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TAKING THE ENVIRONMENT INTO ACCOUNT AT THE LOCAL LEVEL: AN
ENVIRONMENTAL INPUT-OUTPUT TABLE FOR LIPA CITY

by

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ABSTRACT

The study constructs a 10 sector input-output table for the City of Lipa and modifies it to accommodate environmental variables that can be used to gauge the impact of policy induced changes of output on the environment. Input-output impact multipliers were generated using two specifications of the Leontief matrix. Simulations were performed to show how changes in final demand and output will affect environmental and other impact variables.

Taking into account environmental variables, total output was reduced by 0.016% or by PhP 2,323,055.46 which reflects the value of the damage to the environment that the production process causes through water and air pollution. The simulation using the scenario where a 5% final demand increase for agriculture, 7% increase demand for manufacturing, and 15% increase in trading is assumed raise gross output of agriculture by 12%, trade by 14% and manufacturing by 7.2%. Total gross output increases by 7.6%. The increase in sectoral outputs increases the value of environmental waste disposal services for air and water by 16% and 8% respectively. The value of environmental damages for air and water increases by 6% (air) and 3% (water) as result of more intense pressure on the environment by increased production and consumption activities.

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INTRODUCTION

The Local Government Code of 1991 radically changed the roles played by Local Government Units (LGUs) in the nation's quest for economic development and prosperity. Along with this is the increasingly crucial role that local planners play in harnessing the economic potential of their respective localities. This warrants a thorough understanding of the intricacies of the local economy on their part to be able to properly address emerging local issues like environmental degradation and natural resource depletion brought about by the rapid transformation of local economies due mainly to urbanization. One step in contending with these concerns is to provide a snapshot of the local economy that can serve as an input into the local development planning process. Input-output analysis can provide such a snapshot consisting of important and timely information on the interrelationships in a local economy and the impacts of changes on that economy.

Incorporating elements of Environmental and Natural Resource Accounting (ENRA) to the local model would, to some greater degree, equip planners with the necessary tools to address issues pertaining to sustainable development. This information base serves as inputs in designing policies that lead to sustainable development. The benefits of a localized ENRA is immense as it can be used as a planning input at the local level and, at the macro level, adding up local efforts towards sustainable development will eventually redound to sustainable development at the national level.

The study constructs a 10 sector input-output table for the City of Lipa and modifies it to accommodate environmental variables that can be used to gauge the impact of policy induced changes of output on the environment. Input-output impact multipliers were generated using two specifications of the Leontief matrix. Simulations were performed to show how changes in final demand and output will affect environmental and other impact variables. It is the aim the study to present a general equilibrium depiction of the local economy of Lipa City by describing the interdependence of industries in the local economy through market based transactions thus providing a template for analyzing local economic growth and its impact on the environment and the natural resource base.

INPUT-OUTPUT ANALYSIS

Input-output analysis, also known as inter-industry analysis, is the name given to an analytical framework developed by Wassily Leontief in the late 1930's. The Leontief model is an attempt to represent the economy of a country or a region as a system of linear equations with the assumption that each industry in the economy has two types of demands: external demand (from outside the system) and internal demand (demand placed on one industry by another in the same system). The I-O model is a formalization of the basic concepts published in 1758, by French economist François Quesnay in his "Tableau Economique." More than 100 years after Quesnay's work, León Walras developed a theory of general equilibrium that utilizes a set of production coefficients that related the quantities of factors required to produce a unit of particular product to levels of total production of that product. Wassily Leontief's model is a linear approximation of the Walrasian model, constructed in a similar fashion as the Tableau Economique, which allows the general theory of equilibrium to be applied (Miller and Blair,

1985). The approach to economic I–O analysis is as follows. The structure of each industry’s production process is represented by an appropriately defined vector of structural coefficients that describes in quantitative terms the relationship between the inputs it absorbs and the output it produces. The interdependence among the sectors of the given economy is described by a set of linear equations expressing the balances between the total input and the aggregate output of each commodity and service produced and used in the course of one or several periods of time (Leontief, 1985).

Aside from the use of the analysis in economics there were also various attempts to use it in other fields. Leontief (1970) applied the framework to environmental and ecological issues by adding environmental data to basic input-output system to estimate the degree of pollutants generated and evaluate costs of its elimination. Leontief together with Ford extended this study to calculate the level of air pollution associated with sectional increases in final demand sales.

Hirsch (1967) discussed the possibility of the application of input-output models in local government planning and forecasting land requirements. He affirmed its magnitude especially on local government planning since local government is often a major component of a regional economy and expenditure pattern of a local government can make a significant contribution to local income. IO can also be applied to the study of the likely demand for various local government services and analysis of tax base. Hirsch (1959) first applied the input-output model on a population of 15,000 while Harmston and Lund (1967) extended the framework to a community of 20,000 to illustrate the applicability of the input-output framework to a small a local rural type economy.

Mendoza (1997) modified the 1988 11 sector Philippine Input-Output Table to account for income from non-marketed, nature based household production and extended to account for natural resource depreciation and other environmental variables. Orbeta, Cortez and Calara (1997) applied the Mendoza’s framework to regional analysis through a 1988 intraregional 11 x 11 transactions table to simulate the impacts of alternative development scenarios and regional growth targets in Southern Mindanao. Orbeta (1999) further updated and expanded Mendoza’s work in terms of sectoral coverage and transactions table used. Orbeta’s study used the 1990 transactions table aggregated into 40 sectors. The study used the ENRA modified I-O model to simulate the impact of macroeconomic and adjustment policies on the environment.

THE INPUT-OUTPUT FRAMEWORK

Adopting Mendoza (1997), the simple Leontief IO framework, which takes into account the interdependencies among the production sectors through intermediate deliveries, can be represented as follows.

Consider an economy with n production sectors. Let

$\mathbf{X} = [\mathbf{X}_i]$ where \mathbf{X}_i is the gross output of sector i ,
 $= n \times 1$ vector of gross output;

$\mathbf{A} = [\mathbf{a}_{ij}]$ where \mathbf{a}_{ij} is the Leontief IO technical coefficient and $\mathbf{a}_{ij} = \mathbf{z}_{ij}/\mathbf{X}_j$ where \mathbf{z}_{ij} is the monetary value of the input flow from sector i to sector j ,
 $= n \times n$ Leontief IO coefficient matrix; and

$\mathbf{Y} = [\mathbf{Y}_i]$ where \mathbf{Y}_i is the total final demand for sector i ,
 $= n \times 1$ vector of final demands;

The gross output vector \mathbf{X} can be expressed as

$$\mathbf{X} = \mathbf{A}\mathbf{X} + \mathbf{Y}, \quad (1)$$

that is, each groups output should equal the sum of the intermediate demand and final demand for its products. By matrix manipulation, the gross output vector \mathbf{X} can be rewritten as

$$\mathbf{X} = (\mathbf{I}-\mathbf{A})^{-1}\mathbf{Y} \quad (2)$$

where $(\mathbf{I}-\mathbf{A})^{-1}$ is often referred to as the Leontief inverse. The multiplicative effects in the economy of an exogenous change in one or more components of final demand can be obtained by using

$$\Delta\mathbf{X} = (\mathbf{I}-\mathbf{A})^{-1}\Delta\mathbf{Y} \quad (3)$$

where $\Delta\mathbf{Y}$ denotes changes in the final demands and $\Delta\mathbf{X}$ denotes the changes in sectoral gross output.

The change in sectoral gross output may not be the only measure of changes in exogenous demands. Suppose there are other impact variable interest, such as labor income and employment, which can be measured either in monetary or physical flow units. Let

$\mathbf{V} = [\mathbf{v}_{kj}]$ where \mathbf{v}_{kj} is the impact coefficient defined as the amount of impact variable k associated with a peso worth of sector j 's output
= impact coefficient matrix; and

$\Delta\mathbf{v}$ = vector of impact effects

Then, the changes in impact variables due to changes in final demands are given by

$$\Delta\mathbf{v} = \mathbf{V}(\mathbf{I}-\mathbf{A})^{-1}\Delta\mathbf{Y}, \text{ or} \quad (4)$$

$$\Delta\mathbf{v} = \mathbf{V}\Delta\mathbf{X} \quad (5)$$

The environmental and natural resource variables are included as impact variables.

THE ENRA SYSTEM OF ACCOUNTS

The ENRA framework estimates the values of nature-based goods and services that are not marketed or excluded from conventional income accounting: non-marketed fuelwood production, depreciation of natural resources, waste disposal services, unpaid environmental quality services (recreation), and negative outputs or environmental damages (ex. pollution). The accounts cover negative and positive interactions between economic and environmental systems and have the following features: double-entry bookkeeping (allowing for modifications on both sides of the T-accounts), valuation of both market and non-market goods and services; and the inclusion of both positive and negative charges in the stocks of environmental and natural resources. The accounting process itself will reveal possible problem areas in the locality (ENRAP, 2000).

AREA OF STUDY AND DATA COLLECTION

The City of Lipa is located almost at the heart of Batangas Province in Southern Luzon. It is 85 kilometers away from Metro Manila. Lipa has a total land area of 20,940 hectares. It is made up of 72 barangays; with 12 located in the city proper, another 12 considered as emerging urban areas and the remainder still classified as rural areas. The estimated population of the city for the year 2005 was 272,000.

The full survey method (Bonfiglio, 2005) was utilized wherein firms were asked to give information about:

- its sales to local industries and to final users inside the city and outside the city (exports)

- its purchases from local industries, from industries outside the city (imports), and their final payments to primary owners of inputs

Two questionnaires (patterned after Annual Survey of Philippine Business and Industry questionnaires) were constructed, one for local household, & the other for all business establishments. The number and type of business establishments were taken from Lipa City Hall. For local household respondents, sampling was done using the GOFORDEV program wherein barangays were grouped according to the size of population after which barangays from each category were randomly chosen. The study followed the sampling used by the ASPBI where all dominant (large) establishments were surveyed. The medium to small ones were selected randomly.

Secondary data for agriculture (crops) and local government services were taken from the city hall. The agricultural data were used in combination with the information gathered through the agricultural (poultry and piggery) survey. Sample size consists of 200 households and 400 establishments.

Sectors were classified following the national input-output classification, namely:

1. agriculture
2. manufacturing
3. construction
4. electricity and water
5. transportation, communication and storage
6. Trade
7. Finance
8. Real estate and Dwellings
9. Private Services
10. Local Government Services

Mining and quarrying was omitted because no data on the activity in this sector was available. Table 1 provides descriptions of the aforementioned sectors.

RESULTS

THE LIPA I-O TABLE

From the data collected a transactions table was constructed for the City. The transactions table illustrates the transaction that occurs between the endogenous industries and exogenous industries, measured in terms of purchaser's price. Reading down the columns of the transactions table shows the value of inputs purchased from various sectors which are indicated down the left-most column of the table, by the purchasing sector indicated at the head of the column. The lower half of the table that is not included or classified as endogenous indicate sources of leakage from the local economy. The summation of values presented down in columns should equal the total inputs.

Reading across rows shows the value of sales of each producing sector to endogenous sectors. The right half of the table indicates purchases of final demand sectors. As in the case of column entries, the sum of values along the rows should equal the total sales indicated by the rightmost cell of each row. Figure 1 illustrates the basic components of the transactions table.

Table 2 shows the Lipa City 10 X 10 transactions table. Estimated gross local product (the sum of all local final demand less imports) is PhP 3,628,947,298 for 2005 which is 1% of the Gross Regional Domestic Product of CALABARZON. The manufacturing sector contributes 30% of the output; electricity and water, 26%; finance, 16.8%; and private services, 12%.

Sectors with relatively high value added contents are finance and local government services with 93% and 63% of total value of inputs respectively. Manufacturing and agriculture have relatively low value added corresponding to 22% and 25% of total value of inputs.

Table 3 shows the direct requirements matrix also known as the Leontief coefficients matrix or the A matrix. This shows in each cell, for the i^{th} sector, what fraction of total expenditures was made to purchase inputs from the j^{th} sector. The $(I-A)^{-1}$ matrix, more commonly known as the Leontief inverse matrix, is shown on Table 4. This provides the link between production and final demand making it possible to calculate the output levels required to meet a specific demand.

LOCAL I-O MULTIPLIERS

Input-output multipliers give the economic impact on the local economy of a one peso change in the final demand for the output of one of Lipa City's industries. Table 5 gives the output multiplier of each sector. These multipliers are derived by getting the sum of each column of the Leontief inverse. These coefficients represent the direct and indirect effects of an increase in final demand for output. Construction, trade and real estate have relatively large output multipliers indicative of their strong interlinkages with other sectors of the local economy. A boom in the construction sector will have relatively strong positive effects on the utilities and trade sectors. Improvements on the performance of the trade sector will have strong multiplier effects on the agriculture, manufacturing and electricity and water (utilities) sectors. Real estate has relatively strong linkages to the utilities and finance sectors thus any increase in the demand for real estate will have significant spillover effects to these sectors.

Labor income multipliers were also computed. These multipliers transform the impacts of changes in final demand into changes in income received by households or the value of the resulting additional employment generated. Table 6 shows the labor income multipliers for each sector. Computed income multipliers are relatively small with local government services and private services having the highest income multipliers among the sectors with 0.55 and 0.32 respectively. This means that a one peso increase in demand for LGU services will translate to an additional 55 centavos of labor income for workers in that sector. This highlights the important role that the local government as a sector plays in employment generation. Assuming wages are fixed, employment will be maximized if more spending went into these two sectors.

Table 7 gives the local value-added multipliers. These multipliers are analogous to the output and labor income multipliers. It measures the effect of a one peso increase in the final demand of one sector on the value added of that sector. The finance sector has the highest value added multiplier at 0.97.

I-O MODIFICATIONS FOR ENRA

Following Mendoza (1997) and Orbeta (1999), the Lipa City I-O table was modified to account for environmental and resource impacts of changes in final demand in the local economy. Modifications and extensions are:

- a) Inclusion of the household sector in the intermediate demand matrix making it an endogenous transaction to be able to account for induced effects of output changes through household consumption response to changes in labor income.
- b) Inclusion of environmental inputs (environmental waste disposal services) and outputs (associated environmental damages and direct nature services) and depreciation of natural resources.

Table 8 shows the ENRA modified transactions table. The resulting transactions table has 11 sectors, closed with respect to households. An additional row and column was inserted into the intermediate demand matrix where the row entries give the values of the compensation of employees per sector and the column entries contain the proportion of consumption expenditures attributed to labor income. The column entries are derived by multiplying household consumption expenditures per sector with a proportionality constant. Table 9 provides the household adjustment factor. According to the computation, 93% of household consumption in Lipa City is financed by labor income.

Table 10 displays the resulting 11 X 11 A matrix while table 11 presents the household modified Leontief inverse matrix.

To integrate environmental variables, imputed values of environmental waste disposal services (for air and water) and natural resource depreciation are incorporated through environmental input rows and an environmental output column added outside the conventional transactions table.

Environmental services (air and water) reflect the service being provided by the environment as a catch basin for pollution and residuals of the production process. The environment is thus a non-priced input. Imputed values are entered negatively. The monetary values of environmental services are based on the pollution abatement cost that would be incurred by firms if pollution were to be reduced by 90%.

A net environmental benefits (NEB) row is added as a balancing entry on the input side. NEB is the difference between the absolute values of environmental services and environmental damage. Conceptually, it reflects the difference between the pollution abatement cost saved by the firm by actually polluting and the consequent pollution damage. A positive net environmental benefit means that abating pollution will cost more than the damage that could be averted by reducing pollution. Theoretically, from a social standpoint, a positive NEB implies that pollution abatement has negative net social benefits.

Due to lack of local valuation studies specific to Lipa City, ENRAP national estimates for environmental variables were used in the study. The 1990 imputed values for environmental variables utilized by Orbeta (1999) were adjusted to 2005 levels and then scaled down to reflect probable local levels using a conversion factor. This is based on the assumption that levels of pollution and natural depreciation is dependent on the scale or intensity of production and consumption activities as reflected by the relative size of the output and expenditures. Table 12 shows the ENRAP national estimates. Table 13 presents the conversion factors per sector while table 14 shows the inflation adjusted, scaled down environmental variable values presented as components of net environmental benefits. Data not applicable to Lipa City were omitted, thus, a non-entry doesn't necessarily mean a zero value or that pollution and natural resource depletion does not exist in the sector.

ENVIRONMENTAL IMPACTS

Taking into account environmental variables, total output was reduced by 0.016% or by PhP 2,323,055.46 which reflects the value of the damage to the environment that the production and consumption process causes through water and air pollution. The manufacturing sector accounts for the largest share of water and air environmental damage at 40% of the total imputed value followed by households (36%) and private services (13%). Households account for the highest share in water environmental services at 37% arising mainly from domestic wastewater services followed by the private services sector (28%), and agriculture (26%). This implies that most of the stress on the use of water resources for disposal services comes from these three sectors. For air environmental services, 85% is accounted for by the manufacturing sector. Caution must be made, however, in the interpretation and use of these results since they were based on aggregate or national estimates. Pollution problems usually have geographical concentration and thus scaling down of aggregate estimates may not reflect accurately the scenario at the local level.

Table 15 presents the environmental impact coefficients. Coefficients are generated by taking the ratio of the monetary or physical values of the environmental variables to the corresponding sectoral output. These coefficients indicate the amount of impact variable generated per money unit of output.

MULTIPLIERS

Using the modified Leontief inverse matrix, a new set of output multipliers was generated. Table 16 lists the new output multipliers of each sector. The modified output multipliers are larger than the original because it includes direct, indirect and induced effects through households. Tables 17 and 18 lists the modified income and value added multipliers generated using the new Leontief inverse matrix.

Environmental impact multipliers were also computed. Table 19 shows the multipliers for environmental services and environmental damages. Environmental services and environmental damage multipliers give the impact on pollution abatement cost and health and productivity of an increase in the level of pollutants. This is assuming that pollution abatement cost and health and productivity are linear functions of the levels of residuals.

ECONOMIC AND ENVIRONMENTAL IMPACT SIMULATIONS

Using the equation

$$\Delta X = (I-A)^{-1}\Delta Y \quad (3)$$

where ΔY denotes changes in the final demands and ΔX denotes the changes in sectoral gross output, a simulation of the impacts on the local economy of hypothetical changes in final demand was done. The scenario assumes a 5% final demand increase for agriculture, 7% increase demand for manufacturing, and 15% increase in trading. Simulations were done using the ENRA modified I-O table. Table 20 shows the vector of final demand changes and the resulting impact on sectoral gross output in monetary units and in percentage changes. The combined effects of these increases in final demand raise gross output of agriculture by 12%, trade by 14% and manufacturing by 7.2%. Total gross output increases by 7.6%.

Using the same scenario, we simulate the impacts on business taxes, labor income and gross value added. Impact on these variables can be computed using the equation:

$$\Delta v = V(I-A)^{-1}\Delta Y, \text{ or} \quad (4)$$

where V = impact coefficient matrix; and Δv = vector of impact effects.

Table 21 shows the vector of final demand changes and the vector of impact effects in monetary units and in percentage changes. Labor income for trading increased by 80% and total increase is 3.7%. For tax impacts, the increases in final demand will result in an increase of 12% in business tax collection from the manufacturing sector. Over-all business tax collection can be expected to increase by 4.5%. A 6.7% increase in gross local product computed using the value added approach was registered.

Having calculated the sectoral changes in gross output corresponding to the hypothetical changes in final demand (Table 20), we can compute for the impact of these changes to the environment using the equation:

$$\Delta \mathbf{v} = \mathbf{V} \Delta \mathbf{X} \quad (5)$$

Table 22 shows the impacts on environmental services and environmental damages. The increase in sectoral outputs increases the value of environmental waste disposal services for air and water by 16% and 8% respectively. On the other hand, the value of environmental damages for air and water increases by 6% (air) and 3% (water) as result of more intense pressure on the environment by increased production and consumption.

SUMMARY

The development of a local input-output table provides a clearer picture of the local economy of Lipa City. Through multiplier analysis it was found out that construction, trade and real estate have relatively strong interlinkages with other sectors of the local economy. Labor income multipliers are relatively high for local government services and private services which highlight the crucial role that these sectors play in employment. The integration of environmental variables to the model was able to show the impact that pollution and other forms of environmental problems on the local economy. Pollution and other environmental effects production and consumption processes reduce the total output of the local economy.

Simulations performed demonstrate the capability of the model to generate information that can be inputs for local planning and policy analysis. The model can be an aid in the crafting of local development plans.

However, there are some limitations to the study that necessitates a word of caution. The major limitation of the study is embedded on the environmental data utilized. Admittedly scaling down the values and adjusting them for inflation may not accurately depict the real situation at the local level. The authors suggest that an environmental valuation study be conducted at Lipa City. Other limitations are inherent to the use of input-output as a tool for analysis. I-O analysis assumes constant returns to scale, that is, the same mix of inputs will be used by the firms whatever quantity of output produced. Furthermore, the basic I-O model does not allow for price effects as well as substitution of inputs. To overcome some of these limitations, the I-O table can be upgraded to a Social Accounting Matrix (SAM) which can be used as the foundation of an eventual Computable General Equilibrium (CGE) model.

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FIGURE 1
 BASIC COMPONENT OF A TRANSACTION TABLE

| | Production | Final Demands | |
|----------------|----------------------------------|-----------------------------------|---------------|
| Distribution | II Interindustry structure | I Consump- tion patterns | Total outputs |
| Final Payments | III Incomes | IV Nonmarket transfers | |
| | Total inputs | | |

Table 2
LIPA 10 X 10 TRANSACTIONS TABLE

| Sector | Intermediate Demand Matrix (IDM) | | | | | | | | | | | Final Demand Matrix | | | Total Final Demand (TFD) | Total Output (TO) | | | | | | | | | | |
|--------|----------------------------------|------------------|----------------|------------------|----------------|------------------|----------------|----------------|------------------|----------------|-------------------|---------------------|------------------|------------------|--------------------------|-------------------|----|--|----|--|----|--|---------------------------------|-----|------|---------|
| | 01 | | 02 | | 03 | | 04 | | 05 | | 06 | | 07 | | | | 08 | | 09 | | 10 | | Total Intermediate Demand (TID) | PCE | OLFD | Exports |
| | agri | mfg | const | elec | trans | trade | finance | Real | prv svc | LGU | | | | | | | | | | | | | | | | |
| 01 | 2,061,882.77 | 16,586,513.86 | - | - | - | 403,390,795.92 | - | - | 515,470.69 | - | 422,554,663.24 | 93,918.67 | 32,236,653.21 | 67,767,426.04 | 100,097,997.93 | 522,652,661.17 | | | | | | | | | | |
| 02 | 36,414,312.24 | 328,080,961.67 | 80,000.00 | 785,000.68 | 569,443.54 | 375,559,599.97 | 142,651.31 | 524,051.32 | 63,322,022.40 | 400,000.00 | 805,878,043.13 | 5,130,776.31 | - | 4,255,176,097.68 | 4,260,306,873.99 | 5,066,184,917.12 | | | | | | | | | | |
| 03 | 121,250.00 | 1,204,267.06 | 1,534,452.00 | 398,551.34 | 749,827.19 | 2,417,818.65 | 710,672.76 | 2,503,450.64 | 937,952.00 | 129,075.00 | 10,707,316.64 | 703,744.71 | 208,536,737.99 | 2,051,208.72 | 211,291,691.42 | 221,999,008.06 | | | | | | | | | | |
| 04 | 89,844,753.27 | 1,657,016,100.90 | 156,423,766.35 | 7,939,890.04 | 6,705,526.70 | 588,335,928.77 | 16,378,065.01 | 254,265,485.65 | 404,044,569.67 | 13,315,802.62 | 3,194,269,888.97 | 276,223,463.88 | 0 | 1,723,485.55 | 277,946,949.43 | 3,472,216,838.40 | | | | | | | | | | |
| 05 | 1,258,750.00 | 11,672,077.75 | 365,750.00 | 199,271.17 | 403,751.53 | 4,059,057.88 | 658,202.40 | 235,934.67 | 468,200.00 | 386,521.00 | 19,707,516.39 | 18,845,535.11 | 93,317,836.91 | 20,269,615.54 | 132,432,987.57 | 152,140,503.96 | | | | | | | | | | |
| 06 | 10,157,750.00 | 12,694,237.11 | 12,229,500.00 | 1,410,113.72 | 36,411,552.34 | 195,481,069.26 | 2,340,573.58 | 7,108,291.28 | 31,337,975.00 | 3,030,500.00 | 312,201,562.29 | 10,076,041.70 | 1,572,618,701.00 | 80,426,879.78 | 1,663,121,622.47 | 1,975,323,184.76 | | | | | | | | | | |
| 07 | 33,632,228.20 | 56,388,989.83 | 37,150,150.50 | 8,491,263.34 | 31,942,944.17 | 97,447,435.94 | 24,685,729.95 | 54,704,236.50 | 28,761,912.00 | 472,500.00 | 373,677,390.42 | 155,777,199.61 | 0 | 129,454,473.55 | 285,231,673.16 | 658,909,063.58 | | | | | | | | | | |
| 08 | 60,000.00 | 2,753,653.84 | 45,000.00 | 3,000.00 | 1,328,701.59 | 16,530,296.79 | 21,397.70 | 46,488.42 | 1,505,000.00 | 6,000.00 | 22,299,538.35 | 8,079,513.96 | 300,169,138.02 | 1,584,435.21 | 309,833,087.19 | 332,132,625.54 | | | | | | | | | | |
| 09 | 2,013,518.56 | 41,898,736.02 | 1,365,089.21 | 145,084.66 | 6,108,232.58 | 22,604,013.15 | 1,590,608.29 | 9,908,047.97 | 14,546,779.56 | 11,857,239.15 | 112,037,349.14 | 139,858,930.45 | 728,188,397.33 | 39,034,427.84 | 907,081,755.63 | 1,019,119,104.77 | | | | | | | | | | |
| 10 | - | - | - | - | - | - | - | - | - | - | - | 256,285,005.36 | 217,886,013.14 | 0 | 474,171,018.50 | 474,171,018.50 | | | | | | | | | | |
| TII | 175,564,445.04 | 2,128,295,538.03 | 209,193,708.06 | 19,372,174.95 | 84,219,979.64 | 1,705,826,016.32 | 46,527,900.99 | 329,295,986.46 | 545,439,881.32 | 29,597,637.77 | 5,273,333,268.58 | 871,074,129.75 | 3,152,953,477.61 | 4,597,488,049.91 | 8,621,515,657.28 | 13,894,848,925.86 | | | | | | | | | | |
| CE | 14,870,294.95 | 212,568,511.27 | 3,486,500.00 | 72,522,735.46 | 6,873,909.01 | 18,252,893.53 | 31,105,288.31 | 824,292.88 | 197,297,576.27 | 256,285,005.36 | 814,087,007.04 | - | - | - | 814,087,007.04 | 814,087,007.04 | | | | | | | | | | |
| NLL | 7,184,722.55 | 82,076,120.56 | 1,412,100.00 | 16,680,576.15 | 1,091,000.00 | 3,714,353.60 | 8,250,609.42 | 190,000.00 | 102,425,420.77 | - | 223,024,903.05 | - | - | - | 223,024,903.05 | 223,024,903.05 | | | | | | | | | | |
| OP | 107,482,503.02 | 790,293,788.46 | 5,890,883.37 | 862,965,477.46 | 4,750,779.32 | 54,562,025.60 | 569,896,454.46 | 600,980.21 | 132,046,461.67 | 41,976,335.80 | 2,570,465,689.37 | - | - | - | 2,570,465,689.37 | 2,570,465,689.37 | | | | | | | | | | |
| BT | 547,812.91 | 3,829,515.01 | 147,786.63 | 263,755.10 | 10,453,853.51 | 2,185,082.86 | 925,530.57 | 3,016,361.54 | 21,369,698.13 | - | 21,369,698.13 | - | - | - | 21,369,698.13 | 21,369,698.13 | | | | | | | | | | |
| M | 217,002,882.70 | 1,849,121,443.79 | 1,868,030.00 | 2,500,675,874.38 | 54,941,080.89 | 182,514,042.20 | 943,727.54 | 295,835.42 | 38,893,403.20 | 146,312,039.57 | 4,992,568,359.68 | - | - | - | 4,992,568,359.68 | 4,992,568,359.68 | | | | | | | | | | |
| TPI | 347,088,216.13 | 2,937,889,379.09 | 12,805,300.00 | 3,452,844,663.45 | 67,920,524.32 | 269,497,168.44 | 612,381,162.59 | 2,836,639.08 | 473,679,223.45 | 444,573,380.73 | 8,621,515,657.28 | - | - | - | 8,621,515,657.28 | 8,621,515,657.28 | | | | | | | | | | |
| TI | 522,652,661.17 | 5,066,184,917.12 | 221,999,008.06 | 3,472,216,838.40 | 152,140,503.96 | 1,975,323,184.76 | 658,909,063.58 | 332,132,625.54 | 1,019,119,104.77 | 474,171,018.50 | 13,894,848,925.86 | 871,074,129.75 | 3,152,953,477.61 | 4,597,488,049.91 | 8,621,515,657.28 | 22,516,364,583.14 | | | | | | | | | | |

Notes:

- The sector labels are based on the PSIC (Philippine Industrial Classification codes)
- The column TID is the vector of Intermediate demands, AX in equation (1): X=AX+Y
- On the input side GDP is the row sum of TPI

TID = sum of columns 1 to 10

TII = total intermediate inputs = sum of rows 1 to 10

TPI = total primary inputs = CE + NLL + OP+BT + M

TI = total inputs = TII + TPI

86,983,126.24

Notes:

- The column TFD is the vector of final demand Y is equation (1) X= AX +Y
- The column TO is the vector of gross outputs, X in equation (1)
- On the output side, GDP is the columns sum of TFD.

TABLE 5
OUTPUT MULTIPLIER OF EACH SECTOR

| Sectors | VALUES |
|---|--------|
| Agriculture | 1.40 |
| Manufacturing | 1.47 |
| Construction | 2.04 |
| Electricity & Water | 1.01 |
| Transportation, Communication and Storage | 1.90 |
| Trade | 2.18 |
| Finance | 1.08 |
| Real Estate and Ownership of Dwellings | 2.06 |
| Private Services | 1.62 |
| Local Government Services | 1.09 |

TABLE 6
LABOR INCOME MULTIPLIERS

| | agri | mfg | const | elec | trans | trade | finance | Real | prv svc | LGU |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Compensation of Employees | 0.04121 | 0.05520 | 0.04320 | 0.02111 | 0.07669 | 0.04422 | 0.05042 | 0.03467 | 0.21134 | 0.54682 |
| Non Local Labor | 0.01767 | 0.02028 | 0.01362 | 0.00487 | 0.01816 | 0.01422 | 0.01349 | 0.01014 | 0.10607 | 0.00293 |
| Total | 0.05887 | 0.07547 | 0.05682 | 0.02597 | 0.09485 | 0.05844 | 0.06392 | 0.04481 | 0.31741 | 0.54975 |

TABLE 7
VALUE ADDED MULTIPLIERS FOR EACH SECTOR

| | agri | mfg | const | elec | trans | trade | finance | real | prv svc | LGU |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Compensation of Employees | 0.04121 | 0.05520 | 0.04320 | 0.02111 | 0.07669 | 0.04422 | 0.05042 | 0.03467 | 0.21134 | 0.54682 |
| Non Local Labor | 0.01767 | 0.02028 | 0.01362 | 0.00487 | 0.01816 | 0.01422 | 0.01349 | 0.01014 | 0.10607 | 0.00293 |
| Other Payments | 0.33547 | 0.27122 | 0.37760 | 0.25159 | 0.32431 | 0.30504 | 0.90775 | 0.36256 | 0.28646 | 0.10621 |
| Taxes | 0.00150 | 0.00092 | 0.00167 | 0.00001 | 0.00426 | 0.00669 | 0.00349 | 0.00363 | 0.00338 | 0.00014 |
| Total | 0.39584 | 0.34761 | 0.43608 | 0.27757 | 0.42342 | 0.37016 | 0.97515 | 0.41099 | 0.60725 | 0.65610 |

TABLE 8
ENRA MODIFIED TRANSACTIONS TABLE

| Sector | 01 | | 02 | | 03 | | 04 | | 05 | | 06 | | 07 | | 08 | | 09 | | 10 | | 11 | | HH | OLFD | Exports | TFD | Total Output | Output adjustment for Environmental Variables | Total Output Adjusted for Environmental Variables | |
|-------------|----------------|------------------|----------------|------------------|----------------|------------------|----------------|----------------|------------------|----------------|------------------|-------------------|-----------------|------------------|------------------|------------------|-------------------|-------------------|-------------------|------------------|-------------------|-------------------|-------------------|-------------------|------------------|-------------------|------------------|---|---|---|
| | agri | Mfg | Const | Elec | Trans. | Trade | Finance | Real | Private Service | LGU | HH (COE) | Demand | | Demand | | Demand | | Demand | | Demand | | | | | | | | | | |
| 01 | 2,061,892.77 | 16,586,513.86 | - | - | - | 403,390,796.92 | - | - | 515,470.69 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 02 | 36,414,312.24 | 328,080,961.67 | 80,000.00 | 785,000.68 | 569,443.54 | 375,559,599.97 | 142,651.31 | 524,051.32 | 63,322,022.40 | 400,000.00 | 4,795,112.36 | 810,673,155.50 | 335,663.95 | 6,144.32 | 32,236,653.21 | 67,767,426.04 | 100,010,223.57 | 522,652,661.17 | 4,255,511,761.62 | 5,066,184,917.12 | (341,930.53) | 221,999,008.66 | 4,255,511,761.62 | 5,066,184,917.12 | 5,066,184,917.12 | (86,670.24) | 5,065,842,986.59 | | | |
| 03 | 121,250.00 | 1,204,267.06 | 1,534,452.00 | 398,551.34 | 749,827.19 | 2,417,818.65 | 710,672.76 | 2,503,450.64 | 937,952.00 | 129,075.00 | 657,704.56 | 11,365,021.20 | 46,040.15 | 2,051,208.72 | 208,536,737.99 | 2,051,208.72 | 210,633,986.86 | 221,999,008.66 | 2,051,208.72 | 221,999,008.66 | (7,425.40) | 221,999,008.66 | 2,051,208.72 | 221,999,008.66 | 221,999,008.66 | (7,425.40) | 221,991,582.66 | | | |
| 04 | 89,844,753.27 | 1,657,016,100.90 | 156,423,766.35 | 7,939,890.04 | 6,705,526.70 | 588,335,928.77 | 16,378,065.01 | 254,265,485.65 | 404,044,569.67 | 13,315,802.62 | 258,152,464.07 | 3,452,422,353.04 | 18,070,999.81 | 0 | 0 | 1,723,485.55 | 19,794,485.36 | 3,472,216,838.40 | 3,472,216,838.40 | (18.30) | 3,472,216,838.40 | 3,472,216,838.40 | 3,472,216,838.40 | 3,472,216,838.40 | (18.30) | 3,472,216,820.10 | | | | |
| 05 | 1,259,750.00 | 11,672,077.75 | 365,750.00 | 199,271.17 | 403,751.53 | 4,059,057.88 | 658,202.40 | 235,934.67 | 466,200.00 | 386,521.00 | 17,612,629.77 | 37,320,145.16 | 1,232,906.35 | 93,317,836.81 | 83,317,836.81 | 20,269,615.54 | 114,520,358.80 | 152,140,503.96 | 152,140,503.96 | (4,164.49) | 152,140,503.96 | 152,140,503.96 | 152,140,503.96 | 152,140,503.96 | (4,164.49) | 152,136,339.47 | | | | |
| 06 | 10,157,750.00 | 12,694,237.11 | 12,229,500.00 | 1,410,113.72 | 36,411,552.34 | 195,481,069.26 | 2,340,573.58 | 7,108,291.28 | 31,337,976.00 | 3,030,500.00 | 9,416,850.24 | 321,618,412.53 | 659,191.46 | 1,572,618,701.00 | 80,426,879.78 | 1,653,704,772.23 | 1,975,323,184.76 | 1,975,323,184.76 | 1,975,323,184.76 | (597.75) | 1,975,323,184.76 | 1,975,323,184.76 | 1,975,323,184.76 | 1,975,323,184.76 | (597.75) | 1,975,322,587.01 | | | | |
| 07 | 33,632,228.20 | 56,389,989.84 | 37,150,150.50 | 8,491,263.34 | 31,942,944.17 | 97,447,435.94 | 24,685,729.95 | 54,704,236.50 | 28,761,912.00 | 472,500.00 | 145,585,995.34 | 519,263,385.76 | 10,191,204.27 | 0 | 0 | 129,454,473.55 | 139,645,677.82 | 658,909,063.58 | 658,909,063.58 | (13.41) | 658,909,063.58 | 658,909,063.58 | 658,909,063.58 | 658,909,063.58 | (13.41) | 658,909,063.58 | | | | |
| 08 | 60,000.00 | 2,753,653.84 | 45,000.00 | 3,000.00 | 1,328,701.59 | 16,530,296.79 | 21,397.70 | 46,488.42 | 1,505,000.00 | 6,000.00 | 7,550,938.68 | 528,575.28 | 300,169,138.02 | 1,584,435.21 | 302,282,148.52 | 332,132,625.54 | 332,132,625.54 | 332,132,625.54 | 332,132,625.54 | (13.41) | 332,132,625.54 | 332,132,625.54 | 332,132,625.54 | 332,132,625.54 | (13.41) | 332,132,612.13 | | | | |
| 09 | 2,013,518.56 | 41,898,736.02 | 1,365,089.21 | 145,084.66 | 6,108,232.58 | 22,604,013.15 | 1,590,608.29 | 9,908,047.97 | 14,546,779.56 | 11,857,239.15 | 239,516,412.77 | 242,746,475.05 | 9,149,804.55 | 728,188,397.33 | 39,034,427.84 | 776,372,629.72 | 1,019,119,104.77 | 1,019,119,104.77 | 1,019,119,104.77 | (282,536.66) | 1,019,119,104.77 | 1,019,119,104.77 | 1,019,119,104.77 | 1,019,119,104.77 | (282,536.66) | 1,018,836,568.11 | | | | |
| 10 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| 11 | 14,870,294.95 | 212,568,511.27 | 3,486,500.00 | 72,522,735.46 | 6,873,909.01 | 18,252,893.53 | 31,105,288.31 | 824,292.88 | 197,297,576.27 | 256,285,005.36 | 1,019,119,104.77 | 14,708,935,932.90 | 56,987,122.71 | 3,152,953,477.61 | 4,597,488,049.91 | 7,807,428,650.23 | 22,514,812,303.09 | 22,514,812,303.09 | 22,514,812,303.09 | (1,552,280.04) | 22,514,812,303.09 | 22,514,812,303.09 | 22,514,812,303.09 | 22,514,812,303.09 | (1,552,280.04) | 22,513,260,023.05 | | | | |
| TIO | 190,434,799.99 | 2,340,864,049.31 | 212,680,208.06 | 91,894,910.41 | 91,093,888.65 | 1,724,078,909.85 | 77,833,189.31 | 330,120,279.33 | 742,737,457.59 | 285,882,643.13 | 814,087,007.04 | 6,901,507,282.67 | 56,987,122.71 | 3,152,953,477.61 | 4,597,488,049.91 | 7,807,428,650.23 | 14,708,935,932.90 | 14,708,935,932.90 | 14,708,935,932.90 | (1,552,280.04) | 14,708,935,932.90 | 14,708,935,932.90 | 14,708,935,932.90 | 14,708,935,932.90 | (1,552,280.04) | 14,707,383,652.86 | | | | |
| CE | 14,870,294.95 | 212,568,511.27 | 3,486,500.00 | 72,522,735.46 | 6,873,909.01 | 18,252,893.53 | 31,105,288.31 | 824,292.88 | 197,297,576.27 | 256,285,005.36 | 1,019,119,104.77 | 14,708,935,932.90 | 56,987,122.71 | 3,152,953,477.61 | 4,597,488,049.91 | 7,807,428,650.23 | 22,514,812,303.09 | 22,514,812,303.09 | 22,514,812,303.09 | (1,552,280.04) | 22,514,812,303.09 | 22,514,812,303.09 | 22,514,812,303.09 | 22,514,812,303.09 | (1,552,280.04) | 22,513,260,023.05 | | | | |
| NLL | 7,184,722.55 | 82,076,120.56 | 1,412,100.00 | 16,680,576.15 | 1,091,000.00 | 3,714,353.60 | 8,250,609.42 | 190,000.00 | 102,425,420.77 | - | 223,024,903.05 | 2,570,465,689.37 | 21,369,698.13 | 223,024,903.05 | 2,570,465,689.37 | 21,369,698.13 | 2,570,465,689.37 | 2,570,465,689.37 | 2,570,465,689.37 | (4,164.49) | 2,570,465,689.37 | 2,570,465,689.37 | 2,570,465,689.37 | 2,570,465,689.37 | (4,164.49) | 2,566,305,524.88 | | | | |
| CP | 107,482,503.02 | 790,293,788.46 | 5,890,883.37 | 862,965,477.46 | 4,750,779.32 | 54,562,025.60 | 569,896,454.46 | 600,980.21 | 132,046,461.67 | 41,976,335.80 | 3,016,361.54 | 21,369,698.13 | 21,369,698.13 | 21,369,698.13 | 21,369,698.13 | 21,369,698.13 | 21,369,698.13 | 21,369,698.13 | 21,369,698.13 | (597.75) | 21,369,698.13 | 21,369,698.13 | 21,369,698.13 | 21,369,698.13 | (597.75) | 21,369,096.38 | | | | |
| BT | 547,812.91 | 3,829,515.01 | 147,786.63 | 263,755.10 | 10,453,853.51 | 2,185,082.86 | 925,530.57 | 295,835.42 | 38,893,403.20 | 146,312,039.57 | 4,992,568,359.68 | 814,087,007.04 | 814,087,007.04 | 814,087,007.04 | 814,087,007.04 | 814,087,007.04 | 814,087,007.04 | 814,087,007.04 | 814,087,007.04 | (814,087,007.04) | 814,087,007.04 | 814,087,007.04 | 814,087,007.04 | 814,087,007.04 | (814,087,007.04) | 814,087,007.04 | | | | |
| M | 217,002,882.70 | 1,849,121,443.79 | 1,868,030.00 | 2,500,675,874.38 | 54,941,080.89 | 182,514,042.20 | 943,727.54 | 295,835.42 | 38,893,403.20 | 146,312,039.57 | 4,992,568,359.68 | 814,087,007.04 | 814,087,007.04 | 814,087,007.04 | 814,087,007.04 | 814,087,007.04 | 814,087,007.04 | 814,087,007.04 | 814,087,007.04 | (814,087,007.04) | 814,087,007.04 | 814,087,007.04 | 814,087,007.04 | 814,087,007.04 | (814,087,007.04) | 814,087,007.04 | | | | |
| TFP | 332,217,921.18 | 2,725,320,867.81 | 9,316,800.00 | 3,380,321,927.99 | 61,046,615.31 | 251,244,274.91 | 581,275,874.28 | 2,012,346.21 | 276,381,647.18 | 188,288,375.37 | 1,019,119,104.77 | 14,708,935,932.90 | 56,987,122.71 | 3,152,953,477.61 | 4,597,488,049.91 | 7,807,428,650.23 | 22,514,812,303.09 | 22,514,812,303.09 | 22,514,812,303.09 | (1,552,280.04) | 22,514,812,303.09 | 22,514,812,303.09 | 22,514,812,303.09 | 22,514,812,303.09 | (1,552,280.04) | 22,513,260,023.05 | | | | |
| TI | 522,652,661.17 | 5,066,184,917.12 | 221,999,008.66 | 3,472,216,838.40 | 152,140,503.96 | 1,975,323,184.76 | 658,909,063.58 | 332,132,625.54 | 1,019,119,104.77 | 474,171,018.50 | 813,258,083.77 | 14,707,383,652.86 | 56,987,122.71 | 3,152,953,477.61 | 4,597,488,049.91 | 7,807,428,650.23 | 22,514,812,303.09 | 22,514,812,303.09 | 22,514,812,303.09 | (1,552,280.04) | 22,514,812,303.09 | 22,514,812,303.09 | 22,514,812,303.09 | 22,514,812,303.09 | (1,552,280.04) | 22,513,260,023.05 | | | | |
| NR Depn | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| EWDS(Air) | (10,959) | (3,411,022.49) | (26,454.35) | (722.89) | (35,209.74) | (12,256.40) | (479.43) | (232,997.44) | (1,146,544) | (4,876,645.20) | (9,961,811.96) | (13,286,177.11) | (13,286,177.11) | (13,286,177.11) | (13,286,177.11) | (13,286,177.11) | (13,286,177.11) | (13,286,177.11) | (13,286,177.11) | (13,286,177.11) | (13,286,177.11) | (13,286,177.11) | (13,286,177.11) | (13,286,177.11) | (13,286,177.11) | (13,286,177.11) | (13,286,177.11) | (13,286,177.11) | | |
| EWDS(Water) | (1,300,609.18) | (459,127) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| NEB | 1,224,898 | 3,529,218.87 | 19,029 | 705 | 31,045 | 11,658.64 | 486.02 | 3,319,542.32 | 5,150,614.46 | 13,286,177.11 | 13,286,177.11 | 13,286,177.11 | 13,286,177.11 | 13,286,177.11 | 13,286,177.11 | 13,286,177.11 | 13,286,177.11 | 13,286,177.11 | 13,286,177.11 | 13,286,177.11 | 13,286,177.11 | 13,286,177.11 | 13,286,177.11 | 13,286,177.11 | 13,286,177.11 | 13,286,177.11 | 13,286,177.11 | 13,286,177.11 | | |
| TEI | (86,670.24) | (341,930.53) | (7,425.40) | (18.30) | (4,164.49) | (597.75) | - | (13,411) | (252,536.66) | - | (828,923.27) | (1,552,280.04) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Adj TI | 522,565,990.93 | 5,065,842,986.59 | 221,991,582.66 | 3,472,216,820.10 | 152,136,339.47 | 1,975,322,587.01 | 658,909,063.58 | 332,132,612.13 | 1,018,836,568.11 | 474,171,018.50 | 813,258,083.77 | 14,707,383,652.86 | 56,987,122.71 | 3,152,953,477.61 | 4,597,488,049.91 | 7,807,428,650.23 | 22,514,812,303.09 | 22,514,812,303.09 | 22,514,812,303.09 | (1,552,280.04) | 22,514,812,303.09 | 22,514,812,303.09 | 22,514,812,303.09 | 22,514,812,303.09 | (1,552,280.04) | 22,513,260,023.05 | | | | |

Note: Modified total output is the value of total output adjusted for HH production and environmental damages.

NR = natural resource depreciation

ES = Environmental waste disposal services

ED = environmental damages

NEB = net environmental benefits - ABS(ES) - ABS(ED) + direct nature services

TEI = total environmental inputs

Adj TI = adjusted total inputs = TI + TEI

TABLE 9
ADJUSTMENT FACTORS FOR HOUSEHOLD INCOME

| | Value |
|--|----------------|
| Aggregate Labor Income | 814,087,007.04 |
| Aggregate Personal Consumption Expenditure | 871,074,129.75 |
| Proportionality Constant | 0.934578332 |

Note:

Proportionality Constant = $\text{agg. labor income} / \text{agg. PCE}$

TABLE 10
ENRA MODIFIED DIRECT REQUIREMENT MATRIX

| SECTORS | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|
| | agri | mfg | const | elec | trans | trade | finance | Real | prv svc | LGU | HH (COE) |
| 01 | 0.00395 | 0.00327 | - | - | - | 0.20422 | - | - | 0.00051 | - | 0.00011 |
| 02 | 0.06970 | 0.06477 | 0.00036 | 0.00023 | 0.00374 | 0.19013 | 0.00022 | 0.00158 | 0.06215 | 0.00084 | 0.00590 |
| 03 | 0.00023 | 0.00024 | 0.00691 | 0.00011 | 0.00493 | 0.00122 | 0.00108 | 0.00754 | 0.00092 | 0.00027 | 0.00081 |
| 04 | 0.17198 | 0.32713 | 0.70464 | 0.00229 | 0.04408 | 0.29784 | 0.02486 | 0.76555 | 0.39658 | 0.02808 | 0.31743 |
| 05 | 0.00241 | 0.00230 | 0.00165 | 0.00006 | 0.00265 | 0.00205 | 0.00100 | 0.00071 | 0.00046 | 0.00082 | 0.02166 |
| 06 | 0.01944 | 0.00251 | 0.05509 | 0.00041 | 0.23936 | 0.09896 | 0.00355 | 0.02140 | 0.03076 | 0.00639 | 0.01158 |
| 07 | 0.06438 | 0.01113 | 0.16735 | 0.00245 | 0.20999 | 0.04933 | 0.03746 | 0.16471 | 0.02823 | 0.00100 | 0.17902 |
| 08 | 0.00011 | 0.00054 | 0.00020 | 0.00000 | 0.00873 | 0.00837 | 0.00003 | 0.00014 | 0.00148 | 0.00001 | 0.00928 |
| 09 | 0.00385 | 0.00827 | 0.00615 | 0.00004 | 0.04015 | 0.01144 | 0.00241 | 0.02983 | 0.01428 | 0.02501 | 0.16072 |
| 10 | - | - | - | - | - | - | - | - | - | - | 0.29452 |
| 11 | 0.02846 | 0.04197 | 0.01571 | 0.02089 | 0.04519 | 0.00924 | 0.04721 | 0.00248 | 0.19365 | 0.54049 | - |

TABLE 11
ENRA MODIFIED LEONTIEF INVERSE MATRIX

| | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|
| SECTORS | agri | mfg | const | elec | trans | trade | finance | Real | prv svc | LGU | HH (COE) |
| 01 | 1.00933 | 0.00484 | 0.01347 | 0.00027 | 0.05645 | 0.23034 | 0.00134 | 0.00581 | 0.00972 | 0.00596 | 0.00773 |
| 02 | 0.08163 | 1.07289 | 0.01644 | 0.00101 | 0.06888 | 0.24703 | 0.00300 | 0.01095 | 0.08208 | 0.02148 | 0.03118 |
| 03 | 0.00049 | 0.00046 | 1.00744 | 0.00016 | 0.00591 | 0.00182 | 0.00125 | 0.00802 | 0.00153 | 0.00140 | 0.00197 |
| 04 | 0.23412 | 0.38813 | 0.76952 | 1.01423 | 0.23529 | 0.49523 | 0.05730 | 0.82119 | 0.55857 | 0.34020 | 0.54357 |
| 05 | 0.00393 | 0.00411 | 0.00332 | 0.00066 | 1.00599 | 0.00481 | 0.00250 | 0.00204 | 0.00682 | 0.01644 | 0.02849 |
| 06 | 0.02479 | 0.00631 | 0.06537 | 0.00125 | 0.27400 | 1.11944 | 0.00640 | 0.02805 | 0.04333 | 0.02798 | 0.03600 |
| 07 | 0.08158 | 0.02895 | 0.19325 | 0.00803 | 0.26176 | 0.09124 | 1.05275 | 0.18650 | 0.08900 | 0.14284 | 0.25617 |
| 08 | 0.00091 | 0.00136 | 0.00133 | 0.00027 | 0.01213 | 0.01014 | 0.00073 | 1.00087 | 0.00454 | 0.00708 | 0.01272 |
| 09 | 0.01426 | 0.02136 | 0.01728 | 0.00470 | 0.06264 | 0.02632 | 0.01375 | 0.03887 | 1.06222 | 0.14573 | 0.21976 |
| 10 | 0.01543 | 0.02067 | 0.01618 | 0.00790 | 0.02872 | 0.01656 | 0.01889 | 0.01298 | 0.07917 | 1.20480 | 0.37452 |
| 11 | 0.05241 | 0.07020 | 0.05494 | 0.02684 | 0.09753 | 0.05623 | 0.06412 | 0.04409 | 0.26882 | 0.69536 | 1.27164 |

TABLE 12
ENRAP NATIONAL ESTIMATES

| | EWDS | | Damage | | NEB |
|---|-------------|--------------|-------------|-----------|------------|
| | Air | Water | Air | Water | |
| Agriculture | | | | | |
| Palay and corn production | (776) | (2,899,113) | (35) | (107,433) | 2,792,421 |
| Veg., fruits & nuts (exc. coconut) prod | (7,061) | (56,558) | (194) | (2,096) | 61,330 |
| Coconut | (2,641) | (686,560) | (73) | (25,442) | 663,687 |
| Sugarcane | (8,563) | (58,595) | (236) | (2,171) | 64,751 |
| Other agri. Crops | (4,588) | (51,547) | (126) | (1,910) | 54,099 |
| Livestock, poultry & other animal prod. | (10,894) | (344,812) | (300) | 133,016 | 222,391 |
| Manufacturing | | | | | |
| Food manufacturing | (860,041) | (93,442) | (122,273) | (11,233) | 819,977 |
| Beverage Manufacturing | (94,829) | (66,842) | (3,574) | (10,755) | 147,342 |
| Tobacco Manufacturing | (26,571) | - | (656) | - | 25,915 |
| Textile Manufacturing | (84,250) | (35,106) | (2,769) | (3,826) | 112,761 |
| Wearing Apparel, Leather & leatehr products | 46,108 | (7,577) | (109) | (397) | 52,179 |
| Mfr. of wood & wood products incl. fur & fixtures | (417,872) | (3,134) | (12,084) | (83) | 408,839 |
| Mfr of paper & paper prod | (61,815) | (25,964) | (26,340) | (2,068) | 59,372 |
| Printing, publishing & allied products | (34,789) | - | (830) | - | 33,959 |
| Mfr. of chemicals & plastic products | (140,606) | (17,857) | (16,201) | (947) | 141,314 |
| Mfr of rubber products | (23,571) | - | (734) | - | 22,836 |
| Mfr.of glass products | (26,021) | (4,003) | (1,245) | - | 28,779 |
| Mfr of cement | (49,442) | (8,114) | (5,813) | - | 51,743 |
| Mfr. of other non-metallic minerals products | (70,488) | - | (2,459) | - | 68,029 |
| Basic metal industries | (107,272) | (12,979) | (71,854) | (82) | 48,314 |
| Mfr. of fab. Metal prod., mach. & equip | (83,702) | - | (2,067) | (1,163) | 80,472 |
| Mfr.of electrical machinery etc. | (42,759) | (6,172) | (1,041) | - | 47,890 |
| Other manufacturing industries | (14,130) | (402) | (323) | - | 14,208 |
| Construction | (288,093) | | (80,864) | | 207,229 |
| Electricity & Water | | | | | |
| Waterworks & supply | (79) | | (2) | | 77 |
| Transportation, Communication and Storage | | | | | |
| Transportation & storage services | (588,273) | | | (30,045) | 558,228 |
| Communication | (4,964) | | | (40,120) | (35,157) |
| Trade | | | | | |
| Wholesale & retail trade | (57,924) | | (1,593) | (1,233) | 55,099 |
| Real Estate and Ownership of Dwellings | | | | | |
| Financing, insurance, real estate and bus. Ser | (32,002) | | (895) | | 31,107 |
| Private Services | | | | | |
| Agricultural Services | (3,253) | - | (89) | - | 3,163 |
| Public admin & defense | (162,542) | (2,957,390) | (4,750) | - | 3,115,362 |
| Education Services | (2,814) | - | (77) | - | 2,737 |
| Med. Dental, other health & veterinary services | (4,595) | - | (126) | (1,637) | 2,831 |
| Other community, social & personal services | (31,361) | (566) | (426) | (241,133) | 2,255,996 |
| HH (COE) | (2,627,706) | (11,076,499) | (1,252,783) | 646,986 | 11,804,437 |

TABLE 13
CONVERSION FACTORS PER SECTOR

| Sectors | |
|---|---------|
| Agriculture | 0.00017 |
| Manufacturing | 0.00086 |
| Construction | 0.00005 |
| Electricity & Water | 0.00484 |
| Transportation, Communication and Storage | 0.00003 |
| Trade | 0.00011 |
| Finance | |
| Real Estate and Ownership of Dwellings | 0.00001 |
| Private Services | 0.00060 |
| Local Government Services | |
| HH (COE) | 0.00023 |

$$\text{Adjustment Factor} = G D P_i^L / G D P_i^N$$

Table 14
INFLATION ADJUSTED, SCALED DOWN ENVIRONMENTAL VARIABLE VALUES

| | EWDS | | Damage | | NEB |
|---|-----------------|------------------|-----------------|---------------|----------------|
| | Air | Water | Air | Water | |
| Agriculture | (65,248) | (7,743,679.650) | (1,821.960) | (11,408.040) | 7,292,903.310 |
| Manufacturing | (3,953,974.500) | (532,209) | (511,003.080) | (57,747.060) | 4,089,826 |
| Construction | (544,495.770) | | (152,832.960) | | 391,662.810 |
| Electricity & Water | (149.310) | | (3.780) | | 145.530 |
| Transportation, Communication and Storage | (1,121,217.930) | | (132,611.850) | | 988,604.190 |
| Trade | (109,476.360) | | (3,010.770) | (2,330.370) | 104,137.110 |
| Finance | | | | | |
| Real Estate and Ownership of Dwellings | (60,483.780) | | (0.013) | | 58,792.230 |
| Private Services | (386,627.850) | (5,590,536.840) | (10,334.520) | (458,835.300) | 5508333.18 |
| Local Government Services | | | | | |
| HH (COE) | (4,966,364.340) | (20,934,583.110) | (2,367,759.870) | 1,222,804 | 22,310,385.930 |

TABLE 15
ENVIRONMENTAL IMPACT COEFFICIENTS

| Environmental Variables | DESCRIPTION | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 |
|-------------------------|-------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|---------|-----------|-----------|-----|-----------|
| | | agri | mfg | const | elec | trans | trade | finance | Real | prv svc | LGU | HH (COE) |
| NR Depn | Natural Resource Depreciation | - | - | - | - | - | - | - | - | - | - | - |
| EWDS(Air) | Environmental Waste Disposal(Air) | (0.00002) | (0.00067) | (0.00012) | (0.00000) | (0.00023) | (0.00001) | - | (0.00000) | (0.00023) | - | (0.00141) |
| EWDS(Water) | Environmental Waste Disposal(Water) | (0.00249) | (0.00009) | - | - | - | - | - | - | (0.00331) | - | (0.00594) |
| NEB | Net Environmental Benefits | 0.00234 | 0.00070 | 0.00009 | 0.00000 | 0.00020 | 0.00001 | - | 0.00000 | 0.00326 | - | 0.00633 |
| TEI | Total Environmental Inputs | (0.00017) | (0.00007) | (0.00003) | (0.00000) | (0.00003) | (0.00000) | - | (0.00000) | (0.00028) | - | (0.00102) |

TABLE 16
ENRA OUTPUT MULTIPLIER OF EACH SECTOR

| Sectors | VALUES |
|---|---------|
| Agriculture | 1.51888 |
| Manufacturing | 1.61927 |
| Construction | 2.15854 |
| Electricity & Water | 1.06533 |
| Transportation, Communication and Storage | 2.10930 |
| Trade | 2.29917 |
| Finance | 1.22202 |
| Real Estate and Ownership of Dwellings | 2.15939 |
| Private Services | 2.20582 |
| Local Government Services | 2.60927 |
| Household | 2.78374 |

TABLE 17
MODIFIED INCOME MULTIPLIER

| | agri | mfg | const | elec | trans | trade | finance | Real | prv svc | LGU | HH |
|-----------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Local | 0.05241 | 0.07020 | 0.05494 | 0.02684 | 0.09753 | 0.05623 | 0.06412 | 0.04409 | 0.26882 | 0.69536 | 0.27164 |
| Non Local Labor | 0.01886 | 0.02187 | 0.01486 | 0.00547 | 0.02037 | 0.01549 | 0.01495 | 0.01114 | 0.11219 | 0.01869 | 0.02882 |
| Total | 0.07127 | 0.09207 | 0.06980 | 0.03231 | 0.11790 | 0.07173 | 0.07907 | 0.05522 | 0.38102 | 0.71405 | 0.30045 |

TABLE 18
MODIFIED VALUE ADDED MULTIPLIERS

| LABOR INCOME MULTIPLIERS | agri | mfg | const | elec | trans | trade | finance | Real | prv svc | LGU | HH |
|--------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|
| Local Labor | 0.05242 | 0.07020 | 0.05494 | 0.02684 | 0.09754 | 0.05624 | 0.06412 | 0.04409 | 0.26883 | 0.69536 | 0.271639 |
| Non Local Labor | 0.01886 | 0.02187 | 0.01486 | 0.00547 | 0.02037 | 0.01549 | 0.01495 | 0.01114 | 0.11219 | 0.01869 | 0.028816 |
| Other Payments | 0.35317 | 0.29481 | 0.39605 | 0.26060 | 0.35706 | 0.32394 | 0.92927 | 0.37735 | 0.37675 | 0.33955 | 0.426713 |
| Taxes | 0.00157 | 0.00102 | 0.00174 | 0.00005 | 0.00440 | 0.00677 | 0.00358 | 0.00369 | 0.00377 | 0.00112 | 0.001808 |

TABLE 19
MULTIPLIERS FOR ENVIRONMENTAL SERVICES AND ENVIRONMENTAL DAMAGES

| | | agri | mfg | const | elec | trans | trade | finance | Real | prv svc | LGU | HH (COE) |
|-------------|-------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| | DESCRIPTION | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 |
| EWDS(Air) | Environmental Waste Disposal(Air) | (0.00015) | (0.00083) | (0.00021) | (0.00004) | (0.00043) | (0.00026) | (0.00010) | (0.00008) | (0.00068) | (0.00103) | (0.00187) |
| EWDS(Water) | Environmental Waste Disposal(Water) | (0.00288) | (0.00060) | (0.00042) | (0.00018) | (0.00093) | (0.00102) | (0.00043) | (0.00041) | (0.00514) | (0.00463) | (0.00831) |
| ED (Air) | Environmental Damage (Air) | (0.08066) | (0.10812) | (0.08458) | (0.04130) | (0.15012) | (0.08656) | (0.09868) | (0.06785) | (0.41370) | (1.07008) | (1.95690) |
| ED (Water) | Environmental (Water) | 0.04164 | 0.05577 | 0.04366 | 0.02133 | 0.07749 | 0.04468 | 0.05096 | 0.03503 | 0.21336 | 0.55259 | 1.01056 |
| TEI | Total Environmental Inputs | (0.04205) | (0.05377) | (0.04156) | (0.02019) | (0.07400) | (0.04316) | (0.04825) | (0.03331) | (0.20617) | (0.52316) | (0.95652) |

TABLE 20
 VECTOR OF FINAL DEMAND CHANGES AND RESULTING IMPACT ON SECTORAL OUTPUTS
 (5% Final Demand Increase in Agriculture, 7% in Manufacturing & 15 % in Trade)

| SECTORS | CHANGES IN FINAL DEMAND | IMPACT | |
|---|----------------------------|----------------|----------|
| | | PESOS | PERCENT |
| Agriculture | 5,000,511.18 | 63,626,345.87 | 12.17373 |
| Manufacturing | 297,885,823.31 | 381,284,688.77 | 7.52607 |
| Construction | 0 | 590,680.49 | 0.26607 |
| Electricity & Water | 0 | 239,634,996.74 | 6.90150 |
| Transportation, Communication and Storage | 0 | 2,436,408.16 | 1.60142 |
| Trade | 248,055,715.83 | 279,685,611.10 | 14.15898 |
| Finance | 0 | 31,664,558.66 | 4.80560 |
| Real Estate and Ownership of Dwellings | 0 | 2,923,504.64 | 0.88022 |
| Private Services | 0 | 12,962,938.16 | 1.27197 |
| Local Government Services | 0 | 10,343,967.68 | 2.18148 |
| Household | 0 | 35,121,789.75 | 4.31426 |

TABLE 21
 VECTOR OF FINAL DEMAND CHANGES AND RESULTING IMPACT ON LABOR INCOME, TAX EFFECT AND GVA
 (5% Final Demand Increase in Agriculture, 7% in Manufacturing & 15 % in Trade)

| SECTORS | CHANGES | LABOR INCOME EFFECT | | TAX EFFECT | | GVA EFFECT | |
|---|----------------|---------------------|----------|------------|----------|----------------|-----------|
| | | PESOS | PERCENT | PESOS | PERCENT | PESOS | PERCENT |
| Agriculture | 5,000,511.18 | 356,423.92 | 1.61607 | 7,869.46 | 1.43652 | 2,130,344.60 | 1.63765 |
| Manufacturing | 297,885,823.31 | 21,232,555.79 | 7.20616 | 468,792.13 | 12.24155 | 126,906,916.32 | 11.65601 |
| Construction | 0 | - | | - | | - | |
| Electricity & Water | 0 | - | | - | | - | |
| Transportation, Communication and Storage | 0 | - | | - | | - | |
| Trade | 248,055,715.83 | 17,680,790.47 | 80.48706 | 390,372.95 | 3.73425 | 105,678,026.64 | 121.49256 |
| Finance | 0 | - | | - | | - | |
| Real Estate and Ownership of Dwellings | 0 | - | | - | | - | |
| Private Services | 0 | - | | - | | - | |
| Local Government Services | 0 | - | | - | | - | |
| Household | 0 | - | | - | | - | |

TABLE 22
IMPACT ON ENVIRONMENTAL SERVICES AND DAMAGES

| SECTORS | EFFECTS | |
|----------------|--------------|----------|
| | Pesos | Percent |
| EWDS (Air) | (757,740.64) | 15.53815 |
| EWDS (Water) | (771,322.09) | 7.74279 |
| DAMAGE (Air) | (56,961.04) | 5.66241 |
| DAMAGE (Water) | (19,829.28) | 3.24642 |

TABLE 23
Environmental Impact with Damage Coefficients

| SECTORS | EWDS | | Damage | | NEB |
|---|------------|------------|------------|------------|----------|
| | Air | Water | Air | Water | |
| Agriculture | (0.000021) | (0.002488) | (0.000001) | (0.000004) | 0.002344 |
| Manufacturing | (0.000673) | (0.000091) | (0.000087) | (0.000010) | 0.000696 |
| Construction | (0.000119) | - | (0.000033) | - | 0.000086 |
| Electricity & Water | (0.000000) | - | (0.000000) | - | 0.000000 |
| Transportation, Communication and Storage | (0.000231) | - | (0.000027) | - | 0.000204 |
| Trade | (0.000006) | - | (0.000000) | (0.000000) | 0.000006 |
| Finance | - | - | - | - | - |
| Real Estate and Ownership of Dwellings | (0.000001) | - | (0.000000) | - | 0.000001 |
| Private Services | (0.000229) | (0.003306) | (0.000006) | (0.000271) | 0.003257 |
| Local Government Services | - | - | - | - | - |
| HH (COE) | (0.00141) | (0.00594) | (0.00067) | (0.00035) | 0.00633 |