.), and 2.7 million cubic meters of "other" industrial roundwood (that is round wood other than fuelwood, saw logs, veneer logs, pitprops, and logs for pulpwood and particles). The total, 19.5 million cubic meters, is a fairly direct measure of the 1988 demand on Indonesia's forests.[19]

Table 4 suggests that normal domestic demand by a country of Indonesia's size and gross domestic product could approach total 1988 production in only 12 more years. By 2020, Indonesia's internal demand, excluding most lumber to be processed further for exports, might be more than double total production in 1988. These figures are supported by recent World Bank estimates of demand in the year 2001. World Bank analysts estimate total demand in that year, for domestic use as well as for exports, to be in the order of 19-23 million cubic meters after initial processing to sawnwood, etc.[20] These figures compare with the 17 million cubic meters for "normal" domestic use shown for 2000 in Table 4.

The same World Bank study suggests that sustainable production levels in all of Indonesia, assuming "improved policies," would be not much greater than 42 million cubic meters of roundwood. This would be equivalent, at most, to about 23 million cubic meters of what has been called "industrial lumber" in the current report. Thus, despite Indonesia's wealth of forest resources, the World Bank numbers and those from Table 4 suggest that the nation may be hard pressed to keep up with even domestic demand, on a sustainable yield basis from its own current forest resources, after the turn of the century. Certainly the gap between 23 million cubic meters of sustained yield output and the 45 million cubic meter demand suggested by Table 4 for 2020 might seem to be almost insurmountable without severe inroads on the country's forest reserves.

A similar story can be told about energy supply and demand. In 1986, Indonesia produced 145 million metric tons of primary energy excluding fuelwood and

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19 Food and Agricultural Organization of the United Nations, *Yearbook of Forest Products, 1977-1988* (FAO, Rome: 1990). Of the 19.5 million cubic meters total in these three categories, exports amounted to an estimated 9.5 million cubic meters, leaving about 10 million cubic meters for domestic use or further processing.

20 The World Bank, *Indonesia: Sustainable Development of Forests, Land, and Water*, a World Bank Country Study (World Bank, Washington, D.C.: 1990), pp. 8-9. The World Bank's Table 1.6 shows demand and sustainable production levels in total cubic meters of roundwood. For comparison with the processed wood demand figures of the current paper, an "improved" conversion efficiency of 55 percent for producing sanwood from roundwood has been assumed.

bagasse, measured in coal equivalents.[21] Domestic consumption was about 50 million metric tons of coal equivalent (mMTCE). Table 4 suggests that domestic demand in Indonesia for commercial energy could reach 195 mMTCE by 2000 and over 700 mMTCE by 2020. The latter figure is approaching five times that of total production in 1986.

Thus, for industrial lumber, commercial energy, and undoubtedly for other natural resources not examined in this paper, it does not appear that future Indonesian demand during the prospective 25-year plan will be satisfied readily from domestic reserves as presently identified. Indeed, the growing gap between demand and domestic supply may place considerable pressure on the goal of "sustainable" growth, on domestic prices, or on the need to expand other exports so as to finance required natural resource-based imports.

Issues and Challenges

As was pointed out at the beginning of this paper, only one of several approaches is here employed to help identify future resource and environmental issues in Indonesia. Other, complementary methods will be addressed during forthcoming consultations in Jakarta. Nevertheless, this single approach has highlighted its share of important issues.

First, it should have been made apparent that the target rate of economic growth will be a critical aspect of any prospective plan from the viewpoints of sustainability, natural resource exploitation, and environmental impacts. This, of course, is only part of the story since the nature of economic growth and its distributional aspects will play important roles, too. But the overall GDP growth target is likely to be the single most important factor influencing future economic and environmental sustainability.

Second, this paper has shown that even with relatively modest growth targets (as conventionally measured), there are likely to be considerable environmental and resource depletion strains arising during the course of the new 25-year plan. It might be tempting to hope that by assuming a relatively low per capita GDP growth target–such as the illustrative rate of 3.5 percent used for this paper–future resource and environmental problems could be minimized. This paper suggests that when real GDP growth is measured properly so as to take into account the normal and expected change of *relative* prices, it will be found that conventional, constant price growth rate measures will seriously understate real growth. This means that a greater urgency will exist to address environmental and resource issues than might be indicated at first glance.

Third, the conclusion follows that the new 25-year plan should address in a forthright and convincing manner these two questions: (1) how can current and

21 United Nations, *Energy Statistics Yearbook, 1988* (UN, New York: 1990) Table 1. The UN counts primary electricity (hydro, geothermal, nuclear) at its thermal equivalent of .123 MT of coal equivalent per thousand kilowatt hours. To improve comparability, a larger conversion factor for primary electricity, .384, has been used to represent the approximate amount of hydrocarbon fuels that would have been needed to generate the electricity from fossil fuels.

temporary resource "surpluses" be best managed to prepare for the time within the plan period when the surpluses will have disappeared and will have been replaced by large deficits; and (2) will the introduction of pollution abatement and similar environmental rules and regulations be rapid enough in view of an onslaught of environmental problems that is possibly much more imminent than may generally be recognized.

Finally, as part of the answer to the second of the two questions just raised, it will be most important to work out carefully the likely geographical location of future economic activity. Indonesia is a large and populous country which, within the course of the next 25-year plan, should become a modestly rich country, at least in terms of the 1980s and 1990s. If economic activities are distributed widely, the local environmental impact will be less than if the activities are concentrated. In contrast, if economic activities, especially heavy manufacturing, are concentrated on Java, that island within 25 years could begin to look and feel like the Ruhr Valley of Germany or parts of Eastern Europe.

Next must come the necessary caveats. This paper has been based largely on statistical relationships and comparisons derived for the world of twenty and more years ago. Many things have changed. These include technologies, sensitivity to environmental issues, and official appreciation of the importance of prices in influencing both demand and supply of any given commodity. This paper's implications, while derived from careful research by a large group of investigators, have not been widely anticipated in the professional literature. Today's generation of economists and statisticians, especially those involved with planning and policy formulation, will have to convince themselves of the validity of the conclusions drawn here.

This suggests that it may be worthwhile for a research group in Indonesia to reexamine cross-country relations among per capita income, population size, materials consumption, and the production of industrial and urban pollutants. Further testing might be done on how well Indonesia's past patterns of growth and materials use has matched that of a "normal" country of similar size and per capita income. Another important question on which Indonesia's planners must satisfy themselves is whether future natural resource demand and environmental pressures will indeed, as this paper has argued, be more like those of a country with the higher GDP projected from variable price rather than from constant price growth rates.

More work is also needed on the relationship between GDP and population growth, urbanization, income distribution, and materials demand. Earlier studies by the author, not discussed above, suggest important tradeoffs among some of these variables in the case of Indonesia.[22]

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22 Strout, "Pertumuhan Pertanian, Tenaga Kerja dan Pembagian Pendapatan; Dilema bagi Repelita III," *Ekonomi dan Keuangan Indonesia*, vol. XXV, no. 4 (December 1977). The paper in question used a relatively crude and simple four-sector model to explore tradeoffs among economic growth, income distribution, urbanization, and food self-sufficiency.

The production of industrial and urban pollutants, it has been argued above, is likely to grow at rates equal to or greater than, respectively, total GDP and total urban population growth. This could be demonstrated more effectively for Indonesia with the aid of an input-output model, projected final demands and technical coefficient changes, and a row of emission coefficients similar to those used by Leontief for his world model projections.[23] Such a model could follow the related work of Leontief by explicitly introducing various levels and costs of abatement.

Finally a set of studies related to the last issue, and perhaps conducted with the aid of an input-output model disaggregated by regions, would deal with the pollution consequences of alternative patterns of future industrial location. If industry were to be concentrated on Java, for example, what might be the cost of abatement measures needed to limit emissions to some "desirable" level?

In short, to no one's surprise, a great deal more research and analysis is clearly needed. Demonstrating the importance of such research studies is an important outcome of preparing a 25-year plan. It is likely that new studies will change some of the details of the present paper but will leave its broad conclusions intact. These are that the GDP growth target will be the single most important determinant of the potential for future natural resource and environmental problems and, because of the way in which GDP growth is conventionally measured, the tradeoffs among economic growth, natural resource exploitation, and environmental degradation may be far more restricted than generally recognized.

23 See Note 1.

10. GROWTH AND STRUCTURAL CHANGE IN INDONESIA, 1990-2020: IMPLICATIONS FOR EMPLOYMENT, URBANIZATION AND THE ENVIRONMENT

Abstract

"Normal" patterns of growth, based upon cross-country analysis, are used in conjunction with low and medium growth rate assumptions to shed light on the longer-run future of Java and Indonesia's outer islands. When economic growth rates are measured in such a way as to incorporate relative intersectoral price changes, a procedure recently endorsed in principle by the World Bank, Indonesia's per capita gross domestic product (GDP) by the year 2020 might reach $6200 (in 1988 U.S. dollars) under the medium growth scenario. This would be roughly equivalent to the 1988 per capita GDP of Greece or Spain, and one-half of that found in the more affluent countries of Europe. (As conventionally measured in constant base year prices, per capita GDP would be only about $2,200 under the same set of medium growth assumptions.)

The cross-country-derived growth model reveals no major inconsistencies among various population and economic factors. There may be some tendency for agricultural transformation to accelerate, especially on Java, under the medium growth rate conditions, and this could lead to sharply improved sectoral income equality on Java and to a lesser extent outside of Java.

Environmental effects are not directly investigated, but environmental "loading" can be inferred to increase sharply, particularly on the island of Java. Over the 1990-2020 period, Java's population may increase by 30 percent (34 millions), urban population by two-and-one half times (perhaps by 60 millions), and total industrial (manufacturing, construction, transportation, and utilities) GDP by a factor of ten in constant base year prices. Industrial activity on Java with all of its attendant pressures on pollution dispersal, waste disposal, water use, population crowding, and social adjustment, in other words, could well be ten times as great in 2020 as in 1990. It could be as high or higher in terms of the pressure on Java's land area as found today in countries such as Belgium and West Germany.

Indonesia's choice of future economic growth targets and of the preferred location for industrial activity are the principal policy variables highlighted by the analysis.

Introduction

Thirty years is a long time in the life of a rapidly developing nation. Yet this may be the period required to examine future natural resource, environmental, and income distribution problems of a longer-run nature. An earlier paper by the author explored in a preliminary way the longer-term issues for Indonesia with respect to a number of natural resources and environmental pollutants under a relatively low forecast of economic growth.[1] The current paper presents a more

[1] Strout, Alan M., *Forecasting Economic Growth and Environmental Change in Indonesia, 1990-2020*, April 1991.

disaggregated view of future prospects, examining four sectors, two regions (Java and other Indonesia, or off-Java), and a medium growth possibility in addition to the earlier low growth scenario. The detailed projections for these scenarios are summarized in Annex Table A (low growth, Java agriculture unconstrained); Annex Table B (medium growth, Java agriculture unconstrained); and Annex Table C (medium growth, Java agriculture constrained).

Questions asked in the current paper are those of possible imbalances among the various elements examined, namely GDP, employment (as indicated by the size of the labor force), and per worker income (as measured by sectoral GDP per member of the sectoral labor force). In addition, a number of inferences are drawn about income inequality issues and about the environment, especially as the latter is related to urbanization and industrialization.

Broadly, the conclusions are that under "normal" growth patterns (as determined from the historical experience of large developing countries) it should be theoretically possible to achieve a reasonable balance, at low to medium rates of economic growth, among the several factors analyzed. No outright inconsistencies appear inevitable during the thirty years 1990 to 2020, although there could be a modest constraint on Java's desired agricultural growth under the medium growth scenario. On the other hand, the problems of full employment and a more equitable distribution of income will continue to tax policy makers as they have in the past. What is technically achievable may not in fact come to pass without strong and concerted efforts throughout the period.

Two important elements would appear to be the rate at which the Indonesian economy grows in the future and Java's relative share of that growth. A slower rate of economic growth and a smaller share for Java will both decrease environmental and urban population pressures. On the other hand, a faster rate of economic growth (but not a larger share for Java of that growth) should produce larger social revenues to mitigate environmental problems. In addition, a more rapid growth should speed up the modernization of agriculture and thus markedly improve income equality.

The Model

It is difficult or at least hazardous to project "realistic" longer-run structural change, say by major sectors of economic activity, without recourse to comparisons with other countries at more "advanced" stages of development. While there is some variation among larger developing countries in the shares of GDP going to agriculture, manufacturing, and the like, there is a strong tendency among countries to follow relatively predictable patterns over time. Indonesia, for example, seems to conform closely to international norms. A comparison for 1985 and 1990 (preliminary) is found in Table 1 on the following page.

Table 1 shows that Indonesia's GDP shares as recently as 1990 are slightly below average for the primary and manufacturing (including construction) sectors and possibly for the transportation and utilities sector. Shares are slightly above

average, on the other hand, for other services and administration. The general conformity to the normal international structural pattern, however, is close.

Because of the close similarity, the model uses cross-country equations for estimating future GDP shares, adjusting each share by the 1990 ratio between the actual share for Indonesia and that computed for 1990 from the same cross-country equation.

Indonesia's similarity to cross-country norms is less apparent for the distribution of the labor force by sectors, as shown in Table 2 on the next page. In particular, the cross-country equations would suggest a considerably larger number of manufacturing and construction workers and lower numbers of service and utility workers (including transportation and government). Part of the difference may lie in how labor force numbers are estimated, especially with regard to unpaid family workers and very young and very old workers. Kuznets (1971) investigated the problem of labor force data coverage at some length. He concluded that while various adjustments could affect appreciably the magnitude of the sectoral shares, the adjustments had a far smaller affect on the *differences* in shares for similar sectors observed over a range of income levels (Kuznets, 1971, 226).

Table 1

Actual Sectoral Shares of Gross Domestic Product for Indonesia, 1985 and 1990, Compared with Shares Estimated from Cross-Country Equations a/

	1985		1990	
Sector	Actual	Estimated	Actual b/	Estimated
Agriculture & Mining c/	.318	.322	.270	.279
Manufacturing & Construction	.232	.238	.250	.262
Transportation & Utilities	.072	.074	.062	.080
Other Services & Government	.378	.370	.418	.384

a/ All shares estimated after adjusting petroleum price increases to the same rates as for non-oil and gas GDP. Estimated shares are derived from equations of Chenery and Syrquin (1975) as found in Carter (1973).
b/ From preliminary estimates of 1989 GDP, adjusted in some cases to reflect apparent trends between 1984 and 1989.
c/ After necessary adjustments to oil and gas GDP to reflect average price increases for the non-oil and gas GDP.

For modeling purposes, therefore, Indonesia's shares of sectoral labor force are assumed to increase in each period by the number of percentage points found from cross-country equations between countries of similar income and population. Thus under the low economic growth scenario, the 1990 sectoral share of agriculture and mining workers for Indonesia (.568, based on the 1989 labor force survey) is assumed to *decrease* between 1990 and 2000 by 9.3 percentage points to .475 (47.5 percent). The decrease, in turn, equals the difference between the 1990

cross-country estimate of 48.2 percent and that of 38.9 percent estimated from cross-country equations for 2000.

Table 2

Actual Sectoral Shares of Economically Active Population for Indonesia and Java, 1985, Compared with Shares Estimated from Cross-Country Equations a/

	Indonesia		Java	
Sector	Actual	Estimated	Actual	Estimated
Agriculture & Mining	.533	.523	.486	.518
Manufacturing & Construction	.126	.204	.151	.218
All Services & Utilities b/	.320	.258	.363	.233

a/ From Carter (1973). Java's shares assume Java can be treated as a separate "country" of 101 million inhabitants (in 1985).
b/ Separate sectoral equations for Transportation and Utilities and for Other Services are not available.

A second necessary element in making longer-run projections of structural change is to recognize the distinction between constant price and variable price rates of GDP growth. The former is the conventionally measured growth rate is which all prices are held constant (either base year, end year, or some mix of the two). The latter, while abstracting from average inflation, allows some prices to rise relative to others, as in fact occurs during normal economic growth.[2]

The constant price growth rate is important because it is the one ordinarily employed when setting growth targets and when measuring, for example, past growth rates and rates of productivity change. The variable price growth rate, which is uniformly higher than the constant price equivalent, gives a clearer idea of how fast a nation may be "catching up" with those nations which are currently richer. The variable rate, furthermore, is the *only* rate that should be used when applying sectoral shares derived from cross-country comparisons using ordinary exchange rates. Such international data are derived from national figures converted to a common currency using standard exchange rates and thus implicitly include the variable price differences which occur between richer and poorer countries.

Finally, the variable price growth rate is the most appropriate to use for considering sectoral changes in income over time. For policy purposes what matters is not a person's income in constant prices but in prices comparable with

[2] The usual explanation, following Irving Kravis and his co-authors in the University of Pennsylvania/United Nations International Comparison Project, is that during the initial course of development the prices on "non-traded" goods and services rise more rapidly than "traded" goods and services. Non-traded goods include most services, most traditional agriculture and manufactures serving domestic markets, and such seldom-traded commodities as electricity and water and the products of the construction sector. "Traded" goods include most smallholder and estate crops raised for export and much of the output of the "modern" sector, whether or not actually entering into foreign trade.

those in other sectors. If prices in one sector grow faster than another and are passed along to the factors of production in that sector, then the workers in that sector will be increasingly better off than those in the other sector.[3]

The use of "variable price" growth rates when measuring change over long periods is a relatively new practice. Those who have analyzed structural change from cross-country data have long been aware of the problem of differential price movements during the growth process, but they have generally chosen to measure implicit growth rates under the assumption of constant prices.[4] The World Bank, however, in 1991 began to employ chain-linked growth measures as a way to periodically "include the effects of changes in intersectoral relative prices" in their *World Development Report* and their *World Tables* (1991a, p. 270; 1991b, ix).[5]

Note that sectoral shares estimated from international norms for some future year will be in the *relative* prices of the future year and not in base year prices. This means that a conversion back to base year prices will be needed for each sector when applying notions of sectoral productivity changes derived from constant price output or value-added growth. For the current model, the assumption was made of a common relative price increase in all nontraded sectors. After deriving estimates of nontraded GDP in a sector for each base period (1990, 2000 and 2010), an average price change for that sector could be estimated, and the constant price sectoral GDP growth could be determined from the previously determined variable

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[3] Consider the following example in which the returns to labor (labor productivity in nominal terms) increase relative to that in the modern sector over a 25-year period:

	Period 0	Period 25		Period 25 in Period 0 Prices		
	GDP	Price	GDP	Price	GDP	Price
Mod Sector	20	1	120	1	120	1
Trade Sector	80	.5	270	.75	180	.5
Total	100		390		300	

The welfare of those in the traditional sector will be better reflected by recognizing the fact that their average incomes (assuming that incomes are proportional to per capita GDP in each sector) increased relative to those of the modern sector. The GDP increase relevant to sectoral factors of production was 270/80, not 180/80. The constant price growth for the two sectors combined would be 300/100 or 4.5 percent per year. The variable price growth, in contrast, would be 390/100, or 5.6 percent per year. Note that the change to relative prices increases the combined growth rate because it is the larger sector, not the faster growing sector, which experiences relative price increases.

[4] See for example Table 8-2 in Chenery, Robinson, and Syrquin (1986,232). Growth rates in the Table (and corresponding intervals) are estimated from investment ratios and incremental capital-output ratios in constant prices. The resulting growth rates, therefore, implicitly assume constant rather than variable prices.

[5] The World Bank procedure "rebases" constant price data to three base years: 1970 for the period 1960-1975; 1980 for 1976-1982; and 1987 for 1983 and beyond. The three constant price time series are chain-linked to provide long-term trend analysis (World Bank, 1991b,ix). This method moves towards a true variable price growth rate, but it will result in generally lower growth rates than if the constant price data were to be "rebased" in each year. The new World Bank procedure, however, is a formal recognition that intersectoral relative price changes are analytically important and that longer-run growth rates, for some purposes, should reflect these relative changes.

price growth.[6] The average relative inflation rate for nontraded goods and services was estimated for the low economic growth alternative at 1.7 percent to 2.3 percent per year between 1990 and 2020. For the medium growth projections, the implied inflation rate was 2.8 percent annually between 1990 and 2000 and 4.2 percent between 2000 and 2020. (See Table 3 and Annex Table B, "Comments," all-Indonesia constant price growth.)

The four sectors of the structural change model were determined by the sectoral definitions used for the cross-country studies of Chenery and Syrquin (1975). It was this study, based on international data from the 1960s and before, from which the sectoral estimating equations for Indonesia were derived. The lower GDP growth rate projection used in the current set of projections assumed a 5 percent annual rate between 1990 and 2000 and a 4 percent annual rate over the next 20 years. Per capita GDP growth would occur at rates of 3.5 percent and 3.0 percent respectively. The medium growth rate assumed a per capita growth of 5.5 percent per year between 1985 and 2000 and a 4.5 percent growth rate thereafter. These per capita rates translated into *total* GDP growth rates of 7.0 percent and 5.5 percent annually over the periods 1990-2000 and 2000-2020.

The population growth cited here for Indonesia is that projected by the United Nations and reproduced in a journal article by Nathan Keyfitz (1989). It is very similar to more recent projections made by the University of Indonesia's *Lembaga Demografi*. It should be noted that these projections may be somewhat on the low or optimistic side. The 2020 value of 254 millions compares, for example, with a World Bank estimate of 267 million, as derived from 2000 and 2025 estimates in the World Bank's *World Development Report* for 1991. (World Bank, 1991a.)

In 1990, the island of Java had about 60 percent of Indonesia's population, 59 percent of agricultural and mining GDP (including petroleum and natural gas, after adjustment to eliminate differential price rises between the oil and nonoil sectors after 1970) and a somewhat larger fraction, 66 percent of the nation's manufacturing and construction sectors. Java's average per capita GDP appears to have been slightly above that of the nation as a whole, based on evidence from the 1983-1988 provincial income accounts.

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6 The weights representing the fractions of traditional and non-traded goods and services in each sector were as follows:

	All Indonesia			Java		
	1990	2000	2010	1990	2000	2010
Agriculture & Mining	.50	.45	.40	.60	.55	.50
Manufact'g & Construction	.33	.30	.25	.33	.30	.25
Transport & Utilities	.50	.45	.40	.50	.45	.40
Services & Admin	.85	.80	.75	.82	.77	.72

Java's sectoral GDP growth rates have been very similar to national rates in recent years. For projection purposes, it was assumed that Java's constant price sectoral growth rates of GDP would be identical with the national rates in all instances.[7] The projection model is in spreadsheet form, and thus these or other assumptions could easily be varied. For each run of the model in its current form the following steps are needed:

1. Choose initial conditions, population and labor force estimates, and a projected growth rate of GDP in constant prices. The model will then calculate a variable price GDP growth rate and sectoral breakdowns of both GDP and labor force based upon international norms.

2. Estimate the nontraded proportion of each sector's GDP and choose that set of nontraded price increases which equates the sum of the constant price sectoral GDPs with total constant price GDP. This is a trial and error procedure at present.

3. Choose estimates of population 10 years old and older and corresponding labor force participation estimates.[8]

The spreadsheet model then calculates all sectoral shares, both of GDP and of the labor force, the implicit growth rates of each sector, and factor returns (GDP or value added) for each sector measured at variable prices and expressed as a ratio to the sector's estimated labor force. (For convenience, this latter ratio is referred to as "returns to labor" in the summary tables.)

Results for Indonesia as a Whole

The several assumptions made for the initial, benchmark runs of the model are summarized in Table 3. Note in particular that constant price growth of Java's four GDP sectors is assumed to proceed at the same pace as growth outside of Java. While labor force participation rates are assumed the same for Java and the other islands, Java's population and hence labor force shares decline slightly over time. Because of slightly different sectoral shares in 1990 and a lower labor force growth

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[7] Java's percentage of total Indonesian population according to the census was 61.9 percent in 1980 and 60 percent in 1990 (BPS, 1991 b). Earlier projections had suggested that under "medium" rates of transmigration, Java's share might drop to 57.5 percent in 1990 and 53.8 percent by 2000. Under "high" transmigration rates, the population of Java might fall to 51.5 percent by 2000 (Hugo and others, 1987, chapter 10). The fact that Java retained 60 percent of national population in 1990 suggests that actual net transmigration has been closer to low than to medium. There probably will be a further decline of unknown magnitude in Java's future population share. For the benchmark estimates of this paper, however, it was assumed that Java's population growth rate would remain at 80 percent of the national rate throughout the period. This gave years 2000 and 2020 population shares for Java of 58.3 percent and 56.18 percent respectively, These shares are consistent with a relatively low future rate of transmigration.

[8] Indonesia's labor force or economically active population, as measured by Biro Pusat Statistik, amounted in 1988 to 57.3 percent of the total population aged 10 and over (BPS, *Statistik Indonesia*, 1990a, 52-63). Longer-term projections of Indonesia's labor force participation rate are inordinately difficult to make, largely because of uncertainties about (a) actual past rates; (b) future female participation;and (c) future tradeoffs between income and leisure as average incomes rise (see Hugo and others, 1987, 336-339). For the current projections, it was assumed that the economically active population might reach in 2000 60.5 percent of the 10 year old and older population under both a low economic growth scenario and a medium rate of economic growth. This rate could be expected to drop to 59.5 percent by 2020.

rate on Java, both sectoral shares and sectoral measures of output per worker will differ between Java and off-Java.

Sectoral growth in constant prices, as noted, will be the same for Java and elsewhere, but variable price growth rates, which incorporate intersectoral differences in relative prices, will differ slightly depending upon the sector's assumed share of nontraded commodities. (See Tables 4, 5, and 6.)

The most interesting results from the several projections relate to the possible magnitudes of change over a 30-year period, to sectoral growth differences especially with regard to agriculture, and to interregional differences with respect both to agriculture and to intersectoral income equality.

Between 1990 and 2020 there will undoubtedly be substantial increases in the absolute numbers of the economically active population, and in total and sectoral GDP. Even under the low growth assumption, per capita GDP in U.S. dollars would increase by two and one-half times, from US $543 in 1988 prices to US $1379. Under the medium growth alternative, the year 2020 per capita GDP would be closer to US $2220, over a four-fold increase. (See Table 3.)

Recall too that these values are measured at constant base year prices and do not accurately reflect either Indonesia's progress in "catching up" with wealthier countries or the welfare improvements from higher price increases in the traditional and nontraded sectors of the economy. Measuring year 2020 GDP at variable rather than constant prices gives per capita averages of about US $2960 under the low growth alternative and US $6240 under medium growth. These values for Indonesia in 2020 may be directly compared with per capita GDPs in 1988 for Yugoslavia (US $2520), the Republic of Korea (US $3600), Greece (US $4800) and Spain (US $7740). (World Bank, 1990.)

Projected absolute values of GDP (in 1970 U.S. dollars) and labor force are found in Table 5. What is striking about these numbers, as brought out in Table 6, are the relatively slow growth rates for the primary sector and the rapid growth of all three nonprimary sectors. Between 1990 and 2020 agriculture and mining GDP could be expected to rise by less than 100 percent under either the low or medium growth scenarios. Manufacturing and construction, in sharp contrast, would increase by a factor of more than five under low growth conditions and by a factor of more than ten given the medium growth assumptions. Note that these increases are measured at constant base year prices and thus do not reflect differential inflation in nontraded sectors.

Under the model's assumption of uniform sectoral growth rates of GDP in both Java and all of Indonesia, the growth of industrial (nonprimary and nonservice) GDP will also show a ten-fold or greater increase on Java. The magnitude of this increase in industrial activity, coupled with population growth in a relatively small land area, suggests a potential for serious environmental consequences.

Table 3
Assumptions for Projecting Structural Change, 1990, 2000, 2020

	Base Year	Low Growth		Medium Growth	
INDONESIA	1990	2000	2020	2000	2020
Population, millions	180.51	208.33	253.56	208.33	253.56
Labor Force, millions	79.50	100.96	128.07	100.96	128.07
(Participation ratio)	(.575)	(.605)	(.595)	(.605)	(.595)
Per capita GDP					
Constant price, 1988 US$	543	767	1379	924	2220
Variable price, 1988 US$	831	1298	2964	1676	6241
JAVA					
Population, millions	108.31	132.45	142.25	132.45	142.25
Share Indonesia	.600	.583	.561	.583	.561
Labor Force, millions	47.49	58.86	71.85	58.86	71.85
(Participation ratio)	(.575)	(.605)	(.595)	(.605)	(.595)
Per capita GDP					
Constant price, 1988 US$	580	841	1581	1015	2527
Variable price, 1988 US$	885	1443	3419	1853	7195
ANNUAL GROWTH RATES					
INDONESIA		Years 1990-2000	Years 2000-2020	Years 1990-2000	Years 2000-2020
Population		.014	.010	.014	.010
Labor Force		.024	.012	.024	.012
Total GDP, '70 US$		.050	.040	.070	.055
Per capita GDP, constant					
1970 US$		.035	.030	.055	.045
Relative inflation,					
"nontraded" sectors only		.017	.023	.028	.042
JAVA					
Population		.012	.008	.012	.008
Labor Force		.022	.010	.017	.010
Per capita GDP, constant					
1970 US$		.038	.032	.058	.047

Sectoral GDP growth rate in constant prices: same as computed by model for Indonesia as a whole.

Table 4

Summary of Structural Change Projections, 1990, 2000, 2020 - Ratios To Total, Indonesia and Java

	Base Year	Low Growth		Medium Growth	
INDONESIA	1990	2000	2020	2000	2020
Total GDP, 1970 US$ (Constant price growth)					
Agriculture & Mining	.270	.212	.131	.182	.092
Manufacturing & Construction	.250	.299	.394	.326	.469
Transportation & Utilities	.062	.069	.078	.072	.084
Other Services	.418	.419	.397	.420	.356
Total	1.000	.999	1.000	1.000	1.000
Total Labor Force					
Agriculture & Mining	.568	.517	.395	.475	.220
Manufacturing & Construction	.125	.151	.192	.172	.240
Transportation & Utilities	.031	.038	.048	.043	.060
Other Services	.276	.294	.365	.310	.480
Total	1.000	1.000	1.000	1.000	1.000
JAVA					
Total GDP, 1970 US$ (Constant price growth)					
Agriculture & Mining	.254	.199	.121	.170	.085
Manufacturing & Construction	.254	.303	.395	.329	.470
Transportation & Utilities	.066	.073	.083	.076	.088
Other Services	.426	.425	.401	.425	.358
Total	1.000	1.000	1.000	1.000	1.001
Total Labor Force					
Agriculture & Mining	.492	.423	.263	.380	.082
Manufacturing.& Construction	.154	.191	.249	.211	.296
Transportation & Utilities	.036	.048	.062	.053	.074
Other Services	.318	.337	.425	.355	.547
Total	1.000	.999	.999	.999	.999

Table 5

Summary of Structural Change Projections, 1990, 2000, 2020: Absolute Values

	Base Year	Low Growth		Medium Growth	
INDONESIA	1990	2000	2020	2000	2020
Total GDP, 1970 US$ (Constant price growth)					
Agriculture & Mining	10771	13790	18569	14279	21016
Manufacturing & Construction	9973	19434	55986	25519	107339
Transportation & Utilities	2474	4501	11157	5657	19132
Other Services	16675	27242	56542	32863	81475
Total	932	64967	142254	78318	228962
Total Labor Force, millions					
Agriculture & Mining	45.19	52.24	50.64	48.00	28.23
Manufacturing & Construction	9.92	15.22	24.56	17.34	30.71
Transportation & Utilities	2.48	3.81	6.14	4.34	7.68
Other Services	51.91	29.69	46.75	31.28	61.45
Total	79.50	100.96	128.07	100.96	128.07
JAVA					
Total GDP, 1970 US$ (Constant price growth)					
Agriculture & Mining	6492	8312	11193	8606	12667
Manufacturing & Construction	6492	12651	36446	16612	69874
Transportation & Utilities	1687	3069	7607	3857	13044
Other Services	10889	17789	36922	21460	53205
Total	25561	4132	92168	50535	148790
Total Labor Force, millions					
Agriculture & Mining	23.34	24.93	18.93	22.40	5.93
Manufacturing & Construction	7.33	11.26	17.91	12.44	21.29
Transportation & Utilities	1.72	2.81	4.48	3.11	5.32
Other Services	15.10	19.86	30.53	20.92	39.31
Total	47.49	56.86	71.85	58.86	71.85
OFF-JAVA					
Total GDP, 1970 US$ (Constant price growth)					
Agriculture & Mining	4279	5478	7376	5673	8349
Manufacturing & Construction	3481	6783	19540	8907	37465
Transportation & Utilities	787	1432	3550	1800	6088
Other Services	5786	9453	19620	11403	28270
Total	14332	23178	50079	27797	80175
Total Labor Force, millions					
Agriculture & Mining	21.84	27.31	31.71	25.60	22.30
Manufacturing & Construction	2.59	3.97	6.65	4.91	9.42
Transportation & Utilities	.76	.99	1.66	1.23	2.36
Other Services	6.81	9.83	16.20	10.36	22.14
Total	32.00	4.21	56.22	42.10	56.22

Table 6

Summary of Structural Change Projections, 1990, 2000,2020: Annual Growth Rates, Indonesia, Java, and off-Java

	Low Growth		Medium Growth	
INDONESIA	1990-2000	2000-2020	1990-2000	2000-2020
Total GDP, 1970 US$ (CONSTANT price growth)				
Agriculture & Mining	.025	.015	.029	.020
Manufacturing & Construction	.069	.054	.099	.074
Transportation & Utilities	.062	.046	.086	.063
Other Services	.050	.037	.070	.046
Total	.050	.040	.070	.055
Returns to Labor (variable price GDP/labor force)				
Agriculture & Mining	.019	.027	.037	.067
Manufacturing & Construction	.030	.036	.049	.058
Transportation & Utilities	.026	.032	.042	.053
Other Services	.034	.032	.058	.046
Total	.036	.040	.063	.066
JAVA				
Total GDP, 1970 US$ (variable price growth)				
Agriculture & Mining	.036	.028	.047	.044
Manufacturing & Construction	.075	.061	.109	.088
Transportation & Utilities	.071	.057	.102	.084
Other Services	.065	.035	.095	.080
Total	.061	.053	.089	.079
Returns to Labor (variable price GDP/labor force)				
Agriculture & Mining	.029	.042	.051	.115
Manufacturing & Construction	.030	.037	.052	.060
Transportation & Utilities	.020	.033	.039	.055
Other Services	.036	.033	.060	.047
Total	.039	.042	.033	.068
OUTER ISLANDS				
Total GDP, 1970 US$ (variable price growth)				
Agriculture & Mining	.031	.021	.039	.032
Manufacturing & Construction	.075	.061	.109	.088
Transportation & Utilities	.071	.057	.102	.084
Other Services	.066	.057	.098	.084
Total	.060	.052	.086	.078
Returns to Labor (variable price GDP/labor force)				
Agriculture & Mining	.008	.014	.023	.039
Manufacturing & Construction	.031	.034	.041	.054
Transportation & Utilities	.042	.030	.050	.049
Other Services	.028	.031	.052	.043
Total	.031	.037	.057	.063

How serious a potential problem may be judged by comparing Java in 2020 with various West European countries of today. Under the medium growth assumptions, by 2020 Java's industrial GDP per *thousand square meters of total area* would be about $2870 in internationally comparable 1988 U.S. dollars. In contrast, the same 1988 ratio for Belgium was about $1570 and for West Germany about $2320 per thousand square meters. The equivalent 1989 ratio for Czechoslovakia was only about $240 per thousand square meters.[9]

Thus, without allowing for future improvements in technology and for other favorable changes in the capital stock, Java's industrial pollution potential could be as great or greater in 2020 as found today in the heavily industrialized countries of Europe.

Under the low growth option, the agricultural labor force could be expected to increase in absolute numbers between 1990 and 2000 both on and off-Java. The beginning of the decline in the absolute numbers of agricultural workers would not occur on Java until after 2000 under low growth; under medium growth, however, the absolute decline should begin before the turn of the century. Outside Java, the absolute numbers of agricultural workers could be expected to continue to increase or remain more or less constant even under the medium growth assumptions. Since the total size of the labor force between the two growth options remains more or less constant, labor not assigned by the projections to agriculture and mining will be distributed among the other sectors.

With a decrease in the absolute size of the agricultural labor force (at least on Java), there should be disproportionately rapid growth in primary sector output per worker. This will have an important impact on intersectoral income equality and will be discussed below under regional results.

National and Regional Results: Urbanization

Another major change will be the growth of the urban population. The same type of cross-country relationship used for estimating GDP sectoral shares can be used for projecting the "normal" levels of urbanization. Applicability of the

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[9] The European data are from the World Bank (1990, 179, 183) and, for Czechoslovakia from the World Bank (1991a ,205, 209). The large numbers for java arise because of a large population, a relatively small land area, and a year 2020 per capita GDP level which in comparable terms approaches one-half of today's per capita GNP in the countries cited. The details follow:

Country	Pop. (mil)	Area ('000 sq km)	Per Cap GNP 1988 US$	Percent Industry.	Indus. GNP/1/10 km
Belgium	9.9	31	14,490	34	1,573
Germany	61.3	249	18,480	51	2,320
Italy	57.4	301	13,330	40	1,017
Holland	14.8	37	14,520	37	2,149
Czech. ('89 GNP)	15.6	128	3,450	57	240
Java, 2020 (GDP)	142.2	132	7,195	37	2,868

urbanization equation is to this date far lower in the case of Indonesia than appears true for GDP shares. As shown below in Table 7, in 1990 Indonesia appeared to have only 71 percent of the urban population that might have been expected for a "normal" country with Indonesia's per capita GDP and population. About 42 percent of the shortfall occurred on Java (10 million persons) while 58 percent (13 millions) is attributable to the low urbanization rates off-Java.

Java's urban population in 1990 was 80 percent of the normal level. Indonesia's relatively low levels of urbanization quite likely reflect the wide dispersion of population, the relative difficulty of interactions among the dispersed centers, and below average levels of industrial activity outside of Java. To some extent these conditions should change over time, leading to more nearly normal levels of urbanization.

Table 7 includes also a series of urban population projections derived from the assumption that the future difference between urban and rural population growth rates will remain constant over time. This relatively simple assumption has been employed by the United Nations Statistical Office for a number of years with generally good results. United Nations data reproduced by Renaud (1981, Table 2) suggest a median difference between urban and rural growth rates of about 2.9 percent for countries of 15 millions or greater population. This has been used for the "median tempo" estimates shown in the Table. The highest historical value found by Renaud was 5.7 percent (for South Korea). For Table 5, a difference of 4.9 percent equal to the average of the four highest values in the Renaud Table, was used for the "high tempo" projections.

The United Nations method does not explicitly allow for differences in economic growth rate although the "tempo" concept suggests a mix of economic and population activity. In the Indonesian case, as supported by the Table 7 data for Java where the cross-country results might be expected to be more applicable, the UN's "medium" tempo gives 2020 population estimates results comparable to those from the cross country equation under "low" growth. Similarly the UN-based estimate of 107.4 million urban residents by 2020 under the "high tempo" assumptions is quite close to the 105.1 millions derived from medium economic growth and the cross-country equations.

Note that the growth rate of both the medium and high tempo projections exceeds that implicit in the "normal" population estimates. The median tempo projections, furthermore, are roughly consistent with the Java and off-Java labor force projections of Table 5.[10]

[10] Assuming the following labor force percentages are urban: 90 percent for manufacturing and construction; 80 percent for transportation and utilities; and 65 percent for other services and administration.

Table 7

Projected Urban Population Growth, 1990-2020 (in millions)

		Low GDP Growth		Medium GDP Growth	
	1990	2000	2020	2000	2020
All Indonesia					
Actual	55.4				
"Normal" a/	78.2	103.7	153.4	112.1	158.5
UN method b/					
Medium tempo	55.4	77.9	130.9	77.9	130.9
High tempo	55.4	87.9	167.4	87.9	167.4
Java					
Actual	38.3				
"Normal" a/	47.9	62.8	91.3	67.7	105.1
UN method b/					
Medium tempo	38.3	53.1	86.5	53.1	86.5
High tempo	38.3	59.3	107.4	59.3	107.4
Off-Java					
Actual	17.1				
"Normal" c/	30.3	40.9	62.1	44.1	73.4
UN method c/					
Medium tempo	17.1	24.8	44.4	24.8	44.4
High tempo	17.1	28.6	60.0	28.6	60.0

a/ Urbanization level is derived from cross-country equations in Carter (1973); the estimated level is a function of per capita GDP in logs, the square of the same term, and the level of net foreign capital inflows. Projections are independent of initial actual urbanization level. Projections for Java assume that Java is comparable to an independent country having Java's population and per capita income level.
b/ As employed by the United Nations Population Division; based on initial level of urbanization, projected total population growth, and the assumed difference between the urban and rural population growth rates. For the medium tempo this latter difference is assumed to be 2.9%; for the high tempo, 4.9%. Compare with Renaud (1981).
c/ Residual.

The medium tempo projects are also close to the "preferred" forecasts of Indonesia's 1985 National Urban Development Strategy project (NUDSP). As interpreted by Hugo and others (1987, 333), the NUDSP projection implied that the country's urban population in 2000 would be about 36 percent of the total while the percentage for Java's urban population would be about 40. The Table 7 medium tempo results suggest an urban population percentage of 37 percent for Indonesia and 42 percent for Java in 2000, rising to 52 percent and 57 percent respectively, by 2020.

There seems to be a good possibility, therefore, that Indonesia's urban population will at least double by the year 2020 and, under medium economic growth

conditions, might rise by a factor of close to three. The greatest increases are likely to occur outside Java, where urban population under medium economic growth conditions could more than triple over the 30-year period. On Java, where the future pattern may more accurately be reflected by cross-country norms, the urban population might grow by a factor of 2.7. Actual urban growth and distribution will of course be heavily influenced by factors such as patterns of infrastructure investment and industrialization, the pace of economic growth in general and, above all else, by productivity differences between agriculture and rural-based services in contrast to urban-based manufacturing and services.

Regional Results: the Agricultural Transformation

A pattern of declining numbers of agricultural workers is found for most medium and higher income countries. This shift accompanies the transition of agriculture from a labor-intensive activity employing more traditional technology to a more capital-intensive and "modern" technology. The technology changes, in company with decreasing agricultural labor and a relative increase in agricultural income, are sometimes referred to collectively as "the agricultural transformation."

Cross-country studies confirm the pattern of agricultural transformation and reveal a tendency for agricultural labor, after declining in relative numbers at median levels of per capita GDP, to decline even more rapidly at higher levels of income. Thus Kuznets, examining sectoral data for 59 countries about the year 1960, found that agriculture's share of the labor force dropped from 21.8 percent to 18.9 percent between a GDP per capita level of $588 and $999 (both in 1958 U.S. dollars). By the time average income for his country sample had reached $1501, however, the same agricultural share had fallen to 11.6 percent (Kuznets, 1971, 200; similar results have also been found for a larger sample of countries by Chenery and Syrquin, 1975. $1501 in 1958 US$ is equivalent to about $5000 in 1988 dollars.)

The cross-country equations employed for the current model suggest similarly large declines in Indonesia's agricultural labor force by 2020 under both the low and medium growth rate possibilities (Table 4). As noted earlier, these declines are expected to be greater for Java than for Indonesia as a whole, especially under medium growth conditions. The primary labor force on Java (of which over 99 percent was in agriculture rather than mining) might be expected to fall by a precipitous three-fourths between 2000 and 2020 (Table 5).

The net effect of this decline would be a rapid escalation of agricultural GDP per agricultural worker. This change in combination with the expected pattern of intersectoral price increases could mean, for Java, a rough parity of GDP per worker for at least three of the sectors examined.[11] This improvement in per worker agricultural GDP would contribute substantially to greater intersectoral income equality.

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[11] The exception might be "other services." The actual estimates produced for the medium growth assumption on Java, in 1970 US$ (at variable price growth rates) per member of the sectoral labor force, are shown in Table 8.

Regional Results: Intersectoral Income Equality

Java's share of the national population fell slightly between the 1980 and 1990 censuses, from 61.9 percent to 60.0 percent (BPS, 1991b.) Java's share of nonoil-and-gas manufacturing, meanwhile, probably remained about constant.[12] The result of this and of related changes was a small increase in Java's per capita share of gross national product. Projecting a continuing small decline in Java's population share to the year 2020 with no decline in Java's share of industrial activity leads in the benchmark model results to a substantially increased regional differences in average incomes and returns to labor. Under the medium growth alternative, Java's per capita GDP in constant (variable price growth), for example, would rise from 18 percent above that for off-Java in 1990 to 43 percent greater than off-Java in 2020.

Although the sectoral pattern of Java/off-Java differences is mixed, it is not clear that such a large average difference would be permitted in the real world. It is possibly more likely that net migration from Java would decrease still further or fall to zero, thus helping to equalize average per capita income on Java and outside of Java.

The implication for income equality of the benchmark model results may be summarized by the Kuznets' measure of sectoral equality. This is taken to be sum for all sectors of the absolute differences between the GDP share for each sector and the labor force share for each of the same sectors.[13]

The sectoral patterns of GDP per worker are reproduced in Table 8. Kuznets' equality measure is also included for the model's two regions and for both growth scenarios. To the extent that improvements in sectoral equality of GDP per worker are reflected by improvements in general income equality and to the extent that cross-country norms are indeed applicable to Indonesia (two important caveats), income equality could be expected to improve substantially under the medium growth assumption and improve by a smaller degree under low growth conditions. Furthermore, because of the higher average GDP growth assumed for Java, the agricultural transformation would be expected to occur earlier on that island. The resulting higher agricultural incomes on Java could in turn be expected to improve income equality within that region considerably more than income equality for the area outside of Java.

It should be noted that the timing of these results could be accelerated if physical constraints on Java's future agricultural growth were encountered. Constant price primary growth on Java under medium growth conditions is projected by the model at 2.9 percent annually between 1990 and 2000 and by 2.0 percent per year, on the average, between 2000 and 2020. (See Table 6; Java's constant price growth rates, it will be recalled, are assumed equal to those for Indonesia as a whole.) Java may in one sense have already reached one kind of a limit on agricultural growth

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[12] Regional GDP estimates are available on a consistent basis only for the years 1983-1988. Java's 1983 percentage of "non-MIGAS" manufacturing according to this source was 73.9 percent of the national total in current prices. Java's share in 1983 was 74.4 percent (BPS, 1990b).

[13] Kuznets further excludes the GDP of banking, insurance, real estate, and the ownership of dwellings from his inequality calculations on the grounds that these elements of total GDP bear little relationship to sectoral labor (Kuznets, 1971, 210). This refinement was not attempted for the current study.

Table 8

Summary of Changes in Returns to Labor, 1990, 2000, 2020
(Sectoral GDP/Sectoral Labor Force, in 1970 US$)

	BaseYear	Low Growth		Medium Growth	
	1990	2000	2020	2000	2020
INDONESIA Sectoral Returns to Labor (Variable Price Sector Growth)					
Agriculture & Mining	373	451	766	539	1989
Manufacturing & Construction	1563	2104	4290	2527	7774
Transportation & Utilities	1914	2475	4651	2900	8159
Other Services	1090	1516	2848	1909	4659
Total	767	1090	2388	1407	5027
Kuznets Measure of Sectoral Inequality b/	.584	.609	.537	.470	.334
JAVA Sectoral Returns to Labor (Variable Price Sector Growth)					
Agriculture & Mining	434	577	1309	714	6349
Manufacturing & Construction	1373	1845	3815	2286	7273
Transportation & Utilities	1877	2281	4348	2757	8024
Other Services	1030	1470	2792	1847	4609
Total	821	1203	2754	1557	5795
Kuznets Measure of Sectoral Inequality b/	.463	.441	.276	.412	.225
OFF-JAVA Sectoral Returns to Labor (Variable Price Sector Growth)					
Agriculture & Mining	308	335	441	386	535
Manufacturing & Construction	2102	2839	5567	3139	5324
Transportation & Utilities	1999	3025	5467	3262	5211
Other Services	1221	1608	2953	2035	3270
Total	687	932	1920	1197	2252
Kuznets Measure of Sectoral Inequality b/	.755	.830	.868	.823	.631

a/ See table 6 for annual growth rates of sectoral returns to labor.
b/ Equals the sum of the differences, without regard to sign, between each sector's share of GDP and the same sector's share of labor force. A higher value of the measure means greater inequality of GDP/worker among the four sectors.

because of land and water scarcities. In another sense, however, there remains a large scope for increasing the value of Java's agriculture through shifting to higher value commodities. Such shifts, along with further modest increases in purchased inputs and improvements in technology could well be consistent with the GDP growth rates projected by the model.

If, on the other hand, the annual growth of Java's primary GDP were to be constrained to, say, 2.0 percent between 1990 and 2000 and 1.5 percent thereafter, the result could be to accelerate the exodus of workers from agriculture on Java, some of whom might migrate to other Islands. In an actual run of the model under a similar constraint it was assumed that additional migration did not take place and that the additional agricultural labor "surplus" was distributed partly to manufacturing and construction (10 percent), largely to other services (65 percent), and partly back to agriculture at zero productivity. Despite this assumed drag on increases in agricultural sector GDP per worker, the Kuznets' measure of sectoral inequality was largely unaffected both on and off-Java.[14]

Policy Conclusions

A number of conclusions emerge from the benchmark runs of this two-region, four-sector model.

First, the end is clearly in sight for further growth in the agricultural labor force. This broad conclusion is independent of the cross-country results and relies only on the assumption that agricultural workers at some point begin to share more proportionately in the increased incomes projected for the country as a whole. If average per capita income is growing at a rate well above that for agricultural GDP growth (as the model finds for both the low and medium income growth assumptions), then the agricultural labor force *must* decline in numbers before the growth rate of agricultural GDP per agricultural worker can approach the national average growth rate.

The transition to absolute declines in the agricultural labor force could come soonest on Java and is likely to be speeded by higher rates of general economic growth. Lower absolute numbers of agricultural workers will at some point mean an increase in farm size since cultivated land, if anything, should continue to increase gradually outside Java. For some time, however, higher agricultural incomes can result from labor-saving mechanization and from a reduction in the numbers of underemployed agricultural laborers.

One corollary of this first point is that any future policies to decrease Java's population share should concentrate more on expanding nonagricultural rather than agricultural opportunities outside of Java.

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[14] An additional assumption was that "surplus" agricultural labor equaled the loss in agricultural GDP divided by agricultural sector output per worker in the absence of any constraints. Redistributed labor back to agriculture, as noted, was absorbed without any increase in agricultural GDP. In other sectors, the absorbed agricultural labor was assumed to increase sectoral GDP by one-half the sectoral GDP/worker for the unconstrained case.

A second corollary with important policy implications is that the transformation of agriculture is closely related to and interconnected with the growth of non-agricultural sectors. The process cannot be speeded, at least from the viewpoint of favorable overall changes in income equality, merely by mechanizing agriculture, for example.

Second, over a 25-30 year period, constant price growth projections can give a quite misleading idea of future welfare levels and of the extent to which Indonesia is becoming more like richer countries. Average per capita GDP projected for 2020 under variable price and medium growth assumptions would be over two and one-half times greater than for constant price assumptions. This means that Indonesia in 2020 would be more like today's Greece or Spain than today's Brazil.

Third, the growth of industrial activities will play a predominant role in future economic change under even a low growth scenario. Under the low growth assumptions, manufacturing and construction would increase by a factor of more than five between 1990 and 2020. The increase could easily be double under medium growth conditions. Rapid industrial growth assures that potential problems of industrial pollution will increase at a considerably higher rate than GDP itself. The implications of a ten-fold rise in industrial activity on Java could be profound for water and air quality, and indeed for the general quality of life itself. Indeed Java by 2020 could well have a level of industrialization per unit of land area that is as high as found today in industrialized Europe.
Relatively rapid industrial growth will also be reflected by the relative high urbanization rates implied by Table 7. If anything, the rate of urban population growth, and the attendant environmental pressures, is likely to be higher outside of Java than for Java itself. This reflects, in part, the apparent "under urbanization" that at present is more pronounced outside Java.

Fourth, other than the potential environmental problems arising from industrialization and urbanization on Java, there seem to be few physical constraints on economic growth over the next 25-30 years. To be sure, agricultural land area on Java is already fully utilized and can be expected to decline in the future as cities and industrial sites expand. There will be structural changes within agriculture, however, which will result in a more valuable mix of products produced on Java. Between 1984 and 1988, for example, Java's real agricultural GDP was reported to have increased by over 4.5 percent annually (BPS, 1990b) at the same time that agricultural land may have actually declined.

Even if future agricultural growth on Java is constrained, as might be happen under the median or higher economic growth, to 1.5-2 percent per year, the reallocation of labor to other sectors would appear manageable, at least in theory. For example, between 2000 and 2020 under medium growth conditions, the unconstrained model suggests that Java's agricultural labor force might drop in any case to one-fourth of its year 2000 total, or by 16.5 millions. Constraining 1990-2000 growth to 2 percent per year and annual agricultural growth for 2000-2020 to 1.5 percent would mean an *additional* loss of only about 0.7 million workers.

Fifth, under its benchmark assumptions the model results have a number of implications for future regional policy directions. Recent trends suggest: (a) a continued drop in Java's population share even under a lower rate of future transmigration than is often projected; (b) an approximately constant future share of Java's total GDP; and as a consequence (c) an increasing GDP per capita for Java relative to that outside Java. Other small differences will arise because of Java's initially lower share of agricultural GDP and labor force.

On the other hand it could be argued that given Java's current location and labor advantages, future industrial growth on that island could turn out to be disproportionately greater than for the country as a whole. The 1989 and 1982 labor force surveys, for example, report a one million person increase between those two years in Java's manufacturing and construction labor force. (BPS, 1982 and 1990a.) Outside of Java, the same surveys show a small labor force *decrease* for these two sectors. Any future shift of industrial activity to Java would of course help to relieve Java's labor surpluses and underemployment but could also worsen regional income disparities. Such a shift (which could readily be explored by the current model) would of course also increase the environmental pressures from industrial and total population growth.

Sixth, the model produces encouraging news about the prospects for substantial improvements in sectoral income equality. This conclusion follows partly from the initial differences observed among sectors and partly from the projected growth of sector productivity. The latter, in turn, reflect a projected loss in the absolute numbers of agricultural workers, especially under medium growth conditions. Table 8 shows that in 1990 the sectoral returns to labor in Indonesian manufacturing and construction (the initial conditions for the model) were about five times greater than observed for agriculture and mining. (Keep in mind that these represent sectoral value added per worker in current year relative prices. The estimates may be only a proxy for differences in the income actually received by labor.) By 2020 under medium growth conditions, the Indonesian ratio between manufacturing-plus-construction and agriculture-plus-mining returns would fall to about 3.9:1. On Java, where under medium growth conditions the transformation of agriculture could be more advanced, the same ratio might fall from 3.2:1 in 1990 to 1.1:1 in 2000.

The policy implication which follows from this observation is that to minimize increases in income inequality over time, efforts must be made to ensure that labor productivity growth in agriculture and other services (and probably in construction, too) does not lag too far behind labor productivity growth in industry. It is also at least a possibility that this goal can be achieved more easily under conditions of moderate rather than low economic growth.

Finally, it should of course be apparent that the benchmark runs reported on in this paper explore only a few of a large set of potential longer-run developments. The model's ultimate utility will lie chiefly in analyzing alternative, "what if" situations, and in providing a rough check on the results of more disaggregated and comprehensive modeling exercises.

Also, the results of the model depend heavily upon the assumption that Indonesia will follow the sectoral growth trends derived from international norms. (The timing of the agricultural transformation is especially sensitive to this latter assumption.) The theory behind longer-term agricultural labor force movements and the theory of intersectoral relative price changes have been largely neglected in the international economic literature. Until this neglect is remedied, the more detailed results of the cross-country model for Indonesia must properly be regarded with caution.

Note on Annex Tables

These tables are printouts of the spreadsheet model whose results are the source of Tables 1-8 in the main text. The "Comment" column of the annex tables gives the general source for each row, but for full details it may be necessary to view the actual equations embedded in each spreadsheet cell. Printouts are available for three spreadsheet runs: 2020LowU, low economic growth rate, agriculture unconstrained (5 pp.); 2020MedU, medium economic growth rate, agriculture unconstrained (5 pp.); and 2020MedC, medium economic growth rate, agriculture on Java constrained to a growth rate of 2 percent annually (in constant base year prices) between 1990 and 2000 and 1.5 percent annually between 2000 and 2020 (6 pp.).

ANNEX TABLES

ANNEX TABLE A: Low-Growth Alternative; Java Agriculture Unconstrained

ALTERNATIVE PROJECTIONS OF STRUCTURAL CHANGE, INDONESIA, 1990-2020

	Estimated Values				Growth Rate		Shares of Total				Comments
	1990	2000	2010	2020	'90-'00	'00-'20	1990	2000	2010	2020	
ALL INDONESIA – CONSTANT PRICE GROWTH (Values in mil '70 US$)											
Agric.+ Mining	10771	13791	16375	18571	0.025	0.015	0.270	0.212	0.162	0.131	1990 shs extrapolated from BPS ests.;
Mfg + constr	9973	19435	35317	55988	0.069	0.054	0.250	0.299	0.350	0.394	others assume nontraded price growth
Util.+ transp.	2474	4501	7530	11157	0.062	0.046	0.062	0.069	0.075	0.078	rate/year of: 1990–2000: 0.0168
Other services	16675	27218	41602	56433	0.050	0.037	0.418	0.419	0.413	0.397	2000–2010: 0.0221
											2010–2020: 0.023
Total GDP	39893	64999	100903	142247	0.050	0.040	1.000	0.999	1.000	1.000	From constant price GDP projections.
Check:	39893	64945	100824	142149	0.050	0.040					Sum of sectoral subtotals.
Per Cap GDP:											
1970 US$	221	312	435	561	0.035	0.030					From constant price GDP projections.
1988 US$	543	767	1069	1379	0.035	0.030					Equals '70$ x $ price index of 2.4581.
ALL INDONESIA – VARIABLE PRICE GROWTH (Values in mil '70 US$)											
Agric.+ Mining	16804	23465	30924	38653	0.034	0.025	0.276	0.213	0.160	0.126	Each year's shares from Carter (1973)
Mfg + constr	15576	32169	62742	105814	0.075	0.061	0.255	0.292	0.325	0.346	cross-country equations times 1985
Util.+ transp.	4747	9419	17490	28561	0.071	0.057	0.078	0.086	0.090	0.093	ratio actual shares/estimated shares.
Other services	23861	44949	82132	132747	0.065	0.056	0.392	0.412	0.427	0.436	Dollar value is a residual.
Total GDP	60988	110002	193288	305775	0.061	0.052	1.001	1.003	1.002	1.002	From variable price GDP projections.
Per Cap GDP:											
1970 US$	338	528	833	1206	0.046	0.042					From variable price GDP projections.
1988 US$	831	1298	2048	2964	0.046	0.042					Equals '70$ x $ price index of 2.4581.
ALL INDONESIA – POPULATION AND LABOR FORCE (LF)											
TOTAL POP.	180.51	208.33	231.96	253.58	0.014	0.010					In mil.; Keyfitz, BIES, Dec 1989, p. 39.
=>10 yrs	138257	166876	193522	215238	0.019	0.013					In thousands.; Keyfitz, BIES, Dec 1989.
LF partic. rate	0.575	0.605	0.600	0.595							1990 based on 1989 Sakarnas; others estd.
Labor force	79498	100960	116113	128067	0.024	0.012					Over-10 pop. times participation ratio.
ALL INDONESIA, LABOR FORCE DISTRIBUTION (in thousands of persons)											
Agric.+ Mining	45187	52237	52762	50638	0.015	-0.002	0.568	0.517	0.454	0.395	Shares from '89 Sakarnas+"normal" % pts
Mfg + constr	9921	15225	20413	24563	0.044	0.024	0.125	0.151	0.176	0.192	change derived from cross-country eqs.
Util.+ transp.	2480	3806	5103	6141	0.044	0.024	0.031	0.038	0.044	0.048	Assumed ratio to Mfg & Constr. = 1:4.
Other services	21910	29692	37835	46725	0.031	0.023	0.276	0.294	0.326	0.365	A residual.
Total Lab Force	79498	100960	116113	128067	0.024	0.012	1.000	1.000	1.000	1.000	From All Indonesia LF above.
ALL INDONESIA, SECTORAL GDP/SECTORAL LABOR FORCE (VARIABLE PRICE SECTOR GROWTH)											
('70 US$/labor force member)							Ratio of Sector/Total GDP/LF				
Agric.+ Mining	372	449	586	763	0.019	0.027	0.485	0.412	0.352	0.320	Equals sectoral GDP shares (variable prices
Mfg + constr	1570	2113	3074	4308	0.030	0.036	2.047	1.939	1.846	1.804	growth projections) divided by projected
Util.+ transp.	1914	2475	3427	4651	0.026	0.032	2.495	2.271	2.058	1.948	labor force numbers, from variable
Other services	1089	1514	2171	2841	0.033	0.032	1.420	1.389	1.304	1.190	price growth, LF distribution, above.
Total Lab Force	767	1090	1665	2388	0.036	0.040	1.000	1.000	1.000	1.000	Total GDP/Total LF.
Kuznets Measure of Sectoral Inequality:							0.586	0.610	0.590	0.539	Sum, abs diffs between GDP & labor force shares, above.

100

ANNEX TABLE A (Continued)

ALTERNATIVE PROJECTIONS OF STRUCTURAL CHANGE, JAVA, 1990-2020

	Estimated Values				Growth Rate		Shares of Total				Comments
	1990	2000	2010	2020	'90-'00	'00-'20	1990	2000	2010	2020	
ALL JAVA – CONSTANT PRICE GROWTH (Values in mil '70 US$)											
Agric.+ Mining	6492	8312	9869	11193	0.025	0.015	0.254	0.199	0.151	0.122	1990 shares from 1988 regional GRDPs,
Mfg + constr	6492	12651	22909	36444	0.069	0.054	0.254	0.303	0.353	0.396	adjusted to assume petroleum price
Util.+ transp.	1687	3069	5134	7607	0.062	0.046	0.066	0.073	0.079	0.083	rise = non-oil GDP inflation rate
Other services	10889	17774	27167	36852	0.050	0.037	0.426	0.425	0.417	0.400	since '70. Growth rates identical to national; agric unconstrained.
Total GDP	25561	41806	65159	92096	0.050	0.040	1.000	1.000	1.000	1.001	
Per Cap GDP:											1990 = national average times 1.06;
1970 US$	236	344	492	647	0.038	0.032					others are the derived from sums of
1988 US$	580	846	1209	1590	0.038	0.032					sector shares, total GDP. 1988$ = '70$ times price index of 2.4581.
ALL JAVA – VARIABLE PRICE GROWTH (Values in mil '70 US$)											
Agric.+ Mining	10099	14337	19311	24697	0.036	0.028	0.259	0.203	0.155	0.125	1990 shares equal const price Java times
Mfg + constr	10099	20858	40681	68608	0.075	0.061	0.259	0.295	0.326	0.347	national ratio of variable to constant
Util.+ transp.	3236	6421	11923	19470	0.071	0.057	0.083	0.091	0.095	0.098	price shares. Other year sectoral
Other services	15558	29170	52973	85068	0.065	0.055	0.399	0.412	0.424	0.430	GDP growth assume same inflat'n rates as national constant price growth.
Total GDP	38992	70786	124888	197843	0.061	0.053	1.000	1.001	1.000	1.000	Equals sum of sectoral detail.
Per Cap GDP:											
1970 US$	360	583	943	1391	0.049	0.044					1990 equals 1.066 x national average.
1988 US$	885	1433	2318	3419	0.049	0.044					Equals '70$ x $ price index of 2.4581.
ALL JAVA – POPULATION AND LABOR FORCE (LF)											
Java's Pop. Share re	.6	0.583	0.571	0.561							Extrapolation 1983–90 trends in mil.;
TOTAL POP.	108.31	121.46	132.45	142.25	0.012	0.008					'90 from BPS; others=nat popxJava share
=>10 yrs	82600	97289	110501	120749	0.017	0.011					Same, but thousands; nat popxJava share
LF partic. rate	0.575	0.605	0.600	0.595							All rates same as national, LF part rate.
Labor force	47495	58860	66301	71846	0.022	0.010					Equals Java tot pop=>10 yrsxLF part rate.
ALL JAVA – LABOR FORCE DISTRIBUTION ('000 persons)											
Agric.+ Mining	23344	24927	22642	18931	0.007	-0.014	0.492	0.423	0.342	0.263	Shares from '89 Sakarnas+"normal" % pt
Mfg + constr	7328	11260	14938	17911	0.044	0.023	0.154	0.191	0.225	0.249	change derived from cross-country eqs.
Util.+ transp.	1724	2815	3735	4478	0.050	0.023	0.036	0.048	0.056	0.062	Assumed ratio to Mfg & Constr. = 1:4.
Other services	15099	19858	24986	30526	0.028	0.022	0.318	0.337	0.377	0.425	A residual.
Total Lab Force	47495	58860	66301	71846	0.022	0.010	1.000	0.999	1.000	0.999	From all Java LF.
ALL JAVA, SECTORAL GDP/SECTORAL LABOR FORCE (VARIABLE PRICE SECTOR GROWTH) ('70 US$/labor force member)							Ratio of Sector/Total GDP/LF				
Agric.+ Mining	433	575	853	1305	0.028	0.042	0.585	0.528	0.512	0.546	Equals sectoral GDP shares (variable
Mfg + constr	1378	1852	2723	3830	0.030	0.037	1.797	1.699	1.035	1.604	prices growth projections) divided
Util.+ transp.	1877	2281	3192	4348	0.020	0.033	2.447	2.092	1.917	1.821	by projected labor force numbers,
Other services	1030	1469	2120	2787	0.036	0.033	1.343	1.348	1.273	1.167	from above.
Total Lab Force	821	1203	1884	2754	0.039	0.042	1.070	1.104	1.132	1.153	All Java total GDP/total LF.
Kuznets Measure of Sectoral Inequality							0.465	0.442	0.374	0.277	Sum, abs diffs between GDP & labor force shares, above.

101

ANNEX TABLE A (Continued)

ALTERNATIVE PROJECTIONS OF STRUCTURAL CHANGE, OFF-JAVA, 1990-2020

	Estimated Values				Growth Rate		Shares of Total				Comments
	1990	2000	2010	2020	'90-'00	'00-'20	1990	2000	2010	2020	
ALL OFF-JAVA - CONSTANT PRICE GROWTH (Values in mil '70 US$)											
Agric.+ Mining	4279	5479	6506	7378	0.025	0.015	0.299	0.236	0.182	0.147	GRDP values equal Indonesia less Java,
Mfg + constr	3481	6784	12328	19544	0.069	0.054	0.243	0.293	0.345	0.390	as shown above.
Util.+ transp.	787	1432	2396	3550	0.062	0.046	0.055	0.062	0.067	0.071	Growth rates and shares are calculated
Other services	5786	9444	14435	19581	0.050	0.037	0.404	0.407	0.404	0.390	from the GRDPs.
Total GDP	14332	23193	35744	50151	0.049	0.039	1.001	0.998	0.998	0.998	Equals total GDP minus Java GDP.
Per Cap GDP:											
1970 US$	199	267	359	451	0.030	0.027					Equals total off-Java constant GDP/pop.
1988 US$	460	656	882	1109	0.030	0.027					Equals '70$ x $ price index of 2.4581.
ALL OFF-JAVA - VARIABLE PRICE GROWTH (Values in mil '70 US$)											
Agric.+ Mining	6705	9128	11613	13956	0.031	0.021	0.305	0.233	0.170	0.129	GRDP values equal Indonesia less Java,
Mfg + constr	5477	11311	22061	37206	0.075	0.061	0.249	0.288	0.323	0.345	as shown above.
Util.+ transp.	1511	2998	5567	9091	0.071	0.057	0.069	0.076	0.081	0.084	Growth rates and shares are calculated
Other services	8303	15779	29159	47679	0.066	0.057	0.377	0.402	0.426	0.442	from the variable price GRDPs.
Total GDP	21996	39218	68400	107932	0.060	0.052	1.000	0.999	1.000	1.000	Equals total GDP minus Java GDP.
Per Cap GDP:											
1970 US$	305	451	687	970	0.040	0.039					Equals total off-Java variable GDP/pop.
1988 US$	750	1109	1689	2384	0.040	0.039					Equals '70$ x $ price index of 2.4581.
ALL OFF-JAVA - POPULATION AND LABOR FORCE (LF)											
TOTAL POP.	72.2	86.87	99.51	111.31	0.019	0.012					In mil.; equals Indonesia less Java.
Share Indonesia	0.400	0.417	0.429	0.439							
=>10 yrs	55657	69587	83021	94489	0.023	0.015					Same, but in thousands
LF partic. rate	0.575	0.605	0.600	0.595							Equals pop=>10/LF.
Labor force	32003	42100	49812	56221	0.028	0.015					Equals all Indonesia less Java.
LABOR FORCE DISTRIBUTION ('000 persons)											
Agric.+ Mining	21843	27310	30120	31707	0.023	0.007	0.683	0.649	0.605	0.564	All nos of persons = difference between
Mfg + constr	2593	3965	5475	6652	0.043	0.026	0.081	0.094	0.110	0.118	total Indonesia and Java, as shown
Util.+ transp.	756	991	1368	1663	0.027	0.026	0.024	0.024	0.027	0.030	above.
Other services	6811	9834	12849	16199	0.037	0.025	0.213	0.234	0.258	0.288	
Total Lab Force	32003	42100	49812	56221	0.028	0.015	1.001	1.001	1.000	1.000	From all off-Java LF.
ALL OFF-JAVA, GDP/LABOR FORCE: RELATIVE RETURNS (VARIABLE PRICE SECTOR GROWTH) ('70 US$/labor force member)							Ratio of Sector/Total GDP/LF				
Agric.+ Mining	307	334	386	440	0.008	0.014	0.400	0.306	0.232	0.184	Equals sectoral GDP shares (variable
Mfg + constr	2112	2853	4029	5593	0.031	0.034	2.754	2.617	2.420	2.342	prices growth projections) divided
Util.+ transp.	1999	3025	4069	5467	0.042	0.030	2.606	2.775	2.444	2.289	by projected labor force numbers,
Other services	1219	1605	2269	2943	0.028	0.031	1.580	1.472	1.363	1.232	above.
Total Lab Force	687	931	1373	1920	0.031	0.037	0.896	0.854	0.825	0.804	All off-Java total GDP/LF.
Kuznets Measure of Sectoral Inequality:							0.755	0.830	0.870	0.870	Sum, abs diffs between GDP & labor force shares, above.

102

ANNEX TABLE A (Continued)

DATA USED FOR ESTIMATING SECTORAL SHARES OF GDP

	1985	1990	2000	2010	2020
POP	168.46	180.51	208.33	231.96	253.56
GDP/POP, const. pr gr	174.54	220.88	311.74	434.8	561.21
GDP/POP, var pr gr	252.3070	337.8642	528.0197	833.2331	1205.928
Foreign Cap/GDP	-0.014	-0.026	-0.02	-0.01	0

Note: Ratio 1970 GDP at Factor cost & 1964 US$ to Same at Market prices and 1970 US$ assumed equal to: 0.8

Net foreign balance in $/GDP in $

CHENERY-SYRQUIN EQUATIONS for GDP shares: Dep Var non-log ratio to GDP
F = Net For Cap Inflow/GDP

	Inter-cept	GDP*	(GDP*)^2	POP*	(POP*)^2	F	PROJECTION OF VARIABLE PRICE SHARES OF TOTAL GDP 1985	1990	2000	2010	2020	Actual 1985	1989
Agriculture, mining	2.476	-0.5119	0.0316	-0.1473	0.0161	-0.3453	0.322	0.279	0.216	0.162	0.128	0.318	0.277
Manufact'g+constr.	-0.9661	0.2898	-0.0175	0.0797	-0.0093	0.3569	0.238	0.262	0.3	0.333	0.355	0.232	0.247
Utilities, Transp., Comm.	-0.0667	0.0585	-0.0037	-0.0293	0.0032	-0.0498	0.074	0.08	0.088	0.093	0.096	0.072	0.063
Services, admin.	-0.4434	0.1635	-0.0103	0.0969	-0.0099	0.0383	0.37	0.384	0.403	0.418	0.427	0.378	0.413
Total Cap Investmnt	-0.3418	0.2187	-0.016	-0.0802	0.009	0.2061	0.191	0.202	0.22	0.232	0.237		
National Savings	-0.3346	0.2198	-0.0161	-0.0832	0.0093	-0.61	0.208	0.231	0.243	0.245	0.24		
Urbanization	-1.006	0.2843	-0.0104	0.0904	-0.0115	-0.5462	0.379	0.433	0.498	0.56	0.605		
Chk sum, 4 sectors:							1.004	1.005	1.007	1.006	1.006		

*Variable shown is in natural log.

Source: AMS, Pop, Resources & Environment..., T 8.3, p. 8-23;
Chenery & Syrquin (1975), pp. 48 (T.[illegible]) & 210 (T.S14), and Carter (1973), T. II.

CALCULUATION OF VARIABLE-PRICE GDPs

	1985	1990	2000	2010	2020
Per Cap GDP,'70$					
In constant prices	174.54	220.88	311.74	434.8	561.21
Equivalent RGDP, $'70	644.47	815.575	1151.065	1605.450	2072.205
Variable-price GDP:					
Nat log	5.530646	5.822644	6.269133	6.[illegible]25373	7.095004
In '70 US$	252.3070	337.8642	528.0197	833.2831	1205.928

Assumed Growth Rates:	1985-1990	1990-2000	2000-2010	2010-2020	2000-2020
Population	0.016338	0.014436	0.010802	0.008943	0.009872
Total GDP	0.07	0.05	0.045	0.035023	0.04
Per Cap GDP	0.052799	0.035056	0.033832	0.025849	0.029833

CHENERY-SYRQUIN EQUATIONS for Labor Force shares: Dep Var non-log ratio to Total Labor Force

	Inter-cept	GDP*	(GDP*)^2	POP*	(POP*)^2	F	1985	1990	2000	2010	2020	Actual 1985	198
Agriculture, mining	0.4194	0.2406	-0.0328	-0.1368	0.0177	0.9094	0.523	0.482	0.431	0.368	0.309	0.5333	0.568
Manufact'g+constr.	-1.035	0.1761	-0.0077	0.2572	-0.0306	-0.4131	0.204	0.231	0.257	0.282	0.298	0.1264	0.124
Utilities, Transp., Comm.												0.0325	0.031
Services, admin.												0.2878	0.275
Total services, from eq:	1.61	-0.4122	0.0402	-0.1242	0.0132	0.4986	0.258	0.26	0.291	0.34	0.393	0.3203	0.305
As a residual							0.273	0.287	0.312	0.35	0.393		

Source: N.G. Carter, "A Handbook of Expected Values of Structural Characteristics," World Bank Staff Working Paper #154, June 1973. (Eqs. for Utilities, etc., and Services + Admin. not available.)

(Continued)

ANNEX TABLE A (Continued)

{DATA USED FOR ESTIMATING SECTORAL SHARES OF GDP}

CHENERY-SYRQUIN EQUATIONS for GDP shares: Dep Var non-log ratio to GDP
F = Net Foreign Cap inflow/GDP assumed = 0.

	Inter-cept	GDP*	(GDP*)^2	POP*	(POP*)^2	F	JAVA ONLY PROJECTION OF VARIABLE PRICE SHARES OF TOTAL GDP 1985	1990	2000	2010	2020	Java Actual 1985	1988
Agriculture, mining	2.476	-0.5119	0.0316	-0.1473	0.0161	-0.3453	0.312	0.254	0.188	0.136	0.105		0.254
Manufact'g+constr.	-0.9661	0.2898	-0.0175	0.0797	-0.0093	0.3569	0.249	0.283	0.322	0.353	0.372		0.254
Utilities, Transp., Comm.	-0.0667	0.0585	-0.0037	-0.0293	0.0032	-0.0498	0.072	0.079	0.086	0.092	0.095		0.066
Services, admin.	-0.4434	0.1635	-0.0103	0.0969	-0.0099	0.0383	0.371	0.389	0.409	0.425	0.434		0.426
Total Cap Investmnt	-0.3418	0.2187	-0.016	-0.0802	0.009	0.2061	0.19	0.205	0.22	0.228	0.229		
National Savings	-0.3346	0.2198	-0.0161	-0.0832	0.0093	-0.81	0.193	0.208	0.223	0.23	0.231		
Urbanization	-1.006	0.2843	-0.0[illegible]04	0.0904	-0.0115	-0.5462	0.382	0.442	0.517	0.588	0.342		
Chk sum, 4 sectors:							1.004	1.005	1.005	1.006	1.007	0	1

*Variable shown is in natural log.

Source: AMS, Pop, Resources & Environment..., T 8.3, p. 8-23;
Chenery & Syrquin (1975), pp. 49 (T.7) & 210 (T.S14), and Carter (1973), T. II.

CHENERY-SYRQUIN EQUATIONS for Labor Force shares: Dep Var non-log ratio to Total Labor Force
F = Net Foreign Cap inflow/GDP assumed = 0.

	Inter-cept	GDP*	(GDP*)^2	POP*	(POP*)^2	F	JAVA 1985	1990	2000	2010	2020	Actual 1985	1989
Agriculture, mining	0.4194	0.2406	-0.0328	-0.1368	0.0177	0.9084	0.518	0.478	0.41	0.326	0.25	0.4862	0.4915
Manufact'g+constr.	-1.035	0.1761	-0.0077	0.2572	-0.0306	-0.4131	0.218	0.249	0.286	0.32	0.314	0.1506	0.1543
Utilities, Transp., Comm.												0.0374	0.0363
Services, admin.												0.3258	0.3179
Total services, from eq:	1.61	-0.4[illegible]2	0.0402	-0.[illegible]242	0.0132	0.4986	0.263	0.273	0.303	0.352	0.405	0.3632	0.3542
As a residual								0.273	0.304	0.352	0.406	0.3632	0.3542

Source: N.G. Carter, "A Handbook of Expected Values of Structural Characteristics," World Bank Staff Working Paper #154, June 1973. (Eqs. for Utilities, etc., and Services + Admin. not available.)

- 104 -

ANNEX TABLE B: Medium Growth Alternative; Java Agriculture Unconstrained

ALTERNATIVE PROJECTIONS OF STRUCTURAL CHANGE, INDONESIA, 1990-2020

	Estimated Values				Growth Rate		Shares of Total				Comments
	1990	2000	2010	2020	'90-'00	'00-'20	1990	2000	2010	2020	
ALL INDONESIA – CONSTANT PRICE GROWTH (Values in mil '70 US$)											
Agric.+ Mining	10771	14280	17326	21017	0.029	0.020	0.270	0.182	0.122	0.092	1990 shs extrapolated from BPS ests.;
Mfg + constr	9973	25519	56955	107339	0.099	0.074	0.250	0.326	0.402	0.469	others assume nontraded price growth
Util.+ transp.	2474	5657	11219	19132	0.086	0.063	0.062	0.072	0.079	0.084	rate/year of: 1990–2000: 0.0279
Other services	16675	32822	56080	81280	0.070	0.046	0.418	0.419	0.396	0.355	2000–2010: 0.038
											2010–2020: 0.0455
Total GDP	39893	78332	141728	228965	0.070	0.055	1.000	0.999	0.999	1.000	From constant price GDP projections.
Check:	39893	78278	141580	228768	0.070	0.055					Sum of sectoral subtotals.
Per Cap GDP:											
1970 US$	221	376	611	903	0.055	0.045					From constant price GDP projections.
1988 US$	543	924	1502	2220	0.055	0.045					Equals '70$ x $ price index of 2.4581.
ALL INDONESIA – VARIABLE PRICE GROWTH (Values in mil '70 US$)											
Agric.+ Mining	16804	25807	37681	55954	0.044	0.039	0.276	0.182	0.119	0.087	Each year's shares from Carter (1973)
Mfg + constr	15576	44023	111578	239745	0.109	0.088	0.255	0.310	0.351	0.372	cross–country equations times 1985
Util.+ transp.	4747	12574	30008	62644	0.102	0.084	0.078	0.089	0.094	0.097	ratio actual shares/estimated shares.
Other services	23861	59613	138687	285494	0.096	0.081	0.392	0.421	0.439	0.446	Dollar value is a residual.
Total GDP	60988	142017	317954	643837	0.088	0.079	1.001	1.001	1.003	1.003	From variable price GDP projections.
Per Cap GDP:											
1970 US$	338	682	1371	2539	0.073	0.068					From variable price GDP projections.
1988 US$	831	1676	3370	6241	0.073	0.068					Equals '70$ x $ price index of 2.4581.
ALL INDONESIA – POPULATION AND LABOR FORCE (LF)											
TOTAL POP.	180.51	208.33	231.96	253.56	0.014	0.010					In mil.; Keyfitz, BIES, Dec 1989, p. 39.
=>10 yrs	138257	166876	193522	215238	0.019	0.013					In thousands.; Keyfitz, BIES, Dec 1989.
LF partic. rate	0.575	0.605	0.600	0.595							1990 based on 1989 Sakarnas; others estd.
Labor force	79498	100960	116113	128067	0.024	0.012					Over–10 pop. times participation ratio.
ALL INDONESIA, LABOR FORCE DISTRIBUTION (in thousands of persons)											
Agric.+ Mining	45187	47996	41034	28226	0.006	–0.026	0.568	0.475	0.353	0.220	Shares from '89 Sakarnas+"normal" % pts
Mfg + constr	9921	17345	24593	30710	0.057	0.029	0.125	0.172	0.212	0.240	change derived from cross–country eqs.
Util.+ transp.	2480	4336	6148	7678	0.057	0.029	0.031	0.043	0.053	0.060	Assumed ratio to Mfg & Constr. = 1:4.
Other services	21910	31283	44338	61453	0.036	0.034	0.276	0.310	0.382	0.480	A residual.
Total Lab Force	79498	100960	116113	128067	0.024	0.012	1.000	1.000	1.000	1.000	All Indonesia LF, above.
ALL INDONESIA, SECTORAL GDP/SECTORAL LABOR FORCE (VARIABLE PRICE SECTOR GROWTH)											
('70 US$/labor force member)							Ratio of Sector/Total GDP/LF				
Agric.+ Mining	372	538	918	1982	0.038	0.067	0.485	0.382	0.335	0.394	Equals sectoral GDP shares (variable prices
Mfg + constr	1570	2538	4537	7807	0.049	0.058	2.047	1.804	1.657	1.553	growth projections) divided by
Util.+ transp.	1914	2900	4881	8159	0.042	0.053	2.495	2.061	1.783	1.623	projected labor force numbers, from
Other services	1089	1906	3128	4646	0.058	0.046	1.420	1.355	1.142	0.924	variable price growth, LF dist, above.
Total Lab Force	767	1407	2738	5027	0.063	0.066	1.000	1.000	1.000	1.000	Total GDP/total LF.
Kuznets Measure of Sectoral Inequality:							0.586	0.538	0.472	0.336	Sum, abs diffs between GDP & labor force shares, above.

105

ANNEX TABLE B (Continued)

ALTERNATIVE PROJECTIONS OF STRUCTURAL CHANGE, JAVA, 1990-2020

	Estimated Values				Growth Rate		Shares of Total				Comments
	1990	2000	2010	2020	'90-'00	'00-'20	1990	2000	2010	2020	
ALL JAVA - CONSTANT PRICE GROWTH (Values in mil '70 US$)											
Agric.+ Mining	6492	8607	10443	12668	0.029	0.020	0.254	0.170	0.114	0.085	1990 shares from 1988 regional GRDPs,
Mfg + constr	6492	16612	37076	69874	0.099	0.074	0.254	0.329	0.404	0.470	adjusted to assume petroleum price
Util.+ transp.	1687	3857	7649	13044	0.086	0.063	0.066	0.076	0.083	0.088	rise = non-oil GDP inflation rate
Other services	10889	21433	36621	53077	0.070	0.046	0.426	0.424	0.399	0.357	since '70. Growth rates identical to
											national; agric unconstrained.
Total GDP	25561	50509	91789	148663	0.070	0.055	1.000	0.999	1.000	1.000	
Per Cap GDP:											1990 = national average times 1.06;
1970 US$	236	416	693	1045	0.058	0.047					others are the derived from sums of
1988 US$	580	1023	1703	2569	0.058	0.047					sector shares, total GDP. 1988$ = '70$
											times price index of 2.4581.
ALL JAVA - VARIABLE PRICE GROWTH (Values in mil '70 US$)											
Agric.+ Mining	10099	15934	24139	37486	0.047	0.044	0.259	0.174	0.117	0.090	1990 shares equal const price Java times
Mfg + constr	10099	28543	72343	155441	0.109	0.088	0.259	0.312	0.352	0.373	national ratio of variable to constant
Util.+ transp.	3236	8571	20456	42704	0.102	0.084	0.083	0.094	0.099	0.103	price shares. Other year sectoral GDP
Other services	15558	38578	88857	180751	0.095	0.080	0.399	0.421	0.432	0.434	growth assume same inflation rates as
											national constant price growth.
Total GDP	38992	91626	205795	416382	0.089	0.079	1.000	1.001	1.000	1.000	Equals sum of sectoral detail.
Per Cap GDP:											
1970 US$	360	754	1554	2927	0.077	0.070					1990 equals 1.066 x national average.
1988 US$	885	1853	3820	7195	0.077	0.070					Equals '70$ x $ price index of 2.4581.
ALL JAVA - POPULATION AND LABOR FORCE (LF)											
Java's Pop. Sh re	.6	0.583	0.571	0.561							Extrapolation 1983-90 trends in mil.;
TOTAL POP.	108.31	121.46	132.45	142.25	0.012	0.008					'90 from BPS; others=nat popxJava share.
=>10 yrs	82600	97289	110501	120749	0.017	0.011					Same, but thousands; nat popxJava share.
LF partic. rate	0.575	0.605	0.600	0.595							All rates same as national, LF part rate.
Labor force	47495	58860	66301	71846	0.022	0.010					Equals Java tot pop=>10 yrsxLF part rate.
ALL JAVA - LABOR FORCE DISTRIBUTION ('000 persons)											
Agric.+ Mining	23344	22396	15680	5927	-0.004	-0.064	0.492	0.380	0.236	0.082	Shares from '89 Sakernas+"normal" % pts
Mfg + constr	7328	12437	17258	21288	0.054	0.027	0.154	0.211	0.260	0.296	change derived from cross-country eqs.
Util.+ transp.	1724	3109	4315	5322	0.061	0.027	0.036	0.053	0.065	0.074	Assumed ratio to Mfg & Constr. = 1:4.
Other services	15089	20918	29048	39309	0.033	0.032	0.318	0.355	0.438	0.547	A residual.
Total Lab Force	47495	58860	66301	71846	0.022	0.010	1.000	0.999	0.999	0.999	From all Java LF.
ALL JAVA, SECTORAL GDP/SECTORAL LABOR FORCE (VARIABLE PRICE SECTOR GROWTH) ('70 US$/labor force member)							Ratio of Sector/Total GDP/LF				
Agric.+ Mining	433	711	1539	6325	0.051	0.115	0.565	0.505	0.562	1.258	Equals sectoral GDP shares (variable
Mfg + constr	1378	2295	4192	7302	0.052	0.060	1.797	1.631	1.531	1.453	prices growth projections) divided
Util.+ transp.	1877	2757	4741	8024	0.039	0.055	2.447	1.959	1.732	1.596	by projected labor force numbers,
Other services	1030	1844	3059	4598	0.060	0.047	1.343	1.311	1.117	0.915	from above
Total Lab Force	821	1557	3104	5795	0.066	0.068	1.070	1.107	1.134	1.153	All Java total GDP/total LF
Kuznets Measure of Sectoral Inequality:							0.465	0.414	0.251	0.227	Sum, abs diffs between GDP & labor force shares, above.

106

ANNEX TABLE B (Continued)

ALTERNATIVE PROJECTIONS OF STRUCTURAL CHANGE, OFF-JAVA, 1990-2020

	Estimated Values				Growth Rate		Shares of Total				Comments
	1990	2000	2010	2020	'90-'00	'00-'20	1990	2000	2010	2020	
ALL OFF-JAVA - CONSTANT PRICE GROWTH (Values in mil '70 US$)											
Agric.+ Mining	4279	5673	6883	8349	0.029	0.020	0.299	0.204	0.138	0.104	GRDP values equal Indonesia less Java,
Mfg + constr	3481	8907	19879	37465	0.099	0.074	0.243	0.320	0.398	0.467	as shown above, rows 11-14 & 73-76.
Util.+ transp.	787	1800	3570	6088	0.086	0.063	0.055	0.065	0.071	0.076	Growth rates and shares are calculated
Other services	5786	11389	19459	28203	0.070	0.046	0.404	0.409	0.390	0.351	from the GRDPs.
Total GDP	14332	27823	49939	80302	0.069	0.054	1.001	0.998	0.997	0.998	Equals total GDP minus Java GDP.
Per Cap GDP:											
1970 US$	199	320	502	721	0.049	0.041					Equals total off-Java GDP/pop.
1988 US$	489	787	1234	1772	0.049	0.041					Equals '70$ x $ price index of 2.4581.
ALL OFF-JAVA - VARIABLE PRICE GROWTH (Values in mil '70 US$)											
Agric.+ Mining	6705	9873	13542	18468	0.039	0.032	0.305	0.196	0.121	0.081	GRDP values equal Indonesia less Java,
Mfg + constr	5477	15480	39235	84304	0.109	0.088	0.249	0.307	0.350	0.371	as shown above.
Util.+ transp.	1511	4003	9552	19940	0.102	0.084	0.069	0.079	0.085	0.088	Growth rates and shares are calculated
Other services	8303	21035	49830	104743	0.097	0.084	0.377	0.417	0.444	0.460	from the variable price GRDPs.
Total GDP	21996	50391	112159	227455	0.086	0.078	1.000	0.999	1.000	1.000	Equals total GDP minus Java GDP.
Per Cap GDP:											
1970 US$	305	580	1127	2043	0.066	0.065					Equals total off-Java variable GDP/pop.
1988 US$	750	1426	2770	5022	0.066	0.065					Equals '70$ x $ price index of 2.4581.
ALL OFF-JAVA - POPULATION AND LABOR FORCE (LF)											
TOTAL POP.	72.2	86.87	99.51	111.31	0.019	0.012					In mil.; equals Indonesia less Java.
Share Indonesi	0.400	0.417	0.429	0.439							
=>10 yrs	55657	69587	83021	94489	0.023	0.015					Same, but in thousands
LF partic. rate	0.575	0.605	0.600	0.595							Equals pop=>10/LF.
Labor force	32003	42100	49812	56221	0.028	0.015					Equals all Indonesia less Java.
LABOR FORCE DISTRIBUTION ('000 persons)											
Agric.+ Mining	21843	25900	25354	22299	0.016	-0.007	0.683	0.608	0.509	0.397	All nos of persons = difference between
Mfg + constr	2593	4908	7335	9422	0.066	0.033	0.081	0.117	0.147	0.168	total Indonesia and Java, as shown
Util.+ transp.	756	1227	1833	2356	0.050	0.033	0.024	0.029	0.037	0.042	above.
Other services	6811	10365	15290	22144	0.043	0.039	0.213	0.246	0.307	0.394	
Total Lab Force	32003	42100	49812	56221	0.028	0.015	1.001	1.000	1.000	1.001	From all off-Java LF.
ALL OFF-JAVA, GDP/LABOR FORCE: RELATIVE RETURNS (VARIABLE PRICE SECTOR GROWTH)											
('70 US$/labor force member)							Ratio of Sector/Total GDP/LF				
Agric.+ Mining	307	386	534	828	0.023	0.039	0.400	0.274	0.195	0.165	Equals sectoral GDP shares (variable
Mfg + constr	2112	3154	5349	8948	0.041	0.054	2.754	2.242	1.954	1.780	prices growth projections) divided
Util.+ transp.	1999	3262	5211	8463	0.050	0.049	2.606	2.318	1.903	1.684	by projected labor force numbers,
Other services	1219	2029	3259	4730	0.052	0.043	1.589	1.442	1.190	0.941	above.
Total Lab Force	687	1197	2252	4046	0.057	0.063	0.896	0.851	0.822	0.805	All off-Java total GDP/LF.
Kuznets Measure of Sectoral Inequality:							0.755	0.823	0.776	0.631	Sum, abs diffs between GDP & labor force shares, above.

107

ANNEX TABLE B (Continued)

DATA USED FOR ESTIMATING SECTORAL SHARES OF GDP

	1985	1990	2000	2010	2020	
POP	166.46	180.51	208.33	231.96	253.56	
GDP/POP, const. pr gr	174.54	220.88	376.48	611.27	902.53	
GDP/POP, var pr gr	252.3070	337.8642	681.6918	1370.727	2539.189	
Foreign Cap/GDP	-0.014	-0.026	-0.02	-0.01	0	Net foreign balance in $/GDP in $

Note: Ratio 1970 GDP at Factor cost & 1964 US$ to Same at Market prices and 1970 US$ assumed equal to: 0.8

CHENERY-SYRQUIN EQUATIONS for GDP shares: Dep Var non-log ratio to GDP
F = Net For Cap Inflow/GDP

	Inter-cept	GDP*	(GDP*)^2	POP*	(POP*)^2	F	PROJECTION OF VARIABLE PRICE SHARES OF TOTAL GDP 1985	1990	2000	2010	2020	Actual 1985	1989
Agriculture, mining	2.476	-0.5119	0.0316	-0.1473	0.0161	-0.3453	0.322	0.279	0.184	0.12	0.088	0.318	0.277
Manufact'g+constr.	-0.9661	0.2898	-0.0175	0.0797	-0.0093	0.3569	0.238	0.262	0.318	0.36	0.382	0.232	0.247
Utilities, Transp., Comm.	-0.0667	0.0585	-0.0037	-0.0293	0.0032	-0.0498	0.074	0.08	0.091	0.097	0.1	0.072	0.063
Services, admin.	-0.4434	0.1635	-0.0103	0.0969	-0.0099	0.0383	0.37	0.384	0.412	0.43	0.437	0.378	0.413
Total Cap Investmnt	-0.3418	0.2187	-0.016	-0.0802	0.009	0.2061	0.191	0.202	0.225	0.233	0.228		
National Savings	-0.3346	0.2198	-0.0161	-0.0832	0.0093	-0.81	0.208	0.231	0.248	0.246	0.23		
Urbanization	-1.006	0.2843	-0.0104	0.0904	-0.0115	-0.5462	0.379	0.433	0.538	0.631	0.704		
Chk sum, 4 sectors:							1.004	1.005	1.005	1.007	1.007	1	

*Variable shown is in natural log.

Source: AMS, Pop, Resources & Environment..., T 8.3, p. 8-23;
Chenery & Syrquin (1975), pp. 49 (T.7) & 210 (T.S14), and Carter (1973), T. II.

CALCULUATION OF VARIABLE-PRICE GDPs

	1985	1990	2000	2010	2020
Per Cap GDP,'70$					
In constant prices	174.54	220.88	376.48	611.27	902.53
Equivalent RGDP, $'70	644.47	815.575	1390.110	2257.046	3332.492
Variable-price GDP:					
Nat log	5.530646	5.822644	6.524577	7.223096	7.839600
In '70 US$	252.3070	337.8642	681.6918	1370.727	2539.189

Assumed Growth Rates:	1985-1990	1990-2000	2000-2010	2010-2020	2000-2020
Population	0.016338	0.014436	0.010802	0.008943	0.009872
Total GDP	0.07	0.07	0.061	0.049033	0.055
Per Cap GDP	0.052799	0.054772	0.049661	0.039735	0.044686

CHENERY-SYRQUIN EQUATIONS for Labor Force shares: Dep Var non-log ratio to Total Labor Force

	Inter-cept	GDP*	(GDP*)^2	POP*	(POP*)^2	F	1985	1990	2000	2010	2020	Actual 1985	1989
Agriculture, mining	0.4194	0.2406	-0.0328	-0.1368	0.0177	0.9084	0.523	0.482	0.389	0.267	0.134	0.5333	0.5684
Manufact'g+constr.	-1.035	0.1761	-0.0077	0.2572	-0.0306	-0.4131	0.204	0.231	0.278	0.318	0.346	0.1264	0.1248
Utilities, Transp., Comm.												0.0325	0.0316
Services, admin.												0.2878	0.2753
Total services, from eq:	1.61	-0.4122	0.0402	-0.1242	0.0132	0.4986	0.258	0.26	0.312	0.405	0.519	0.3203	0.3069
As a residual							0.273	0.287	0.333	0.415	0.52		

Source: N.G. Carter, "A Handbook of Expected Values of Structural Characteristics," World Bank Staff Working Paper #154, June 1973. (Eqs. for Utilities, etc., and Services + Admin. not available.)

(Continued)

108

ANNEX TABLE B (Continued)

{DATA USED FOR ESTIMATING SECTORAL SHARES OF GDP}

CHENERY-SYRQUIN EQUATIONS for GDP shares: Dep Var non-log ratio to GDP
F = Net Foreign Cap inflow/GDP assumed = 0.

	Inter-cept	GDP*	(GDP*)^2	POP*	(POP*)^2	F	JAVA ONLY PROJECTION OF VARIABLE PRICE SHARES OF TOTAL GDP 1985	1990	2000	2010	2020	Java Actual 1985	1988
Agriculture, mining	2.476	-0.5119	0.0316	-0.1473	0.0161	-0.3453		0.254	0.158	0.098	0.072		0.254
Manufact'g+constr.	-0.9661	0.2898	-0.0175	0.0797	-0.0093	0.3569		0.283	0.34	0.378	0.395		0.254
Utilities, Transp., Comm.	-0.0667	0.0585	-0.0037	-0.0293	0.0032	-0.0498		0.079	0.089	0.096	0.098		0.066
Services, admin.	-0.4434	0.1635	-0.0103	0.0969	-0.0099	0.0383		0.389	0.413	0.436	0.442		0.426
Total Cap Investmnt	-0.3418	0.2187	-0.016	-0.0802	0.009	0.2061		0.205	0.225	0.227	0.215		
National Savings	-0.3346	0.2198	-0.0161	-0.0832	0.0093	-0.81		0.208	0.228	0.23	0.218		
Urbanization	-1.006	0.2843	-0.0104	0.0904	-0.0115	-0.5462		0.442	0.557	0.659	0.739		
Chk sum, 4 sectors:								1.005	1.005	1.008	1.007	0	

*Variable shown is in natural log.
Source: AMS, Pop, Resources & Environment..., T 8.3, p. 8-23;
Chenery & Syrquin (1975), pp. 49 (T.7) & 210 (T.S14), and Carter (1973), T. II.

CHENERY-SYRQUIN EQUATIONS for Labor Force shares: Dep Var non-log ratio to Total Labor Force
F = Net Foreign Cap inflow/GDP assumed = 0.

	Inter-cept	GDP*	(GDP*)^2	POP*	(POP*)^2	F	JAVA 1985	1990	2000	2010	2020	Actual 1985	1985
Agriculture, mining	0.4194	0.2406	-0.0328	-0.1368	0.0177	0.9084		0.478	0.367	0.223	0.069	0.4862	0.491
Manufact'g+constr.	-1.035	0.1761	-0.0077	0.2572	-0.0306	-0.4131		0.249	0.306	0.355	0.391	0.1506	0.154
Utilities, Transp., Comm.												0.0374	0.036
Services, admin.												0.3258	0.317
Total services, from eq:	1.61	-0.4122	0.0402	-0.1242	0.0132	0.4986		0.273	0.327	0.422	0.54	0.3632	0.354
As a residual								0.273	0.327	0.422	0.54	0.3632	0.354

Source: N.G. Carter, "A Handbook of Expected Values of Structural Characteristics," World Bank Staff Working Paper #154, June 1973. (Eqs. for Utilities, etc., and Services + Admin. not available.)

ANNEX TABLE C: Medium Growth Alternative; Java Agriculture Constrained*

ALTERNATIVE PROJECTIONS OF STRUCTURAL CHANGE, INDONESIA, 1990-2020

	Estimated Values				Growth Rate		Shares of Total				Comments
	1990	2000	2010	2020	'90-'00	'00-'20	1990	2000	2010	2020	
ALL INDONESIA – CONSTANT PRICE GROWTH (Values in mil '70 US$)											
Agric.+ Mining	10771	14280	17326	21017	0.029	0.020	0.270	0.182	0.122	0.092	1990 shs extrapolated from BPS ests.;
Mfg + constr	9973	25519	56955	107339	0.099	0.074	0.250	0.326	0.402	0.469	others assume nontraded price growth
Util.+ transp.	2474	5657	11219	19132	0.086	0.063	0.062	0.072	0.079	0.084	rate/year of: 1990–2000: 0.0279
Other services	16675	32822	56080	81280	0.070	0.046	0.418	0.419	0.396	0.355	2000–2010: 0.038
											2010–2020: 0.0455
Total GDP	39893	78332	141728	228985	0.070	0.055	1.000	0.999	0.999	1.000	From constant price GDP projections.
Check:	39893	78278	141580	228768	0.070	0.055					Sum of sectoral subtotals.
Per Cap GDP:											
1970 US$	221	376	611	903	0.055	0.045					From constant price GDP projections.
1988 US$	543	924	1502	2220	0.055	0.045					Equals '70$ x $ price index of 2.4581.
ALL INDONESIA – VARIABLE PRICE GROWTH (Values in mil '70 US$)											
Agric.+ Mining	16804	25807	37681	55954	0.044	0.039	0.276	0.182	0.119	0.087	Each year's shares from Carter (1973)
Mfg + constr	15576	44023	111578	19745	0.109	0.088	0.255	0.310	0.351	0.372	cross-country equations times 1985
Util.+ transp.	4747	12574	30008	62644	0.102	0.084	0.078	0.089	0.094	0.097	ratio actual shares/estimated shares.
Other services	23861	59613	138687	285494	0.096	0.081	0.392	0.421	0.439	0.446	Dollar value is a residual.
Total GDP	60988	142017	317954	643837	0.088	0.079	1.001	1.001	1.003	1.003	From variable price GDP projections.
Per Cap GDP:											
1970 US$	338	682	1371	2539	0.073	0.068					From variable price GDP projections.
1988 US$	831	1676	3370	6241	0.073	0.068					Equals '70$ x $ price index of 2.4581.
ALL INDONESIA – POPULATION AND LABOR FORCE (LF)											
TOTAL POP.	180.51	208.33	231.96	253.56	0.014	0.010					In mil.; Keyfitz, BIES, Dec 1989, p. 39.
=>10 yrs	138257	166876	193522	215238	0.019	0.013					In thousands.; Keyfitz, BIES, Dec 1989.
LF partic. rate	0.575	0.605	0.600	0.595							1990 based on 1989 Sakarnas; others estd.
Labor force	79498	100960	116113	128067	0.024	0.012					Over–10 pop. times participation ratio.
ALL INDONESIA, LABOR FORCE DISTRIBUTION (in thousands of persons)											
Agric.+ Mining	45187	47996	41034	28226	0.006	–0.026	0.568	0.475	0.353	0.220	Shares from '89 Sakarnas+"normal" % pts
Mfg + constr	9921	17345	24593	30710	0.057	0.029	0.125	0.172	0.212	0.240	change derived from cross-country eqs.
Util.+ transp.	2480	4336	6148	7678	0.057	0.029	0.031	0.043	0.053	0.060	Assumed ratio to Mfg & Constr. = 1:4.
Other services	21910	31283	44338	61453	0.036	0.034	0.276	0.310	0.382	0.480	A residual.
Total Lab Force	79498	100960	116113	128067	0.024	0.012	1.000	1.000	1.000	1.000	From all Indonesia LF above.
ALL INDONESIA, SECTORAL GDP/SECTORAL LABOR FORCE (VARIABLE PRICE SECTOR GROWTH)											
('70 US$/labor force member)							Ratio of Sector/Total GDP/LF				
Agric.+ Mining	372	538	918	1982	0.038	0.087	0.485	0.382	0.335	0.394	Equals sectoral GDP shares (variable prices
Mfg + constr	1570	2538	4537	7807	0.049	0.058	2.047	1.804	1.657	1.553	growth projections) divided by
Util.+ transp.	1914	2900	4881	8159	0.042	0.053	2.495	2.061	1.783	1.623	projected labor force numbers, from
Other services	1089	1906	3128	4648	0.058	0.046	1.420	1.355	1.142	0.924	variable price growth, LF distribution,
											above.
Total Lab Force	767	1407	2738	5027	0.063	0.066	1.000	1.000	1.000	1.000	Total GDP/total LF.
Kuznets Measure of Sectoral Inequality:							0.586	0.588	0.472	0.336	Sum, abs diffs between GDP & labor force shares, above.

**See Worksheet, below, for changes introduced when Java's agricultural growth (constant prices) is constrained to rates shown for all Java agriculture & mining constant proice growth (next page).*

ANNEX TABLE C (Continued)

ALTERNATIVE PROJECTIONS OF STRUCTURAL CHANGE, JAVA, 1990-2020

	Estimated Values				Growth Rate		Shares of Total				Comments
	1990	2000	2010	2020	'90–'00	'00–'20	1990	2000	2010	2020	
ALL JAVA – CONSTANT PRICE GROWTH (Values in mil '70 US$)*											
Agric.+ Mining	6492	7914	9185	10659	0.020	0.015	0.254	0.157	0.100	0.072	1990 shares from 1988 regional GRDPs,
Mfg + constr	6492	16667	37134	69756	0.099	0.074	0.254	0.330	0.406	0.474	adjusted to assume petroleum price
Util.+ transp.	1687	3857	7649	13044	0.086	0.063	0.066	0.076	0.084	0.089	rise = non-oil GDP inflation rate
Other services	10889	22061	37470	53618	0.073	0.045	0.426	0.437	0.410	0.365	since '70. Growth rates identical to national; agric unconstrained.
Total GDP	25561	50499	91438	147077	0.070	0.055	1.000	1.000	1.000	1.000	
Per Cap GDP:											1990 = national average times 1.06;
1970 US$	236	416	690	1034	0.058	0.047					others are the derived from sums of
1988 US$	580	1023	1696	2542	0.058	0.047					sector shares, total GDP. 1988$ = '70$ times price index of 2.4581.
ALL JAVA – VARIABLE PRICE GROWTH (Values in mil '70 US$)*											
Agric.+ Mining	10099	14651	21231	31542	0.038	0.039	0.259	0.160	0.104	0.077	1990 shares equal const price Java times
Mfg + constr	10099	28638	72457	155180	0.110	0.088	0.259	0.313	0.353	0.377	national ratio of variable to constant
Util.+ transp.	3236	8571	20456	42704	0.102	0.084	0.083	0.094	0.100	0.104	price shares. Other sectoral GDP
Other services	15558	39708	90916	182590	0.098	0.079	0.399	0.434	0.443	0.443	growth assume same inflation rates as national constant price growth.
Total GDP	38992	91568	205060	412016	0.089	0.078	1.000	1.001	1.000	1.001	Equals sum of sectoral detail.
Per Cap GDP:											
1970 US$	360	754	1548	2896	0.077	0.070					1990 equals 1.066 x national average.
1988 US$	885	1853	3805	7110	0.077	0.070					Equals '70$ x $ price index of 2.4581.
ALL JAVA – POPULATION AND LABOR FORCE (LF)											
Java's Pop. Shar re	.6	0.583	0.571	0.561							Extrapolation 1983–90 trends in mil.
TOTAL POP.	108.31	121.46	132.45	142.25	0.012	0.008					'90 from BPS; others=natl popxJava share.
=>10 yrs	82600	97289	110501	120749	0.017	0.011					Same, but thousands; natl popxJava share.
LF partic. rate	0.575	0.605	0.600	0.595							All rates same as natl, LF part rate.
Labor force	47495	58860	66301	71846	0.022	0.010					Equals Java tot pop=>10yrs· .F part rate.
ALL JAVA – LABOR FORCE DISTRIBUTION ('000 persons)											
Agric.+ Mining	23344	21044	14234	5223	–0.010	–0.067	0.492	0.358	0.215	0.073	Shares from '89 Sakarnas+"normal" % pts
Mfg + constr	7328	12617	17447	21382	0.056	0.027	0.154	0.214	0.263	0.298	change derived from cross-country eqs.
Util.+ transp.	1724	3109	4315	5322	0.061	0.027	0.036	0.053	0.065	0.074	Assumed ratio to Mfg & Constr. = 1:4.
Other services	15099	22090	30275	39919	0.039	0.030	0.318	0.375	0.457	0.556	A residual.
Total Lab Force	47495	58860	66301	71846	0.022	0.010	1.000	1.000	1.000	1.001	From all Java LF.
ALL JAVA, SECTORAL GDP/SECTORAL LABOR FORCE (VARIABLE PRICE SECTOR GROWTH)											
('70 US$/labor force member)							Ratio of Sector/Total GDP/LF				
Agric.+ Mining	433	696	1488	6039	0.049	0.114	0.565	0.495	0.543	1.201	Equals sectoral GDP shares (variable
Mfg + constr	1378	2270	4153	7258	0.051	0.060	1.797	1.613	1.517	1.444	prices growth projections) divided
Util.+ transp.	1877	2757	4741	8024	0.039	0.055	2.447	1.959	1.732	1.596	by projected labor force numbers,
Other services	1030	1798	3003	4574	0.057	0.048	1.343	1.278	1.097	0.910	from above.
Total Lab Force	821	1556	3093	5735	0.066	0.067	1.070	1.108	1.130	1.141	All Java total GDP/total LF.
Kuznets Measure of Sectoral Inequality:							0.465	0.397	0.250	0.226	Sum, abs diffs between GDP & labor force shares, above.

ANNEX TABLE C (Continued)

ALTERNATIVE PROJECTIONS OF STRUCTURAL CHANGE, OFF-JAVA, 1990-2020

	Estimated Values				Growth Rate		Shares of Total				Comments
	1990	2000	2010	2020	'90-'00	'00-'20	1990	2000	2010	2020	
ALL OFF-JAVA – CONSTANT PRICE GROWTH (Values in mil '70 US$)											
Agric.+ Mining	4279	6366	8141	10358	0.041	0.025	0.299	0.229	0.162	0.126	GRDP values equal Indonesia less Java,
Mfg + constr	3481	8852	19821	37583	0.098	0.075	0.243	0.318	0.394	0.459	as shown above.
Util.+ transp.	787	1800	3570	6088	0.086	0.063	0.055	0.065	0.071	0.074	Growth rates and shares are calculated
Other services	5786	10761	18610	27662	0.064	0.048	0.404	0.387	0.370	0.338	from the GRDPs.
Total GDP	14332	27833	50290	81888	0.069	0.055	1.001	0.999	0.997	0.997	Equals total GDP minus Java GDP.
Per Cap GDP:											
1970 US$	199	320	505	736	0.049	0.043					Equals total off-Java GDP/pop.
1988 US$	489	787	1241	1809	0.049	0.042					Equals '70$ x $ price index of 2.4581.
ALL OFF-JAVA – VARIABLE PRICE GROWTH (Values in mil '70 US$)											
Agric.+ Mining	6705	11156	16450	24412	0.052	0.040	0.305	0.221	0.146	0.105	GRDP values equal Indonesia less Java,
Mfg + constr	5477	15385	30121	84565	0.109	0.089	0.249	0.305	0.347	0.365	as shown above.
Util.+ transp.	1511	4003	9552	19940	0.102	0.084	0.069	0.079	0.085	0.086	Growth rates and shares are calculated
Other services	8303	19905	47771	102904	0.091	0.086	0.377	0.395	0.423	0.444	from the variable price GRDPs.
Total GDP	21996	50449	112894	231821	0.087	0.079	1.000	1.000	1.001	1.000	Equals total GDP minus Java GDP.
Per Cap GDP:											
1970 US$	305	581	1134	2083	0.067	0.066					Equals total off-Java var GDP/pop.
1988 US$	750	1428	2787	5120	0.067	0.066					Equals '70$ x $ price index of 2.4581.
ALL OFF-JAVA – POPULATION AND LABOR FORCE (LF)											
TOTAL POP.	72.2	86.87	99.51	111.31	0.019	0.012					In mil.; equals Indonesia less Java.
Share Indonesia	0.400	0.417	0.429	0.439							
=>10 yrs	55657	69587	83021	94489	0.023	0.015					Same, but in thousands
LF partic. rate	0.575	0.605	0.600	0.595							Equals pop=>10/LF.
Labor force	32003	42100	49812	56221	0.028	0.015					Equals all Indonesia less Java.
LABOR FORCE DISTRIBUTION ('000 persons)											
Agric.+ Mining	21843	26952	26770	23003	0.021	-0.008	0.683	0.640	0.537	0.409	All nos of persons = difference between
Mfg + constr	2593	4728	7146	9328	0.062	0.035	0.081	0.112	0.143	0.166	total Indonesia and Java, as shown
Util.+ transp.	756	1227	1833	2356	0.050	0.033	0.024	0.029	0.037	0.042	above.
Other services	6811	9193	14063	21534	0.030	0.043	0.213	0.218	0.282	0.383	
Total Lab Force	32003	42100	49812	56221	0.028	0.015	1.001	0.999	0.999	1.000	From all off-Java LF.
ALL OFF-JAVA, GDP/LABOR FORCE: RELATIVE RETURNS (VARIABLE PRICE SECTOR GROWTH) ('70 US$/labor force member)							Ratio of Sector/Total GDP/LF				
Agric.+ Mining	307	414	614	1061	0.030	0.048	0.400	0.294	0.224	0.211	Equals sectoral GDP shares (variable
Mfg + constr	2112	3254	5475	9066	0.044	0.053	2.754	2.313	2.000	1.803	prices growth projections) divided
Util.+ transp.	1999	3262	5211	8463	0.050	0.049	2.606	2.318	1.903	1.684	by projected labor force numbers,
Other services	1219	2165	3397	4779	0.059	0.040	1.589	1.539	1.241	0.951	from above.
Total Lab Force	687	1198	2266	4123	0.057	0.064	0.896	0.851	0.828	0.820	All off-Java total GDP/LF.
Kuznets Measure of Sectoral Inequality:							0.755	0.839	0.784	0.608	Sum, abs diffs between GDP & labor force shares, above.

112

ANNEX TABLE C (Continued)

***WORKSHEET FOR CALCULATING REDISTRIBUTION OF LABOR FORCE AND SUBSEQUENT CHANGES IN SECTORAL GDPs IF JAVA'S AGRICULTURAL GROWTH IS CONSTRAINED**

JAVA	Estimated Values 1990	2000	2010	2020	Growth Rate '90–'00	'00–'20	Shares of Total 1990	2000	2010	2020	Comments
Sector GDP, Constant Price Growth, Agriculture & Mining											
Unconstrained	6492	8606	10442	12667	0.029	0.020	0.254	0.171	0.115	0.086	2020MedU model, Annex B.
Constrained	6492	7914	9185	10659	0.020	0.015					
Sector GDP, Variable Price Growth, Agriculture & Mining											
Unconstrained	10138	15994	24230	37628	0.047	0.044	0.259	0.175	0.118	0.090	2020MedU model, Annex B.
Constrained	10138	14707	21313	31664	0.038	0.039					
Difference	0	1287	2917	5964							
Sector GDP/Sectoral Labor Force, Unconstrained (Variable Price Sector Growth)											
Agric.+ Mining	434	714	1545	6349	0.051	0.115	0.566	0.507	0.564	1.263	2020MedU model, Annex B.
Mfg + constr	1373	2286	4176	7273	0.052	0.060	1.790	1.625	1.525	1.447	2020MedU model, Annex B.
Util.+ transp.	1877	2757	4751	8024	0.039	0.055	2.447	1.959	1.732	1.596	2020MedU model, Annex B.
Other services	1030	1847	3065	4609	0.060	0.047	1.343	1.313	1.119	0.917	2020MedU model, Annex B.
Total Lab Force	821	1557	3104	5795	0.066	0.068	1.070	1.107	1.134	1.153	2020MedU model, Annex B.
Difference (Row 209)/(Agr+ Min GDP/LF, row 212) = "surplus"											
agri lab force	0	1803	1888	939							
Assumed distribution "surplus" labor to:											
Agric.+ Mining	0	451	472	235							1/4 total, agriculture labor force.
Mfg + constr	0	180	189	94							1/10 total, agriculture labor force.
Util.+ transp.	0	0	0	0							None.
Other services	0	1172	1227	610							Residual.
Total LF distrd	0	1803	1888	939							
Assumed marginal sectoral GDP/reallocated sectoral labor force:											
Agric.+ Mining	0	0	0	0							Assumed zero.
Mfg + constr	686.5	1143	2088	3636.5							1/2 unconstrained (variable price growth).
Util.+ transp.	938.5	1378.5	2375.5	4012							1/2 unconstrained (variable price growth).
Other services	515	923.5	1532.5	2304.5							1/2 unconstrained (variable price growth).
Therefore, additional sectoral GDP (var. price growth) resulting from transfer of surplus agricultural labor:											
Agric.+ Mining	0	0	0	0							(Assumed dist labor surplus) x (assumed marginal GDP/LF)/100
Mfg + constr	0	206	395	342							(Assumed dist labor surplus) x (assumed marginal GDP/LF)/100
Util.+ transp.	0	0	0	0							(Assumed dist labor surplus) x (assumed marginal GDP/LF)/100
Other services	0	1082	1880	1406							(Assumed dist labor surplus) x (assumed marginal GDP/LF)/100
Total	0	1288	2275	1748							
GDP, Variable Price Growth, Unconstrained											
Agric.+ Mining	10138	15994	24230	37628	0.047	0.044	0.260	0.175	0.118	0.090	2020MedU model, Annex B.
Mfg + constr	10060	28432	72062	154838	0.109	0.088	0.258	0.310	0.350	0.372	2020MedU model, Annex B.
Util.+ transp.	3236	8571	20456	42704	0.102	0.084	0.083	0.094	0.099	0.103	2020MedU model, Annex B.
Other services	15558	38626	89036	181184	0.095	0.080	0.399	0.422	0.433	0.435	2020MedU model, Annex B.
Labor Force, Medium Growth, Unconstrained											
Agric.+ Mining	23344	22396	15680	5927	–0.004	–0.064	0.492	0.380	0.236	0.082	2020MedU model, Annex B.
Mfg + constr	7328	12437	17258	21288	0.054	0.027	0.154	0.211	0.260	0.296	2020MedU model, Annex B.
Util.+ transp.	1724	3109	4315	5322	0.061	0.027	0.036	0.053	0.065	0.074	2020MedU model, Annex B.
Other services	15099	20918	29048	39309	0.033	0.032	0.318	0.355	0.438	0.547	2020MedU model, Annex B.

113

ANNEX TABLE C (Continued)

DATA USED FOR ESTIMATING SECTORAL SHARES OF GDP

	1985	1990	2000	2010	2020
POP	166.46	180.51	208.33	231.96	253.56
GDP/POP, const. pr gr	174.54	220.88	376.48	611.27	902.53
GDP/POP, var pr gr	252.3070	337.8642	681.6918	1370.727	2539.189
Foreign Cap/GDP	-0.014	-0.026	-0.02	-0.01	0

Note: Ratio 1970 GDP at Factor cos & 1984 US$ to Same at Market prices and 1970 US$ assumed equal to: 0.8

Net foreign balance in $/GDP in $

CHENERY-SYRQUIN EQUATIONS for GDP shares: Dep Var non-log ratio to GDP
F = Net For Cap Inflow/GDP

	Inter-cept	GDP*	(GDP*)^2	POP*	(POP*)^2	F	PROJECTION OF VARIABLE PRICE SHARES OF TOTAL GDP 1985	1990	2000	2010	2020	Actual 1985	1989
Agriculture, mining	2.476	-0.5119	0.0316	-0.1473	0.0161	-0.3453	0.322	0.279	0.184	0.12	0.088	0.318	0.277
Manufact'g+constr.	-0.9661	0.2898	-0.0175	0.0797	-0.0093	0.3569	0.238	0.262	0.318	0.36	0.382	0.232	0.247
Utilities, Transp., Comm.	-0.0667	0.0585	-0.0037	-0.0293	0.0032	-0.0498	0.074	0.08	0.091	0.097	0.1	0.072	0.063
Services, admin.	-0.4434	0.1635	-0.0103	0.0969	-0.0099	0.0383	0.37	0.384	0.412	0.43	0.437	0.378	0.413
Total Cap Investmnt	-0.3418	0.2187	-0.016	-0.0802	0.009	0.2061	0.191	0.202	0.225	0.233	0.228		
National Savings	-0.3346	0.2198	-0.0161	-0.0832	0.0093	-0.81	0.208	0.231	0.248	0.246	0.23		
Urbanization	-1.006	0.2843	-0.0104	0.0904	-0.0115	-0.5462	0.379	0.433	0.538	0.631	0.704		
Chk sum, 4 sectors:							1.004	1.005	1.005	1.007	1.007	1	

*Variable shown is in natural log.

Source: AMS, Pop, Resources & Environment..., T 8.3, p. 8-23;
Chenery & Syrquin (1975), pp. 49 (T.7) & 210 (T.S14), and Carter (1973), T. II.

CALCULUATION OF VARIABLE-PRICE GDPs

	1985	1990	2000	2010	2020
Per Cap GDP,'70$					
In constant prices	174.54	220.88	376.48	611.27	902.53
Equivalent RGDP, $'70	644.47	815.575	1390.110	2257.046	3332.492
Variable-price GDP:					
Nat log	5.530646	5.822644	6.524577	7.223096	7.839600
In '70 US$	252.3070	337.8642	681.6918	1370.727	2539.189

Assumed Growth Rates:	1985-1990	1990-2000	2000-2010	2010-2020	2000-2020
Population	0.016338	0.014436	0.010802	0.008943	0.009872
Total GDP	0.07	0.07	0.061	0.049033	0.055
Per Cap GDP	0.052799	0.054772	0.049861	0.039735	0.044686

CHENERY-SYRQUIN EQUATIONS for Labor Force shares: Dep Var non-log ratio to Total Labor Force

	Inter-cept	GDP*	(GDP*)^2	POP*	(POP*)^2	F	1985	1990	2000	2010	2020	Actual 1985	1989
Agriculture, mining	0.4194	0.2406	-0.0328	-0.1368	0.0177	0.9084	0.523	0.482	0.389	0.267	0.134	0.5333	0.5684
Manufact'g+constr.	-1.035	0.1761	-0.0077	0.2572	-0.0306	-0.4131	0.204	0.231	0.278	0.318	0.346	0.1264	0.1248
Utilities, Transp., Comm.												0.0325	0.0316
Services, admin.												0.2878	0.2753
Total services, from eq:	1.61	-0.4122	0.0402	-0.1242	0.0132	0.4986	0.258	0.26	0.312	0.405	0.519	0.3203	0.3069
As a residual							0.273	0.287	0.333	0.415	0.52		

Source: N.G. Carter, "A Handbook of Expected Values of Structural Characteristics," World Bank Staff Working Paper #154, June 1973. (Eqs. for Utilities, etc., and Services + Admin. not available.)

(Continued)

ANNEX TABLE C (Continued)

{DATA USED FOR ESTIMATING SECTORAL SHARES OF GDP}

CHENERY-SYRQUIN EQUATIONS for GDP shares: Dep Var non-log ratio to GDP
F = Net Foreign Cap inflow/GDP assumed = 0.

	Inter-cept	GDP*	(GDP*)^2	POP*	(POP*)^2	F	JAVA ONLY PROJECTION OF VARIABLE PRICE SHARES OF TOTAL GDP 1985	1990	2000	2010	2020	Java Actual 1985	1988
Agriculture, mining	2.476	-0.5119	0.0316	-0.1473	0.0161	-0.3453		0.254	0.158	0.098	0.072		0.254
Manufact'g+constr.	-0.9661	0.2898	-0.0175	0.0797	-0.0093	0.3569		0.283	0.34	0.378	0.395		0.254
Utilities, Transp., Comm.	-0.0667	0.0585	-0.0037	-0.0293	0.0032	-0.0498		0.079	0.080	0.095	0.098		0.066
Services, admin.	-0.4434	0.1635	-0.0103	0.0969	-0.0099	0.0383		0.389	0.418	0.436	0.442		0.426
Total Cap Investmnt	-0.3418	0.2187	-0.016	-0.0802	0.009	0.2061		0.205	0.225	0.227	0.216		
National Savings	-0.3346	0.2198	-0.0161	-0.0832	0.0093	-0.81		0.208	0.228	0.23	0.218		
Urbanization	-1.006	0.2843	-0.0104	0.0904	-0.0115	-0.5462		0.442	0.557	0.658	0.738		
Chk sum, 4 sectors:								1.005	1.005	1.007	1.007	0	1

*Variable shown is in natural log.

Source: AMS, Pop, Resources & Environment..., T 8.3, p. 8-23;
Chenery & Syrquin (1975), pp. 49 (T.7) & 210 (T.S14), and Carter (1973), T. II.

CHENERY-SYRQUIN EQUATIONS for Labor Force shares: Dep Var non-log ratio to Total Labor Force
F = Net Foreign Cap inflow/GDP assumed = 0.

	Inter-cept	GDP*	(GDP*)^2	POP*	(POP*)^2	F	JAVA 1985	1990	2000	2010	2020	Actual 1985	1989
Agriculture, mining	0.4194	0.2406	-0.0328	-0.1368	0.0177	0.9084		0.478	0.367	0.223	0.071	0.4862	0.4915
Manufact'g+constr.	-1.035	0.1761	-0.0077	0.2572	-0.0306	-0.4131		0.249	0.306	0.355	0.39	0.1506	0.1543
Utilities, Transp., Comm.												0.0374	0.0363
Services, admin.												0.3258	0.3179
Total services, from eq:	1.61	-0.4122	0.0402	-0.1242	0.0132	0.4986		0.273	0.327	0.422	0.538	0.3632	0.3542
As a residual								0.273	0.327	0.422	0.539	0.3632	0.3542

Source: N.G. Carter, "A Handbook of Expected Values of Structural Characteristics," World Bank Staff Working Paper #154, June 1973. (Eqs. for Utilities, etc., and Services + Admin. not available.)

115