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Environment and Development in Indonesia: An Input-Output Analysis of Natural Resource Issues

IEA Working Paper No. 2: Case Study Methodology

by

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Preface

The Natural Resources Management Project (NRMP) of USAID, with support from NRMP and the Environmental Programming Support Services Project (EPSS) of the Canadian International Development Agency (CIDA), in association with the Institute for Economic Analysis (IEA) of New York University, are carrying out an analysis of the economic, employment and environmental consequences of alternative development paths for the Indonesian economy. The purpose is to provide advice to the Indonesian National Planning Agency (BAPPENAS) to assist in the development of the newest five-year plan (Repelita VI) and the next Long-Term Development Plan. The first stage of this work has already been completed by IEA with the support of EPSS.

The objective of this work is to evaluate the possible trade-offs between the growth of income and employment on the one hand, and the levels of natural resource depletion and degradation of the natural environment on the other, that are likely to be associated with alternative patterns of structural change. For instance, it is important for policy makers to know how the development of the pulp or cement industry over the next 20 years is likely to affect air and water pollution and how costly, or cost saving, it might be to adopt cleaner technologies than are being used now.

The analytic framework includes a dynamic input-output model covering all economic activities and the associated input-output database. The model is dynamic in two senses. First, it incorporates a representation in which levels of sectoral investment depend on expected growth of output, the technology in use, and levels of capacity utilization. Secondly, the model is dynamic in that it explicitly incorporates projections of changes in technology for agricultural sectors, forestry, energy sectors and key manufacturing and service sectors.

Technological scenarios are developed for each sector using detailed information about likely technological and institutional changes obtained from technical experts. This includes expected changes in intermediate inputs, notably energy and raw materials, capital stocks, and human resources of different skill types as well as changes in natural resource usage and environmental degradation associated with current and alternative future technologies.

This is one of a series of working papers being prepared by NRMP and IEA researchers in collaboration with industry experts. The papers provide a critical part of the database for the numerical computations, as well as the methodology for building it.

Introduction

A dynamic input-output model of the Indonesian economy, and the corresponding input-output database, are used in this study to examine alternative strategies for sustainable development. One of the principal tasks of the study is the construction of the database.

The preliminary gathering of information regarding likely future technological changes in industry, forestry, and agriculture, respectively, was accomplished in the first 3 IEA and NRMP working papers (Duchin and Lange, 1992c; Hamilton, 1992; and Foley, 1992). This paper on case study methodology outlines a systematic approach to completing these studies in order to produce significant portions of the input-output database. The first part of the paper describes how the case studies fit into the overall analysis; the second part provides practical guidance for carrying out an individual case study.

Part I. The Motivation for Case Studies

The case study, generally covering one or several related sectors of the economy, serves as the principal organizing device for both the development of scenarios about the future and the construction of the corresponding database. The first objective involves a qualitative analysis to identify what are likely to be the important choices facing this sector in the future. For the present study, this analysis needs to result in two alternative scenarios about actions the government could promote, one

aggressive and the other more moderate, to achieve environmentally sound economic development.

Once the scenarios are defined, it is necessary to quantify specific variables and parameters for each scenaric by collecting information of two types: economic information about likely future consumption, production, and/or trade in the goods and economic or environmental services in question and technical information, describing alternative potential future production processes in terms of inputs and outputs. The principal objective of this paper is to present the data sheets (see below) onto which the latter information will be entered and to describe how they are to be filled out.

"Case studies" are empirical, micro-level investigations. Generally, a case study is organized according to principles relevant to that study alone. The input-output case study, by contrast, must produce data that are highly structured; for this reason, it is distinguished by the following two characteristics. First, the case study is not begun until the theoretical framework (i.e., the mathematical model) with which it will be used is completed. The framework for this study includes the definition of several vectors of economic or environmental variables (output, factor inputs, pollutant outputs, final deliveries, factor prices, and unit prices) and several matrices of technical parameters (A, R, B, L, and N). The parameters are defined in terms of the variables (e.g., a parameter may measure inputs of one variable per

unit of output of another variable). These variables and parameters, which are defined in Annex A, are the objects that need to be quantified in the course of each case study. Second, the variables are classified according to a well-defined numerical code, and a standard unit is associated with each variable; the new, integrated classification scheme, covering both the 30-sector level of the dynamic model and the 75-sector level of the static model, is given in Annex B. Information collected in the course of each case study has to be reported using the classification scheme and the standard unit of measure.

This classification scheme represents a compromise based on various substantive and practical considerations and fixes the level of detail at which the analysis can be carried out. One consideration in defining this classification scheme was to separately identify, to the extent practical, the main users of land, energy, and water and the major polluters of air and water. (Other sectors that need to be considered because of their use of resources, but which are not shown in Annex B, are households and government activities.)

Numerous problems and exceptions will be encountered when trying to describe the real world in a formal framework and when trying to collect information that has not previously been assembled. This is especially true in the area of the environment; since the use of air, water, and land as inputs to production and repositories for wastes is just beginning to be studied in a

systematic manner, the conceptual framework for this study needs to progress in parallel with data collection. For this reason, the formal model, the classification scheme, and possibly even the units should in principle be continually modified. In practice, however, it is necessary to freeze them at certain stages. The data sheets in Annex C define the data that will be collected for this study.

Each case study is bound to identify information that appears pertinent but that does not fit into this conceptual framework. Descriptive material that is not directly incorporable into the database should be kept to a minimum. Such material should not be distributed throughout the different sections of the case study but rather gathered into two sections about information that may be useful either in providing ideas about how the classification scheme, the units, or the matrices and vectors may need to be redefined in the future or in interpreting the results of the subsequent analysis.

Often case studies make use of whatever information happens to be available that seems in any way related to the topic. The input-output case study is more demanding because certain information is required whether or not it is readily available. This is a strength, not a weakness: a crude estimate of the appropriate parameters is more useful than an accurate measurement of extraneous variables. However, to assure meaningful empirical

content requires a realistic attitude about the level of ambition that should be attempted for the scenarios.

The study should include from the outset a "back-up scenario": the back-up scenario for a sector states that if no additional information can be obtained, we will assume that there will be changes in only a pre-selected set of parameters and that the percentage changes in these parameters will be predetermined in some formal way. This provides a practical as well as a psychological back-up since the individuals collecting the data will realize that whatever they accomplish will only improve on the back-up scenario.

It is not possible to do detailed case studies for all sectors. Some work has already been carried out for Paddy (Foley, 1992) and for Forestry (Hamilton, 1992) in Indonesia, and data sheets based on this work will be prepared. New work will be done for the remaining agricultural sectors. Preliminary parameter projections based on international but not in all cases Indonesian data have been made for households, transportation, electricity generation, pulp and paper, cement, construction, metal processing and use, and industrial energy conservation (Duchin and Lange, 1992c). The scenario underlying these projections is focused especially on changes in energy use, and associated air pollution coefficients have also been projected. This work will provide the industrial back-up scenario; the objective of the next round of industrial case studies is to improve on this scenario by probing

more deeply into, and quantifying, sustainable development scenarios for these sectors in Indonesia.

Part II. Guidelines for Carrying Out a Case Study

1. Choose the Subject of the Case Study

The subject of a particular case study is generally selected because of the **a priori** idea that it is important for the larger study. For the preliminary industrial case study, for example, we chose those sectors that use a great deal of energy and focused attention on potential technological options for reducing energy requirements and associated air pollution. Thus, the case study work was largely, but not exclusively, organized around columns of input coefficients. Candidate sectors for the follow-up industrial case study include those sectors which potentially use and discharge large amounts of water. (A working paper about the industrial use of water (IEA Working Paper #3) indicates what the important issues are likely to be.) The choice of case study is also influenced by the availability of information in the form of a technical literature or access to experts.

Table 1 groups the sectors and identifies those groupings that are being considered for case studies.

Case studies for the first three groups (agricultural sectors and forestry) are already in progress.

Technological changes in mining over the next few decades are likely to be less important for the economy as a whole than those that can be anticipated in other areas of the economy. For sectors

Table 1. Candidates for Case Studies

*1	Paddy	#1
*1	Other Agriculture	2-4
*1	Forestry	5
	Fisheries	6
*4	Coal Mining	7
	Crude Oil Mining	8
	Natural Gas Mining	9
*4	Metal Ore Mining	10.1
	Other Mining	10.2
*3	Food/Bev/Cig	11
*1x	Pulp and Paper	13
*1	Chemicals, etc.	14, 15
*2x	Cement	16
*2	Yarn/Text/App	17.1, 17.2
*3x	Basic Iron & Steel	17.5
*4x	Basic Non-Ferrous	17.6
	Other Manuf.	12, 17.3, 17.4, 17.7-17.10, 18, 19
*1x	Electricity	20
*1	Gas Utilities	21
	Water Supply	22
x	Construction	23
	Other Services	24-30
x	Household Consumption (part of final deliveries)	
x	Transportation (part of households and 17.9, 26.1-26.5)	
x	Industrial Energy Conservation, Service Sectors, and Government	

Notes:
1. * indicates a sector designated as a candidate for a case study by Clive Hamilton in his memo on scenarios of October 13. The figure following * indicates the priority accorded to that sector (1 being highest).
2. x indicates a case study sector (or collection of sectors) covered by IEA Working Paper #1.

#7-10, it is probably more interesting to look at the changing use of these materials (i.e., the rows) than the input structures.

Of the manufacturing sectors, all seven which have been distinguished in Table 1 are good choices for a case study: food, paper, chemicals, cement, textiles, steel, and non-ferrous metals. Perhaps all should be subjected to an initial analysis with the choice among (if not all can be completed) them to be based on the availability of the required information.

Electricity is an obvious choice for a case study, and the person working on this sector should also be responsible for gas utilities. The gas utilities column will probably not be subjected to major changes, but it is important to make projections as to who the major users will be (i.e., the row). The water supply row, which is bound to be of increasing importance in Indonesia, can possibly be included in the same case study.

The construction sector is important because it is very large and is also a major user of all materials including wood products, cement, and metals as well as labor. This is an important candidate for a case study.

The changing structure of household consumption has been estimated as part of the macroeconomic scenario (Hamilton and Hulu, 1992), and household use of energy is separately projected by Duchin and Lange (1992c). It would be useful to estimate the present and likely future household use of water.

Transportation is a major use of energy and a principal source of air pollution. In addition, the means of providing mobility to households and for freight change dramatically with industrialization. For these reasons, it should be considered for a case study.

The assumptions made by Duchin and Lange (1992c) about industrial energy conservation and changing energy use in the service sectors and in government will be incorporated into the database as these issues are not likely to be reexamined during the case studies.

2. Identification of Relevant Sectors

Once the general subject for each case study is decided, the next task is to identify the sectors that are involved. This requires establishing a correspondence between one or more sectors in the input-output classification scheme and the industry such as it is discussed by experts or in the technical literature. Any given input-output sector encompasses multiple products and multiple production processes even for a single product. The easiest case is where a sector is characterized by one dominant product and one dominant production process, for example Paddy. An example of a more difficult case is Food products (#11) since it is more problematic to generalize about changes in technology in the sector as a whole. Three possible strategies are: a. generalize information obtained about a subsector to the sector as a whole because the subsector is representative and/or dominant, b. develop data sheets for individual subsectors and combine them at the end, or c. make a crude direct estimate for the sector as a whole. A tentative decision among these options needs to be made as early in the case study as is practical.

3. Describe the Sectors

The case study should begin with a description of the sector(s) involved. This includes identifying the sectors producing the major inputs to the case-study sector, the most important resource inputs, the principal users of its output, and the major pollution problems. The principal activities, or stages

of production, need to be identified as well as the alternative technologies currently in use. Examples of input-output case studies for sectors such as paper, cement, metal processing, etc. are included in (Duchin and Lange, 1992a). At this stage, the appropriate unit for measuring the output of the case study sector also needs to be determined.

The technical literature, and technical experts, generally measure the output of a sector in physical units like tons or tons of coal equivalent. It is common to also specify a unit price. When only value units are used, it proves difficult to reconcile information from different sources (because of ambiguities regarding differences in quantities vs differences in unit prices). After an initial familiarization with the area, the best choice of physical unit generally becomes apparent. The data sheets should be filled out in terms of this physical unit (with the unit price in the 1985 rupiahs also specified) even if it should not prove possible to make the conversion from base-year rupiahs to the physical unit in the numerical modeling.

The best source of background information for the manufacturing case studies is the study of strategies for sustainable development on a global scale by Duchin and Lange (1992a). The input-output case studies appearing in this source are based on technological information gathered from many other places.

4. Distinguish Column Issues from Row Issues

In principle, a given scenario should specify changes, if any, for the entire matrices of parameters. In practice, the case studies are organized by covering selected columns of parameters. However, some types of technological changes affect many sectors in the same way. In these instances, a case study should be organized to cover selected rows rather than columns. Examples are provided by the case studies on pollution emission parameters and on industrial energy conservation in the global study by Duchin and Lange (1992a). Thus, the full matrices get covered by a combination of column-oriented and row-oriented case studies with co-ordination required in the areas of overlap.

In this study, technologies for conserving on water use and reducing the water-borne effluent may be treated in the same way. In a more general way, each case study analyst should give some thought to the row issues associated with the column-oriented work. The case study on electricity, for example, will be mainly about changing technologies for providing electricity. Thought also needs to be given, however, to the changing pattern of use of electricity (electricity row) as well as to compensating changes in the input structures (i.e., columns) of electricity-using sectors. The standard data sheet is easily used to record percentage changes across a row instead of down a column; however, the row orientation needs to be explicitly marked on the data sheet. At the start of

each case study, the analyst should plan how many column and row data sheets will be needed for each scenario.

5. Identify Possible Future Technologies

In identifying possible future technologies that are likely to be adopted under each scenario -- aggressive and moderate -- the analyst will need to distinguish new processes from new products and changes in the way individual activities are carried out from the wider diffusion of existing activities. The technological projections may be associated with a single part of the production process. In the case of electricity, for example, the analyst may assume that only generation (and not distribution) differs for the two scenarios. The information for these assumptions will be gleaned from the technical literature and from conversations with experts.

While these case studies will be far more detailed than the data work underlying other economic models, still the analyst will need to abstract and generalize in order to utilize detailed technical information about individual products and processes in a sector-level description.

6. Control Totals

To begin the quantification stage of the case study, it is useful to estimate the magnitudes of some major aggregates for the case study sector such as total production, consumption, imports, exports, and energy use in 1985 and possibly projections for the

future. The control totals for 1985 should be compared to the figures in the official input-output table to be sure they are of the same order of magnitude. If they are not, it will be necessary to discuss with the staff at BPS to discover the principal reasons for major discrepancies and to resolve them.

Control totals projected for the future are used only in a very informal way to provide an idea of the anticipated rates of change. Once the case studies are completed and the model is run, these variables will be calculated to take the full set of scenario assumptions into account. These calculated values will in general be superior to control totals projected without the advantage of the model.

7. Define the Two Scenarios, S1 and S2

We have until now referred to the two scenarios as embodying government and private sector actions that are aggressive, or more moderate, in pursuing the goals of sustainable development. At this point it is necessary to specify the concrete differences between the two scenarios for the sector(s) under examination. The two scenarios may differ simply in the timing of introducing new techniques.

Scenario S1, for the economy as a whole, will combine the moderate assumptions that have been made in each case study. Scenario S2 will combine the more aggressive assumptions.

8. Customize the Data Sheets for Each Case Study

The analyst will need to fill out two sets of data sheets for each sector, one each for Scenarios S1 and S2. If, for example, changes will be projected for the row as well as the column, than four sets of data sheets will be required.

Each set of data sheets elicits a standardized description of the figures that will be filled in and allows for parameters in the A, B, L, and N matrices. Any departures from the standards need to be noted. Sheets are also included for an elaborated representation of the phasing in of new investment although these will not generally be needed.

The analyst should customize the data sheets, which have been made available to NRMP on diskette, to the needs of each individual case study. In particular, since only a handful of variables are likely to change, the sheets should be editted to exclude the sectors for which numerical information is not likely to be collected.

9. Fill In the Data Sheets

The analyst should attempt to begin each case study with a set of data sheets representing a back-up scenario which itself made a preliminary identification of the key parameters and specified the percentage change from their 1985 values. The text describing the backup scenario scenario will be important in understanding the most important areas for improvement.

10. Provide documentation

The figures appearing on each data sheet need to be documented by providing a reference to the technical literature, to an individual expert or agency, or to a rule of thumb or other rough estimation procedure.

The documents referred to should be collected in a library that can be used in future case study work. A full listing of experts consulted should also be maintained for this purpose.

References

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Annex A. Variables and Parameters in the Dynamic Input-Output Model of Indonesia

The dynamic physical model which will be used to carry out the analysis is presented here without comment because it has been discussed at length in other places including (Duchin and Lange, 1992b).

The following description of the model includes a list of the variables and parameters comprising the database. All the parameters need to be projected for future years; the projections which will be made in the case studies (for A, B, L, and N in equations 4-6) are explicitly identified in Annex C.

(Note that generally y and δ are exogenous variables while c, c*, o, and x are endogenous. In some instances, however, c* may be exogenous; in this case, the equation defining it is dropped.)

Definition of Variables and Parameters

$c(t)$	capacity at beginning of period t (n x 1)
$c^*(t + \tau)$	capacity planned in period t for $t + \tau$ where τ is the maximum number of periods lag between delivery of a capital good and its use in production (n x 1)
$o(t + \tau)$	increase in capacity, if any, planned in period t for $t+\tau$ (n x 1)
R	matrix of requirements for replacement of existing capacity (n x 1)
δ_i	maximum admissible annual rate of expansion of capacity for sector i (n x 1)

A, x, y	defined as usual (A is the matrix of current account requirements per unit of output, x is the vector of outputs, and y is the vector of deliveries to final users)
$B^{\theta}(t)$	matrix of those capital requirements per unit increase in output that need to be produced in period t for first use in period $t + \theta$ (n x 1).
e	total employment (scalar)
L	labor requirements per unit of output (ℓ x n)
h	environmental variables (m x 1)
N	environmental parameters (m x n) (See Annex B.)

Initial Conditions

$c(t_0)$

$c^*(t),\ t = t_0+1, \ldots, t_0+\tau-1$

$x(t),\ t = t_0-\tau, \ldots, t_0-1$

The initial conditions are completed by computing o and then c, according to the equations below for $t = t_0+1, \ldots, t_0+\tau-1$.

Model

For $t = t_0, \ldots, t_T$

(1) $$c^*(t+\tau) = \min \left[1+\delta_i, \frac{x_i(t-1)+x_i(t-2)}{x_i(t-2)+x_i(t-3)} \right]^{\tau+1} \cdot x_i(t-1)$$

(2) $o(t+\tau) = \max\ [0,\ c^*(t+\tau) - c(t+\tau-1)]$

(3) $c(t+\tau) = c(t+\tau-1) + o(t+\tau)$

(4) $$[I-A(t)-R+(t)]\,x(t) = \sum_{\theta=1} B^{\theta}(t)\,o(t+\theta) + y(t).$$

(5) $e_t = L_t\, x_t$

(6) $h_t = M_t\, x_t$ where M is the appropriate transformation of N

For example,

$h_{1.6,t} = \hat{N}_{i.6,t}\, \hat{N}_{1.2,t}\, x_t$ where the individual components (e.g., $N_{1.6}$) are defined in Annex B.

Annex B. Sectoral Classification Scheme

This classification scheme has been developed to accomodate both the 30- and the 75- sector classifications. The 2-digit (i.e., #1-30) level corresponds to the 30 sector scheme and the full code (of up to 3 digits, e.g., #11.5) corresponds to the 75-sector scheme. The unit is 1985 rupiahs unless otherwise noted.

Code	Sector
1	Paddy
2	Other Farm Food Crops
2.1	Handpounded rice
2.2	Maize
2.3	Root crops & flour
2.4	Vegetables & fruits
2.5	Other farm food crops
3	Other Agricultural Crops
3.1	Rubber
3.2	Sugar cane & brown sugar
3.3	Coconut
3.4	Crude coconut & palm oil
3.5	Tobacco
3.6	Coffee
3.7	Tea
3.8	Cloves
3.9	Pepper & nutmeg
3.10	Other estate crops
3.11	Other crops
4	Livestock and Products
4.1	Livestock products
4.2	Slaughtering
4.3	Poultry and products
5	Forest Products
5.1	Wood
5.2	Other forest products
6	Fisheries
7	Coal mining (tons of coal equivalent)
8	Crude oil mining (tons of coal equivalent)
9	Natural gas mining (tons of coal equivalent)
10	Other mining and Quarrying
10.1	Metal ore mining
10.2	Other nonmetallic mining and quarrying
11	Food and Tobacco Products
11.1	Food processing & preserving
11.2	Oil & fat
11.3	Cereal mill products
11.4	Flour
11.5	Sugar
11.6	Other food products

11.7 Beverages
11.8 Cigarettes

12 Wood Products
12.1 Sawn and processed wood
12.2 Plywood & other products
12.3 Wooden construction material
12.4 Wooden furniture and fixtures
12.5 Wood and cork products
12.6 Woven goods other than yarn and plastic

13 Pulp, paper and products

14 Fertilizer & pesticide

15 Chemicals

16 Cement

17 Other Manufacturing
17.1 Yarn spinning
17.2 Textile, leather & wearing apparel
17.3 Rubber & plastic wares
17.4 Glass, clay, and non-metallic mineral products
17.5 Basic iron and steel
17.6 Nonferrous basic metal
17.7 Fabricated metal products
17.8 Machines, electrical mach. & apparatus
17.9 Transportation equipment & repair
17.10 Other products n.e.c.

18 Oil refineries (tons of coal equivalent)

19 Liquid natural gas (tons of coal equivalent)

20 Electric Utilities

21 Gas Utilities (tons of coal equivalent)

22 Water supply

23 Construction

24 Retail & wholesale trade

25 Restaurant & hotels

26 Transportation and Communication
26.1 Railway transport
26.2 Road transport
26.3 Water transport
26.4 Air transport
26.5 Services allied to transport
26.6 Communications

27 Financial and Business Services
27.1 Financial intermediaries
27.2 Real estate & business services

28 Public adm. and defense

29	Services
29.1	Social & community services
29.2	Other services
30	Unspecified sector

Categories of Labor

Code	Sector
L1	Highly trained
L2	Technically trained
L3	Unskilled

Environmental Categories

Code	Sector
	Water
N1.1	Water Input (000's of m^3/unit of output)
N1.2	Water Output (000's of m^3/unit of output)
N1.3	BOD (kg/000's of m^3)
N1.4	Dissolved Solids (kg/000's of m^3)
N1.5	Suspended Solids (kg/000's of m^3)
N1.6	Heavy Metals (kg/000's of m^3)
	Land
N2.1	Land Area (ha/unit of output)
N2.2	Soil Erosion (tons/ha)
N2.3	Deforestation (ha deforested/ha logged)
	Air
N3.1	Carbon (tons/tce)
	oil
	gas
	coal
N3.2	Sulfur Dioxide (tons/tce)
	oil
	gas
	coal
N3.3	Nitrogen Oxides (tons/tce)
	oil
	gas
	coal
N3.4	Particulate (tons/tce)

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Annex C. Data Sheets

1. Intermediate Matrix (A)
2. Unit Prices (p)
3. Labor Matrix (L)
4. Environmental Matrix (N)
5. Capital Matrix (B)
6. Supplementary Sheet for Captial and Labor Inputs

Notes:

1. The full set of data sheets needs to be filled out for each scenario and for each "user" sector. User sectors may include any producing sector or any category of final deliveries, such as households.

2. It is indispensable to document the numbers on data sheets. A sheet should be added with a list of the principal sources. Further discussion of how the estimates were made should be provided in the text of the case study.

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Input for sector _____

Scenario S1_____ S2_____ (check one)

1. Intermediate Matrix (A) The unit is 1985 rupiahs unless otherwise noted

			Percentage Change of Input Coefficient from 1985		
Code	Sector	1985	Other Year if Relevant	Other Year if Relevant	2020
1	Paddy				
2	Other farm food crops				
2.1	Handpounded rice				
2.2	Maize				
2.3	Root crops & flour				
2.4	Vegetables & fruits				
2.5	Other farm food crops				
3	Other Agricultural crops				
3.1	Rubber				
3.2	Sugar cane & brown sugar				
3.3	Coconut				
3.4	Crude coconut & palm oil				
3.5	Tobacco				
3.6	Coffee				
3.7	Tea				
3.8	Cloves				
3.9	Pepper & nutmeg				
3.10	Other estate crops				
3.11	Other crops				
4	Livestock and Products				
4.1	Livestock products				
4.2	Slaughtering				
4.3	Poultry and products				
5	Forest Products				
5.1	Wood				
5.2	Other forest products				
6	Fisheries				
7	Coal mining (tons of coal equivalent)				
8	Crude oil mining (tons of coal equivalent)				
9	Natural gas mining (tons of coal equivalent)				

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			Percentage Change of Input Coefficient from 1985		
Code	Sector	1985	Other Year if Relevant	Other Year if Relevant	2020
10	Other mining and Quarrying				
10.1	Metal ore mining				
10.2	Other nonmetallic mining and quarrying				
11	Food and Tobacco Products				
11.1	Food processing & preserving				
11.2	Oil & fat				
11.3	Cereal mill products				
11.4	Flour				
11.5	Sugar				
11.6	Other food products				
11.7	Beverages				
11.8	Cigarettes				
12	Wood Products				
12.1	Sawn and processed wood				
12.2	Plywood & other products				
12.3	Wooden construction material				
12.4	Wooden furniture and fixtures				
12.5	Wood and cork products				
12.6	Woven goods other than yarn and plastic				
13	Pulp, paper and products				
14	Fertilizer & pesticide				
15	Chemicals				
16	Cement				

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			Percentage Change of Input Coefficient from 1985		
Code	Sector	1985	Other Year if Relevant	Other Year if Relevant	2020
17	Other Manufacturing				
17.1	Yarn spinning				
17.2	Textile, leather & wearing apparel				
17.3	Rubber & plastic wares				
17.4	Glass, clay, and non-metallic mineral products				
17.5	Basic iron and steel				
17.6	Nonferrous basic metal				
17.7	Fabricated metal products				
17.8	Machines, electrical mach. & apparatus				
17.9	Transportation equipment & repair				
17.10	Other products n.e.c.				
18	Oil refineries (tons of coal equivalent)				
19	Liquid natural gas (tons of coal equivalent)				
20	Electric Utilities				
21	Gas Utilities (tons of coal equivalent)				
22	Water supply				
23	Construction				
24	Retail & wholesale trade				
25	Restaurant & hotels				
26	Transportation and Communication				
26.1	Railway transport				
26.2	Road transport				
26.3	Water transport				
26.4	Air transport				
26.5	Services allied to transport				
26.6	Communications				

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			Percentage Change of Input Coefficient from 1985		
Code	Sector	1985	Other Year if Relevant	Other Year if Relevant	2020
27	Financial and Business Services				
27.1	Financial intermediaries				
27.2	Real estate & business services				
28	Public adm. and defense				
29	Services				
29.1	Social & community services				
29.2	Other services				
30	Unspecified sector				

2. Unit prices (p) unit: 1985 rupiahs per physical units

Code	Sector	
7	Coal mining (tons of coal equivalent)	
8	Crude oil mining (tons of coal equivalent)	
9	Natural gas mining (tons of coal equivalent)	
18	Oil refineries (tons of coal equivalent)	
19	Liquid natural gas (tons of coal equivalent)	
21	Gas utilities (tons of coal equivalent)	

Notes:
1. Output for all sectors is in 1985 Rps. unless otherwise noted.
2. Prices must be provided for sectors in physical units.

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Input for sector _____, #_____.

Scenario S1_____ S2_____ (check one)

3. Labor Matrix (L) unit: person-years per unit of output

			Percentage Change of Input Coefficient from 1985		
Code	Sector	1985	Other Year if Relevant	Other Year if Relevant	2020
L1	Highly trained				
L2	Technically trained				
L3	Unskilled				

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Input and discharges for sector _____, _____.

Scenario S1_____ S2_____ (check one)

4. Environmental Matrix (N)

			Percentage Change of Input Coefficient From 1985		
Code	Sector	1985	Other Year if Relevant	Other Year if Relevant	2020
	Water				
N1.1	Water Input (1000m³/unit of output)				
N1.2	Water Output (1000m³/unit of output)				
N1.3	BOD (kg/1000m³)				
N1.4	Dissolved Solids (kg/1000m³)				
N1.5	Suspended Solids (kg/1000m³)				
	Land				
N2.1	Land Area (ha/unit of output)				
N2.2	Soil Erosion (tons/ha)				
N2.3	Deforestation (ha deforested/ha logged)				
	Air				
N3.1	Carbon (tons/TCE) oil gas coal				
N3.2	Sulfur Dioxide (tons/TCE) oil gas coal				
N3.3	Nitrogen Oxides (tons/TCE) oil gas coal				
N3.4	Particulates (tons/TCE)				

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Input for sector _____ _____.

Scenario S1_____ S2_____ (check one)

5. Capital Matrix (B)

			Percentage Change of Input Coefficient from 1985			
Code	Sector	1985	Other Year if Relevant	Other Year if Relevant	2020	Lag[1]
4	Livestock and Products					
4.1	Livestock products					
4.2	Slaughtering					
4.3	Poultry and products					
17	Other Manufacturing					
17.1	Yarn spinning					
17.2	Textile, leather & wearing apparel					
17.3	Rubber & plastic wares					
17.4	Glass, clay, and non-metallic mineral products					
17.5	Basic iron and steel					
17.6	Nonferrous basic metal					
17.7	Fabricated metal products					
17.8	Machines, electrical mach. & apparatus					
17.9	Transportation equipment & repair					
17.10	Other products n.e.c.					
23	Construction					

[1]A lag of τ means that the capital must be ordered τ years before the investment becomes productive.

Notes:
1. Output for all sectors is in 1985 Rps. unless otherwise noted.
2. More rows should be added as needed; the sector code must be provided for each additional row.

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Input for sector _____, _____

Scenario S1_____ S2_____ (check one)

6. Supplementary Sheet for Capital and Labor Inputs (Use only if needed)

Indicate below if the requirement for a particular type of capital and/or labor is phased in over a period of time as opposed to being delivered in its entirety τ years (where τ is the corresponding lag in Table 5) before the investment is productive.

Capital Input Sector_____

Year	Coefficient
1	
⋮	
τ_K	

Indicate below if labor, not otherwise accounted for, is required to put the investment in place.

Type of Labor Input_____

Year	Coefficient
1	
⋮	
τ_L	

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