# LINKAGES BETWEEN THE ECONOMY AND THE ENVIRONMENT OF THE COASTAL ZONE OF MISSISSIPPI



## PART III

## SEMI-TECHNICAL SUMMARY

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# LINKAGES BETWEEN THE ECONOMY AND THE ENVIRONMENT OF THE COASTAL ZONE OF MISSISSIPPI

Part III

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# INTRODUCTION

America has achieved one of the highest standards of living known. Now, some ecologists contend that economic activities are causing irreparable damages to the environment. On the other hand, some people perceive growth as an essential requirement of our social welfare and it has long been government policy to promote economic growth.

There is a need to quantify environmental costs associated with economic activities. Such analysis could identify some projects as not being beneficial on environmental grounds though justifiable on economic grounds. It can also identify projects or programs that induce growth and simultaneously require ecologic trade-off.

A three-year research project was undertaken to quantify the relationship between the economy and the environment of the Coastal Region of Mississippi. The work this year culminated the project. A detailed report has been prepared. Its title is "Linkages Between the Economy and the Environment of the Coastal Zone of Mississippi, Part III." It is dated June, 1980, and carries Mississippi-Alabama Sea Grant Consortium publication number MASGP-79-014. The purpose of this report is to describe briefly selected aspects of the research presented in that report. Anyone interested in the details should refer to that publication. Only a few tables are included herein for illustrative purpose due to the large numbers of pages of detailed data and calculations presented in the detailed report.

## APPROACH

The method used in this research consists of three main phases:

1. Construction of an economic model. The one used is commonly referred to by economists as an input-ouput model. The various types of business firms and economic activities were divided into groups referred to as sectors. Each uses products produced by other sectors, called inputs, to produce its product, called output, which is sold to others. It is a detailed description of the flows of goods and services of the economy of the region, evaluated in dollars. It also provides a systematic way of measuring the total effects on the economy of various actions, such as new government expenditures, changes in exports, expansion in existing industries, or the introduction of new industries and services.

2. Construction of an environmental model. The primary objective of this phase was to allocate physical volumes of pollutants to the proper economic sectors. The analysis focused on three main categories of pollutants, namely: water effluents, air pollution, and solid wastes.

3. Construction of the linkages between the economic and environmental models. At this stage, information obtained in Phase I and Phase II is combined to produce the mutual interdependence of the economic activities and the environment.

The research report provides this link. It emphasizes that changes in the environment will accompany changes in the economy. Estimates in the form of pollution per dollar of output, employment, and income are presented. Environmental-economic multipliers are calculated for each combination of environmental category and economic sector. Some uses of the model are also discussed.

## SELECTED RESULTS

The sectors into which the economic activity of the region is grouped and the groups of pollutants are as follows:

| Economic Sectors | | Pollution Categories |
|---|---|---|
| Number | Sector | Waste Water |
| | | Chlorine |
| 1 | Fisheries | Nitrogen |
| 2 | Forestry | Sulfides |
| 3 | Livestock | Fluoride |
| 4 | Crops | Phosphate |
| 5 | Ag., Forestry & Fish. Services | Heavy Metals |
| 6 | Mining | Zinc |
| 7 | Construction | Cadmium |
| 8 | Food Processing | Iron |
| 9 | Apparel & Other Finished Products | Chromium |
| 10 | Lumber & Wood | Aluminum |
| 11 | Paper & Allied | Copper |
| 12 | Printing & Publishing | Nickel |
| 13 | Chemicals & Petroleum | Lead |
| 14 | Stone, Clay, & Glass | Fecal Coliform |
| 15 | Primary & Fabricated Metals | BOD |
| 16 | Transportation Equipment | COD |
| 17 | Miscellaneous Mfg. | Suspended Solids |
| 18 | Water Transportation | Settleable Solids |
| 19 | Other Transportation & Warehousing | Oil & Grease |
| 20 | Communications & Public Utilities | Phenols |
| 21 | Eating & Drinking Places | Organic Carbons |
| 22 | Service Stations | Nitrogen Oxide |
| 23 | Wholesale & Retail Trade | Sulfur Oxide |
| 24 | Finance, Insurance, & Real Estate | Carbon Monoxide |
| 25 | Hotels, Motels & Lodging | Particulates |
| 26 | Medical Services | Aldehydes |
| 27 | Educational Services | Hydrocarbons |
| 28 | Other Services | Solid Waste |
| 29 | State & Local Government | |
| 30 | Households | |

The volume of pollution is measured in tons except for Waste Water which is measured in million gallons per year (MGY).

The technical relationships between the economic sectors and pollutants are presented. They are the units of pollutants in tons produced by these sectors as a result of their activities for each $1,000 of output. For instance, Sector 8, Food Processing, contributes .075 (MGY) of waste water, .002 tons of nitrogen, .005 tons of BOD, .008 tons of suspended solids, .004 tons of settleable solids, .002 tons of oil and grease, .002 tons of nitrogen oxide, .008 tons of sulfur oxides, .001 tons of particulates, and .426 tons of solid waste for each $1,000 of output. These values are the direct requirements resulting from the sales from the Food Processing sector.

The secondary environmental effects resulting from the interindustry sales and purchases are called the indirect effects. Together the direct and the indirect effects of $1,000 of each sector's output are given. This represents the total exports of pollution to the environment. That is, a $1,000 increase in economic activity of a certain sector will cause increases in production in all other sectors due to the multiplier effect. Through their economic activities to meet the demands of that sector, they in turn will contribute to the pollution. For example, Sector 8, the Food Processing, when increasing its output by $1,000 will cause a total discharge to the environment of .1 (MGY) of waste water, .003 tons of nitrogen, .005 tons of BOD, .009 tons of suspended solids, .005 tons of settleable solids, .002 tons of oil and grease, .002 tons of nitrogen oxides, .016 tons of sulfur oxides, .002 tons of carbon monoxide, .004 tons of particulates, and .644 tons of solid wastes.

Some of the sectors were not contributing to pollution directly through their production process, nevertheless, indirectly they caused other sectors to do so through their supporting activities. The construction industry, Sector 7, does not produce BOD directly, yet through the round of economic activities by the supporting industries, .001 tons of BOD is produced for each $1,000 increase in construction.

The trade-off between income and the environment is given in a matrix. The entries represent the physical quantities of pollutants generated through each $1,000 increase in income of the various sectors. Again, using Sector 8 as an example, a $1,000 increase in income in the Food Processing industry will cause a contribution of .257 (MGY) of waste water, .007 tons of nitrogen, .014 tons of BOD, .024 tons of suspended solids, .012 tons of settleable solids, .006 tons of oil and grease, .005 tons of nitrogen oxide, .040 tons of sulfur oxide, .004 tons of carbon monoxide, .011 tons of particulates, .001 tons of hydrocarbons, and 1.653 tons of solid waste.

Looking at this from another point, the limitation in environmental pollution by the quantities listed will necessarily cause a $1,000 decrease in income. This fact in a sense is a prime example of what is meant by the term "trade off" between the economy and the environment.

Environmental multipliers were calculated. They show the impacts of economic activity on the environment. For example, the resource-output multipliers show the magnitude of the changes of environmental resources (water effluents, air pollution, solid wastes) resulting from an increase of one unit of sales for each of the processing sectors. The environmental-income multipliers measure the impact on the environment due to one unit change in money income resulting from each producing sector. They are useful to show the volume of pollution emissions as the result of income to employees. The multipliers are calculated such that the direct and indirect effects may be determined.

The different types of industries can be compared in terms of the amount of pollution emission per unit of income and per unit of output. This is illustrated in Tables 1 and 2. The sectors are ranked in terms of the environmental factors for each $1,000 of sales in the case of Table 1 and for each $1,000 of income in the case of Table 2. In both situations, the ranking is for Type II multipliers which show both the direct and

TABLE 8

RANKING OF POLLUTANT QUANTITIES PER $1,000 OUTPUT CATEGORY BY SECTOR
TYPE II ENVIRONMENTAL - OUTPUT
MISSISSIPPI COASTAL REGION, 1977

| Rank | Waste Water (MGY) | Chlorine (Tons) | Nitrogen (Tons) | Sulfides (Tons) | Flouride (Tons) | Phosphate (Tons) | Heavy Metals (Tons) | Zinc (Tons) | Cadmium (Tons) | Iron (Tons) | Chromium (Tons) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 16 | 28 | 8 | | | | 13 | 9 | 15 | 13 | 9 |
| 2 | 14 | 8 | 28 | | | | | 15 | 13 | 15 | 15 |
| 3 | 1 | 22 | 10 | | | | | 16 | 7 | 4 | 13 |
| 4 | 4 | 21 | 13 | | | | | 1 | 17 | 7 | 17 |
| 5 | 8 | 15 | 3 | | | | | 7 | | 17 | |
| 6 | 11 | 9 | 27 | | | | | 17 | | 1 | |
| 7 | 6 | 27 | 21 | | | | | 23 | | 3 | |
| 8 | 13 | 30 | 15 | | | | | | | 6 | |
| 9 | 28 | 26 | 9 | | | | | | | 8 | |
| 10 | 9 | 3 | 30 | | | | | | | 9 | |
| 11 | 15 | 25 | 27 | | | | | | | 11 | |
| 12 | 3 | 29 | 26 | | | | | | | 12 | |
| 13 | 10 | 18 | 7 | | | | | | | 14 | |
| 14 | 21 | 7 | 18 | | | | | | | 16 | |
| 15 | 7 | 19 | 25 | | | | | | | 18 | |
| 16 | 22 | 23 | 29 | | | | | | | 19 | |
| 17 | 18 | 4 | 19 | | | | | | | 25 | |
| 18 | 30 | 2 | 23 | | | | | | | 26 | |
| 19 | 17 | 14 | 17 | | | | | | | 27 | |
| 20 | 19 | 17 | 4 | | | | | | | 29 | |
| 21 | 27 | 10 | 11 | | | | | | | | |
| 22 | 29 | 11 | 14 | | | | | | | | |
| 23 | 26 | 13 | 12 | | | | | | | | |
| 24 | 25 | 16 | 5 | | | | | | | | |
| 25 | 12 | 1 | 1 | | | | | | | | |
| 26 | 23 | 24 | 24 | | | | | | | | |
| 27 | 24 | 2 | 16 | | | | | | | | |
| 28 | 5 | 5 | 6 | | | | | | | | |
| 29 | 2 | 6 | 2 | | | | | | | | |
| 30 | 20 | 20 | 20 | | | | | | | | |

TABLE 8 (Cont)

| Rank | Aluminum (Tons) | Copper (Tons) | Nickel (Tons) | Lead (Tons) | BOD (Tons) | COD (Tons) | Suspended Solids (Tons) | Settleable Solids (Tons) | Oil & Grease (Tons) | Phenols (Tons) | Organic Carbon (Tons) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15 | 15 | 15 | 17 | 11 | 13 | 14 | 8 | 28 | 10 | 13 |
| 2 | 7 | 7 | 7 | | 8 | 4 | 11 | 3 | 8 | 13 | 4 |
| 3 | 17 | | 17 | | 28 | 17 | 6 | 30 | 22 | 7 | 3 |
| 4 | 16 | | | | 10 | 11 | 8 | 26 | 21 | | 9 |
| 5 | 1 | | | | 14 | 18 | 28 | 27 | 14 | | 11 |
| 6 | 3 | | | | 22 | 19 | 30 | 5 | 13 | | 14 |
| 7 | 6 | | | | 21 | 14 | 10 | 19 | 10 | | 17 |
| 8 | 8 | | | | 3 | 25 | 7 | 29 | 3 | | 18 |
| 9 | 11 | | | | 13 | 3 | 29 | 18 | 27 | | 19 |
| 10 | 12 | | | | 30 | 26 | 18 | 21 | 30 | | 25 |
| 11 | 14 | | | | 27 | 27 | 21 | 22 | 26 | | 26 |
| 12 | 18 | | | | 26 | 9 | 22 | 23 | 15 | | 27 |
| 13 | 19 | | | | 9 | 12 | 13 | 7 | 25 | | 29 |
| 14 | 24 | | | | 7 | 15 | 3 | 4 | 18 | | |
| 15 | 25 | | | | 25 | 29 | 19 | 25 | 7 | | |
| 16 | 29 | | | | 18 | 6 | 27 | 28 | 29 | | |
| 17 | 30 | | | | 29 | 7 | 9 | 17 | 19 | | |
| 18 | | | | | 19 | 8 | 25 | 10 | 23 | | |
| 19 | | | | | 12 | 1 | 26 | 14 | 4 | | |
| 20 | | | | | 23 | 2 | 15 | 15 | 17 | | |
| 21 | | | | | 4 | 10 | 12 | 13 | 12 | | |
| 22 | | | | | 17 | 21 | 23 | 12 | 11 | | |
| 23 | | | | | 15 | 22 | 17 | 11 | 9 | | |
| 24 | | | | | 1 | 5 | 4 | 1 | 24 | | |
| 25 | | | | | 24 | 23 | 1 | 9 | 1 | | |
| 26 | | | | | 16 | 28 | 24 | 24 | 16 | | |
| 27 | | | | | 5 | 16 | 16 | 2 | 5 | | |
| 28 | | | | | 6 | 24 | 2 | 16 | 6 | | |
| 29 | | | | | 2 | 30 | 5 | 6 | 2 | | |
| 30 | | | | | 20 | 20 | 20 | 20 | 20 | | |

TABLE 8 (Cont)

| Rank | Nitrogen Oxide (Tons) | Sulfur Oxide (Tons) | Carbon Monoxide (Tons) | Particulates (Tons) | Aldehydes (Tons) | Hydro-Carbons (Tons) | Solid Waste (Tons) |
|---|---|---|---|---|---|---|---|
| 1 | 22 | 20 | 22 | 4 | 6 | 22 | 3 |
| 2 | 9 | 22 | 30 | 22 | 18 | 12 | 21 |
| 3 | 13 | 14 | 18 | 14 | 28 | 18 | 15 |
| 4 | 14 | 29 | 7 | 10 | 20 | 29 | 8 |
| 5 | 17 | 30 | 19 | 3 | 14 | 30 | 27 |
| 6 | 18 | 27 | 21 | 20 | 9 | 7 | 10 |
| 7 | 19 | 26 | 23 | 11 | 15 | 13 | 30 |
| 8 | 7 | 6 | 29 | 18 | 28 | 21 | 29 |
| 9 | 30 | 9 | 25 | 19 | 8 | 29 | 26 |
| 10 | 16 | 28 | 28 | 15 | 13 | 28 | 7 |
| 11 | 21 | 18 | 4 | 7 | 29 | 23 | 14 |
| 12 | 15 | 25 | 27 | 8 | 3 | 25 | 4 |
| 13 | 23 | 13 | 26 | 2 | 17 | 27 | 18 |
| 14 | 29 | 19 | 15 | 29 | 10 | 4 | 25 |
| 15 | 25 | 21 | 14 | 17 | 7 | 26 | 19 |
| 16 | 4 | 8 | 17 | 30 | 30 | 6 | 13 |
| 17 | 28 | 11 | 11 | 6 | 4 | 15 | 22 |
| 18 | 11 | 23 | 3 | 9 | 26 | 14 | 28 |
| 19 | 8 | 15 | 10 | 27 | 27 | 17 | 17 |
| 20 | 27 | 7 | 12 | 26 | 28 | 11 | 23 |
| 21 | 26 | 17 | 13 | 28 | 25 | 3 | 9 |
| 22 | 1 | 3 | 1 | 25 | 12 | 10 | 11 |
| 23 | 10 | 12 | 8 | 21 | 21 | 20 | 12 |
| 24 | 3 | 10 | 9 | 13 | 22 | 1 | 16 |
| 25 | 12 | 4 | 24 | 23 | 1 | 8 | 1 |
| 26 | 24 | 24 | 2 | 12 | 23 | 9 | 24 |
| 27 | 2 | 1 | 6 | 24 | 2 | 24 | 5 |
| 28 | 6 | 16 | 16 | 1 | 24 | 2 | 2 |
| 29 | 5 | 2 | 5 | 16 | 5 | 16 | 6 |
| 30 | 20 | 5 | 20 | 5 | 16 | 5 | 20 |

TABLE 9

RANKING OF POLLUTANT QUANTITIES PER $1,000 INCOME CATEGORY BY SECTOR
TYPE II ENVIRONMENTAL - INCOME
MISSISSIPPI COASTAL REGION, 1977

| Rank | Waste Water (MGY) | Chlorine (Tons) | Nitrogen (Tons) | Sulfides (Tons) | Flouride (Tons) | Phosphate (Tons) | Heavy Metals (Tons) | Zinc (Tons) | Cadmium (Tons) | Iron (Tons) | Chromium (Tons) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 16 | 8 | 8 | | | | 13 | 9 | 15 | 13 | 9 |
| 2 | 14 | 28 | 10 | | | | 4 | 15 | 13 | 15 | 15 |
| 3 | 1 | 22 | 13 | | | | 17 | 16 | 1 | 17 | 13 |
| 4 | 6 | 21 | 28 | | | | | 1 | 6 | 4 | 17 |
| 5 | 4 | 9 | 3 | | | | | 17 | 7 | 7 | 1 |
| 6 | 8 | 15 | 15 | | | | | 6 | 16 | 1 | 7 |
| 7 | 11 | 3 | 22 | | | | | 7 | 17 | 6 | 16 |
| 8 | 13 | 27 | 9 | | | | | 23 | | 11 | 23 |
| 9 | 9 | 26 | 21 | | | | | 25 | | 14 | 25 |
| 10 | 28 | 25 | 27 | | | | | | | 16 | |
| 11 | 15 | 4 | 26 | | | | | | | 2 | |
| 12 | 3 | 16 | 17 | | | | | | | 3 | |
| 13 | 10 | 6 | 4 | | | | | | | 5 | |
| 14 | 21 | 17 | 7 | | | | | | | 8 | |
| 15 | 7 | 12 | 25 | | | | | | | 9 | |
| 16 | 22 | 7 | 5 | | | | | | | 10 | |
| 17 | 17 | 14 | 6 | | | | | | | 12 | |
| 18 | 12 | 23 | 11 | | | | | | | 18 | |
| 19 | 27 | 18 | 23 | | | | | | | | |
| 20 | 26 | 29 | 2 | | | | | | | | |
| 21 | 20 | 19 | 20 | | | | | | | | |
| 22 | 19 | 20 | 29 | | | | | | | | |
| 23 | 18 | 24 | 14 | | | | | | | | |
| 24 | 25 | 11 | 18 | | | | | | | | |
| 25 | 29 | 13 | 19 | | | | | | | | |
| 26 | 24 | 1 | 24 | | | | | | | | |
| 27 | 23 | 5 | 16 | | | | | | | | |
| 28 | 5 | 10 | 1 | | | | | | | | |
| 29 | 2 | 2 | 2 | | | | | | | | |
| 30 | 30 | 30 | 30 | | | | | | | | |

TABLE 9 (Cont)

| Rank | Aluminum (Tons) | Copper (Tons) | Nickel (Tons) | Lead (Tons) | BOD (Tons) | COD (Tons) | Suspended Solids (Tons) | Settleable Solids (Tons) | Oil & Grease (Tons) | Phenols (Tons) | Organic Carbons (Tons) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15 | 15 | 15 | 17 | 11 | 13 | 14 | 8 | 8 | 10 | 13 |
| 2 | 7 | 7 | 7 | | 8 | 4 | 6 | 3 | 28 | 13 | 4 |
| 3 | 17 | 17 | 1 | | 28 | 17 | 11 | 5 | 14 | 7 | 6 |
| 4 | 16 | | 6 | | 10 | 11 | 8 | 26 | 22 | 11 | 11 |
| 5 | 1 | | 16 | | 14 | 6 | 10 | 27 | 21 | 20 | 17 |
| 6 | 6 | | 17 | | 22 | 14 | 28 | 4 | 13 | | 1 |
| 7 | 14 | | | | 21 | 9 | 13 | 23 | 10 | | 2 |
| 8 | 2 | | | | 13 | 18 | 9 | 22 | 3 | | 3 |
| 9 | 3 | | | | 3 | 19 | 7 | 21 | 15 | | 5 |
| 10 | 4 | | | | 9 | 25 | 3 | 17 | 27 | | 7 |
| 11 | 5 | | | | 27 | 3 | 22 | 19 | 26 | | 8 |
| 12 | 8 | | | | 12 | 12 | 21 | 29 | 25 | | 9 |
| 13 | 9 | | | | 26 | 2 | 12 | 13 | 4 | | 10 |
| 14 | 10 | | | | 25 | 15 | 15 | 18 | 17 | | 12 |
| 15 | 11 | | | | 4 | 26 | 17 | 2 | 6 | | 14 |
| 16 | 12 | | | | 7 | 27 | 20 | 1 | 7 | | 15 |
| 17 | 13 | | | | 17 | 1 | 27 | 6 | 12 | | 18 |
| 18 | 18 | | | | 6 | 8 | 26 | 9 | 23 | | 19 |
| 19 | 19 | | | | 23 | 5 | 4 | 14 | 29 | | 25 |
| 20 | 20 | | | | 20 | 10 | 29 | 15 | 20 | | 26 |
| 21 | 21 | | | | 29 | 29 | 25 | 24 | 18 | | 27 |
| 22 | 22 | | | | 15 | 7 | 24 | 7 | 11 | | 29 |
| 23 | 23 | | | | 18 | 21 | 23 | 11 | 9 | | |
| 24 | 24 | | | | 24 | 22 | 18 | 12 | 24 | | |
| 25 | 25 | | | | 19 | 20 | 19 | 20 | 19 | | |
| 26 | 26 | | | | 5 | 23 | 5 | 10 | 5 | | |
| 27 | 27 | | | | 16 | 24 | 16 | 25 | 16 | | |
| 28 | 28 | | | | 1 | 28 | 30 | 28 | 21 | | |
| 29 | 29 | | | | 2 | 16 | 1 | 16 | 2 | | |
| 30 | | | | | 30 | 30 | 2 | 30 | 30 | | |

TABLE 9 (Cont)

| Rank | Nitrogen Oxide (Tons) | Sulfer Oxide (Tons) | Carbon Monoxide (Tons) | Particulates (Tons) | Aldehydes (Tons) | Hydro-Carbons (Tons) | Solid Waste (Tons) |
|---|---|---|---|---|---|---|---|
| 1 | 22 | 20 | 22 | 4 | 6 | 22 | 3 |
| 2 | 9 | 6 | 4 | 22 | 20 | 12 | 21 |
| 3 | 13 | 22 | 7 | 20 | 19 | 20 | 15 |
| 4 | 17 | 14 | 23 | 14 | 18 | 6 | 8 |
| 5 | 14 | 9 | 21 | 10 | 14 | 13 | 27 |
| 6 | 16 | 13 | 6 | 3 | 9 | 4 | 10 |
| 7 | 19 | 11 | 19 | 11 | 11 | 19 | 4 |
| 8 | 18 | 8 | 17 | 15 | 15 | 18 | 14 |
| 9 | 15 | 17 | 18 | 7 | 13 | 21 | 13 |
| 10 | 4 | 26 | 15 | 6 | 8 | 23 | 16 |
| 11 | 11 | 27 | 14 | 2 | 17 | 7 | 17 |
| 12 | 7 | 15 | 11 | 19 | 3 | 17 | 26 |
| 13 | 23 | 29 | 13 | 18 | 10 | 15 | 9 |
| 14 | 8 | 28 | 12 | 8 | 4 | 14 | 29 |
| 15 | 1 | 23 | 28 | 17 | 12 | 28 | 11 |
| 16 | 21 | 21 | 24 | 9 | 2 | 11 | 12 |
| 17 | 6 | 12 | 2 | 13 | 29 | 24 | 7 |
| 18 | 10 | 25 | 25 | 29 | 1 | 27 | 25 |
| 19 | 12 | 24 | 1 | 12 | 7 | 25 | 1 |
| 20 | 2 | 4 | 10 | 23 | 28 | 2 | 23 |
| 21 | 25 | 3 | 29 | 24 | 26 | 10 | 22 |
| 22 | 28 | 10 | 27 | 28 | 27 | 1 | 20 |
| 23 | 24 | 19 | 26 | 27 | 21 | 29 | 6 |
| 24 | 3 | 18 | 16 | 26 | 22 | 26 | 5 |
| 25 | 20 | 7 | 20 | 21 | 25 | 9 | 28 |
| 26 | 29 | 16 | 3 | 25 | 23 | 8 | 24 |
| 27 | 27 | 5 | 9 | 16 | 24 | 3 | 18 |
| 28 | 26 | 1 | 8 | 1 | 5 | 16 | 19 |
| 29 | 5 | 2 | 5 | 5 | 16 | 5 | 2 |
| 30 | 30 | 3 | 30 | 30 | 30 | 30 | 30 |

indirect effects.

For instance, in Table 1 with .000077 tons of chlorine per $1,000 of induced sales, Sector 28, the Other Services sector, ranks the highest followed by a contribution of .000059 tons by Sector 8, the Food Processing sector, for every $1,000 of its induced sales. On the other hand, Table 2 presents corresponding type of information when accounting for $1,000 of induced income. Taking chlorine as an example with a production of .000114 tons per $1,000 in induced income, Sectors 8 and 28 rank the highest followed by Sector 22 with .000058 tons for each $1,000 of induced income.

## SOME USES OF THE MODEL

The model may be used in a variety of ways depending on the nature of information desired regarding the interplay between the economy and the environment in the Coastal Region of Mississippi. Three topics are discussed in the detailed report. They are:

1. Environmental requirements to sustain self-sufficiency in related industries.

2. Environmental requirements due to expansion of exports in selected industries.

3. Environmental requirements due to attracting new industries.

Consider the case when expansion of exports is contemplated by an existing industry, for example. Assume that a 10 percent increase in exports is expected for the Food Processing sector. The environmental emissions can be calculated and are presented in Table 3 for only the induced environmental impacts.

## CONCLUDING COMMENTS

Evidence indicates that intense economic activities emit significant waste to air, water, and land. The extensive outflow of such residuals

TABLE 3

INDUCED (TYPE II) ENVIRONMENTAL IMPACT IN A
10% EXPORT EXPANSION (THOUSANDS OF 1972 DOLLARS)
THE FOOD PROCESSING SECTOR
MISSISSIPPI COASTAL ZONE

| Environmental Factors | (Tons) |
|---|---|
| Waste Water (MGY) | 796558.39 |
| Chlorine | 435.30 |
| Nitrogen | 21241.26 |
| Sulfides | |
| Flouride | |
| Phosphate | |
| Heavy Metals | |
| Zinc | |
| Cadmium | |
| Iron | 7.38 |
| Chromium | 516.46 |
| Aluminum | |
| Copper | |
| Nickel | |
| Lead | |
| Fecal Coliform | |
| BOD | 11244.07 |
| COD | 44.27 |
| Suspended Solids | 43611.36 |
| Settleable Solids | 309.88 |
| Oil & Grease | 2825.77 |
| Phenols | |
| Organic Carbons | 7.38 |
| Nitrogen Oxide | 171280.27 |
| Sulfur Oxide | 268994.50 |
| Carbon Monoxide | 106073.50 |
| Particulates | 28471.70 |
| Aldehydes | 1387.06 |
| Hydrocarbons | 15353.62 |
| Solid Waste | 1376970.80 |

creates concern among the public as well as the government.

The establishment of many governmental agencies involved with the environment encouraged legislators to enact controls that would ensure the reduction of waste or at least the transforming of waste to lesser harmful substances. In order to aid the legislative and regulative agencies in forming regulations, an understanding of the interactions between the economy and the environment is prerequisite.

This study, which is the result of three years' effort, is primarily concerned with how the economic activity of the Coastal Region of Mississippi generates waste loadings. This is done through quantification of the discharges to show how the economic interactions cause their generation. The study, therefore, does not attempt to determine the significance of harm to the environment in any manner other than the economic basis.

The model follows accepted procedures that have been in development and use for many years. The abundance of publications in the type of approach attests to its popularity and acceptability by economists concerned in regional inquiries. The theoretical basis is sound, and the information it yields could be valuable to those who seek to make decisions on rational foundations.

The report presents a systematic approach for the economic-ecologic interactions in the Coastal Region of Mississippi. A great deal of time and effort was spent in collecting and assimilating data from primary and secondary sources. In some instances, lack of data in usable form made it imperative to use value judgements.

The researchers do not wish to comment on the magnitude of the pollution problem in the Coastal Region in the sense as to whether or not it is acute enough to discourage further industrial or population expansion. The reason for this is the unavailability of the proper ecologic data in terms of the upper limits of pollutants which the environment of the region can handle naturally with present technology. However, the information provided by this research project would be of great help to those who are in a position to make decisions relative to the expansion of economic activity in the region. As environmental data become more available in the future, an updating of the model might be desired.