ECONOMIC-ECOLOGIC MODEL FOR MISSISSIPPI-ALABAMA COASTAL COUNTIES

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PREFACE

The work upon which this report was based was financed in part by funds provided by Mississippi-Alabama Sea Grant.

The theoretical and computational developments were undertaken jointly by researchers at the Bureau of Business Research at the University of Southern Mississippi and the Department of Agricultural Economics and Rural Sociology at Auburn University.

Any errors of fact, logic, or judgment in the report are the responsibility of the authors.

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I. INTRODUCTION

In recent years there has been a growing awareness of the limitations of our natural resources on the part of the public as well as the private sectors. It was made clear by those concerned that economic growth irreparably damages the environment. They call for an end or at least sharp curtailment of such growth. On the other hand, economists, in general, perceive growth as an essential requirement of our social welfare. The restoration and protection of the environment envisioned by ecologists require reduction in living standards which could seriously endanger the political well-being of the American society.

From all indications, the world, especially the western democracies and Japan, is destined and committed to a policy of economic growth. It then becomes necessary for policy makers to devise positions and enforce policies where a trade-off between the benefits of growth and its environmental costs can be calculated in a quantifiable manner.

Such objective 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 minimal ecologic trade-off.

Among the most promising empirical models available at the present to evaluate the economic-ecologic trade-off is the "Materials Balance Approach" for the entire economy. The principle states that resources taken from the environment for use in production and services must be returned to the environment as waste residuals in equal mass. In describing this approach Allen

Kneese [5] says:

> The inputs of the system are fuels, foods, and raw materials which are partly converted into final goods, and partly become residuals. Except for increases in inventory, final goods also ultimately enter the residuals stream. Thus, goods which are "consumed" really only render certain services. Their material substance remains in existance and must be either reused or discharged to the natural environment.

This report is in essence an adaptation of the "Materials Balance Approach" for the Mississippi-Alabama Coastal counties. The modifications incorporated made the model easy to apply in a small region where data problems are usually encountered.

The model utilizes the Input-Output methodology developed by Leontief. It consists of three phases as follows:

(1) Development of an input-output accounting of the region. It is the flow of goods and services in dollars usually, during a year period. The economic activities of the region are depicted in terms of sectors composed of industries. The elements of the transactions among these sectors are displayed in the "Transactions Matrix." These elements are inter-industry flow in the sense that goods are transferred from some sectors as output to be used by others as input. An exogeneous sector defined as Final Demand which includes households, government, and exports absorbs the remainder of output. Output and employment multipliers can be calculated.

(2) Development of an inventory of water and air pollutants as well as solid wastes that were produced as consequences of economic activities of the diverse producing sectors including households. This is the residual stream of the material substances which are discharged to the natural environment.

(3) The economic-ecologic trade-off is then accomplished through the incorporation of the results obtained in (1) and (2) as follows:

Let:

E = A matrix of outflows of residuals to the environment.

$(I-A)^{-1}$ = The Leontief inverse. It is the inverse of the input-output model.

U = A matrix of the direct and indirect environmental impact of each economic sector.

Then:

$$E\ (I-A)^{-1} = U.$$

The multiplication of these matrices provides the necessary linkage between the economy and the environment. The analysis is carried further by obtaining the environmental-output multipliers and environmental-income multipliers. These multipliers are obtained by dividing the output and income multipliers calculated from the input-output matrix by the economic-ecologic matrix.

These multipliers, in the form of matrices, in a sense show the impacts of economic growth on the ecologic system. They can provide valuable information regarding the trade-off between the benefits of economic growth and its environmental costs.

Such information is potentially valuable in decision making. It is an empirical assessment of benefit-cost relationships between economic growth and environmental integrity.

The methodology followed in this research is similar in nature to many others undertaken throughout the country. In particular Blaylock and Jones [1] and Laurent and Hite [3] have pursued such investigations for the lower Rio Grande region of Texas and the Charleston, S.C., metropolitan area, respectively.

The region under study encompasses Hancock, Harrison, and Jackson counties in Mississippi and Mobile and Baldwin counties in Alabama. As a region, it is one of the fastest growing, with a population of over 700,000.

Through a combined effort among researches at the Bureau of Business Research at the University of Southern Mississippi and the Department of Agricultural Economics at Auburn University a sequence of empirical studies concerned with this region was undertaken. It consists of three phases:

(1) The input-output model is arranged with 26 endogenous sectors. It is constructed by using regionalization techniques of the 83-sector national input-output tables [13]. A report regarding this phase was completed in November 1978 [8].

(2) An inventory of water and air pollution as well as solid wastes was prepared. The list comprises 25 major effluents. The research relied heavily on primary data that were supplemented when necessary by scientific and engineering evaluation. A report regarding this phase was completed in June 1980 [9].

(3) The linkage of the economic and ecologic portion is then performed by using equation (1) as follows:

Let:

E = matrix with 25 rows of effluents and 26 columns of economic sectors.

$(I-A)^{-1}$ = matrix with 26 rows and 26 columns. This matrix is the inverse of the technology matrix known as the Leontief inverse.

Then:

$$E(I-A)^{-1} = U$$

is a matrix with 25 rows and 26 columns. This matrix represents the direct and indirect environmental impact of each economic sector.

The analysis so far is called Type I. When the Households sector is included in the input-output table, the analysis is called "Type II." In this case matrix E is composed with 25 rows of effluents and 27 columns of economic sectors. Hence, $E(I-A)^{-1} = U$ is a matrix with 25 rows and 27 columns. The

matrix U in the Type II case represents the direct, indirect and induced environmental impact of each economic sector.

The linkage of the ecologic and economic portions was performed through the use of a computer routine adopted from Blaylock and Jones [2]. The trade-off matrices obtained include:

(a) Environmental-Output Interdependence Type I and Type II.

(b) Environmental-Income Interdependence Type I and Type II.

Since the findings of this report are based on the previous two studies [8 and 9], it might be necessary for the reader to refer to them occasionally.

II. APPLICATION OF THE ECONOMIC-ECOLOGIC MODEL MISSISSIPPI-ALABAMA COASTAL COUNTIES

The objective of this section is to calculate the impact that changes in output and employment would have on the production of pollution in the region. The results should be of interest to regional planners as well as those who are in power to make decisions regarding alternatives in assessing the trade-offs between economic growth and environmental quality.

There are six tables in this section. These tables are the result of the immediate application of the theoretical portion given in Section I. In each of the tables, the rows indicate the pollutants and the columns numbered 1 through 26 or 1 through 27 are the economic sectors of the region as follows:

Number	Sector
1	Fisheries
2	Forestry
3	Livestock
4	Crops
5	Agricultural,Forestry, Fishery Services
6	Mining
7	Construction
8	Food Processing
9	Apparel & Textiles
10	Lumber & Wood
11	Paper & Allied
12	Printing & Publishing
13	Chemicals & Allied
14	Stone, Clay, & Glass
15	Primary, Fabricated Metals
16	Transportation Equipment
17	Other Manufacturing
18	Water Transportation
19	Other Transportation
20	Communication & Utilities
21	Wholesale & Retail Trade
22	Finance, Insurance, Real Estate
23	Hotel, Personel & Repair Services
24	Medical, Educational & Nonprofit Enterprises
25	Other Services
26	State and Local Government
27	Households

Environmental Factors

Table 1 shows the quantity of pollutants produced by each of the 26 endogenous sectors and households in the economy during 1977. Most of the empty cells represent lack of data rather than lack of production of pollution. A few empty cells represent small numbers with no significant digits. The last column in the table gives the total for the row. All units are in short tons (2000 lbs. per ton) per year except the first (Waste Water) which is given in million gallons per year (MGY). It is noteworthy that a single sector often contributes the bulk of a pollutant, demonstrating that certain critical environmental factors of production can be characteristic of certain industries.

Environmental Factors Per Thousand Dollars of Output

Table 2 shows the environmental factors per thousand dollars of output. It is derived simply by dividing each environmental factor in a given column by the toal dollar output produced by the sector named at the top of the column for the year 1977. Since one assumption of input-output analysis is that factors of production are linearly related, Table 2 allows the description of the economic-environmental relationships wihtin a broader range than just the year 1977. This time range is generally accepted to be between five and ten years, depending on the rate of change in technology and the diversification of the product mix in the economy. Thus, given the dollar amount of output in any one year, it is possible to convert this to the number of units per year of any given environmental factor.

In essence, entries in Table 2 give the technical relationships between the economic sectors and pollutants. For instance, Sector 11, Paper and Allied Products, contributes .129 (MGY) of waste water, .002 tons of nitrogen, .015 tons of BOD and so on for each $1,000 of output. These values are the direct requirements resulting from the sectoral sales.

Environmental Interdependence

Tables 3 and 4 represent the total effect on each environmental factor of a change in sales to final demand by each sector. The difference between the two tables is that in Table 4 the Households sector is included among the producing sectors; hence, the table is labled Type II. Both tables are in contrast to Table 2 which represents only the direct change from an increase in output.

Table 3 captures the environmental effects resulting from the inter-industry sales and purchases. Hence, both the direct and indirect effects of the economic activity of each sector are taken into account. Aside from the direct and indirect effects, Table 4 accounts for the induced effects due to the inclusion of the Households sector among the producing sectors.

Notice that the values in both Tables 3 and 4 are larger than the corresponding values in Table 2. This can be explained by the fact that through the economic efforts of all the sectors to meet the demands for a particular sector, they in turn will contribute to the pollution. For example, Sector 11 when increasing its output by $1,000 will cause a total discharge to the environment of .331 (MGY) of waste water, .0030 tons of nitrogen, and so on when looking at Table 3, and even higher values when looking at Table 4. There the values are .373 (MGY) for waste water and .0035 tons for nitrogen, and so on.

It can be observed from Tables 3 and 4 that although some of the sectors were not contributing to pollution directly as can be seen from Table 2, nevertheless indirectly, they caused other sectors to do so through their supporting acitivities.

Environmental-Income Multipliers

The trade-off between income and the environment is given in the

matrices presented in Tables 5 and 6. Table 6 includes Households among the producing sectors and is labeled Type II as explained earlier.

The entries represent the physical quantities of pollutants generated through a $1,000 increase in income of the various sectors resulting from increased sales to final demand. Again, using Sector 11 as an example and observing the entries in Table 5, the quantities of pollutants generated through $1,000 increase in income in that sector are .781 (MGY) of waste water, .007 tons of nitrogen and so on. The corresponding values in Table 6 are .576 (MGY) for waste water and .005 tons of nitrogen and so on. It can be observed from Tables 5 and 6 that the magnitudes in Table 6 are not necessarily uniformly higher in Table 6 than in Table 5.

Environmental Factors

Table 1

	1	2	3	4	5	6	7	8
1.WASTE WATER (MGY)	0.000	0.000	0.000	175.634	0.000	633.600	759.000	7997.729
2.NITROGEN	1.560	0.000	0.000	0.000	0.000	0.246	8.990	248.092
3.SULFIDE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4.FLORIDE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5.PHOSPHATE	0.520	0.000	0.000	0.000	0.000	0.081	3.030	0.798
6.ZINC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7.CADMIUM	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.IRON	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9.CHROMIUM	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10.ALUMINUM	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.COPPER	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12.NICKEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13.LEAD	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.BOD	1.560	0.090	0.000	0.000	0.000	0.246	9.080	472.601
15.SUSPENDED SOLIDS	1.560	40425.000	7a800.000	28a7400.000	0.000	113.548	152.320	819.522
16.OIL & GREASE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	211.742
17.PHENOLS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18.ORGANIC CARBON	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19.NITROGEN OXIDE	3032.540	525.170	48.160	621.470	0.000	89.520	1223.550	303.804
20.SULFUR OXIDE	238.250	0.640	5.460	46.060	0.000	206.106	78.880	1128.834
21.CARBON MONOXIDE	1193.750	18227.280	503.120	3698.900	0.000	157.470	14516.600	24.824
22.PARTICULATES	0.000	2240.223	78.350	310.477	0.000	25.342	115.620	585.917
23.ALDEHYDES	0.000	0.000	1.930	23.350	0.000	15.480	43.080	7.904
24.TOTAL HYDROCARBONS	459.090	3125.190	23.490	216.610	0.000	25.210	621.470	15.964
25.SOLID WASTE	0.000	0.000	23914.400	0.000	0.000	21.450	4457.500	53958.280

Environmental Factors

Table 1 (Cont)

	9	10	11	12	13	14	15	16
1.WASTE WATER (MGY)	328.634	744.118	56617.050	6.495	660506.250	3544.608	1510.978	325192.890
2.NITROGEN	4.496	16.959	937.230	0.936	285.236	3.510	18.659	3.623
3.SULFIDE	0.000	0.012	0.403	0.000	3964.301	0.000	0.000	0.000
4.FLORIDE	0.000	0.000	0.000	0.000	257.054	3.210	0.002	0.000
5.PHOSPHATE	0.744	0.930	83.930	0.310	49.580	0.248	7.228	1.510
6.ZINC	0.671	0.011	19.270	0.000	17.017	0.000	0.872	2.740
7.CADMIUM	0.000	0.000	0.000	0.000	0.579	0.000	1.508	0.000
8.IRON	0.000	0.005	0.005	0.000	49.381	0.000	2.914	0.000
9.CHROMIUM	0.671	3.170	36.490	0.000	7.196	0.053	0.452	0.817
10.ALUMINUM	0.000	0.030	0.000	0.000	104.500	0.000	7.429	0.000
11.COPPER	0.000	10.860	0.002	0.000	0.013	0.002	0.778	0.000
12.NICKEL	0.000	0.000	0.001	0.000	0.408	0.000	1.766	0.000
13.LEAD	0.000	0.001	0.003	0.000	0.005	0.000	0.000	0.000
14.BOD	9.010	130.494	6667.000	0.936	940.390	38.865	0.931	40.555
15.SUSPENDED SOLIDS	23.135	155.970	12633.000	0.936	1639.041	1896.101	36.139	53.660
16.OIL & GREASE	0.000	9.047	3.170	0.000	176.828	12.902	16.951	0.703
17.PHENOLS	0.000	0.218	54.860	0.000	0.638	0.000	0.000	0.000
18.ORGANIC CARBON	0.000	67.290	12.780	0.000	407.936	0.000	0.000	0.000
19.NITROGEN OXIDE	191.496	191.644	3715.604	28.230	6092.643	1104.920	106.200	2366.191
20.SULFUR OXIDE	164.040	239.970	8866.744	42.253	7162.280	2953.310	108.732	258.468
21.CARBON MONOXIDE	1.499	24.058	376.034	2.260	244.912	75.052	4.368	5.620
22.PARTICULATES	15.003	705.238	1945.670	6.550	1244.687	1676.850	305.940	20.540
23.ALDEHYDES	1.219	2.528	31.624	0.830	15.753	5.042	0.988	0.860
24.TOTAL HYDROCARBONS	1.359	11.508	129.654	251.480	471.557	30.192	2.428	3.300
25.SOLID WASTE	1098.450	112753.700	17752.000	653.170	35162.971	3268.800	44165.350	33507.900

Environmental Factors

Table 1 (Cont)

	17	18	19	20	21	22	23	24
1.WASTE WATER (MGY)	997.738	17.500	10.335	44.832	613.906	5.685	61.628	293.785
2.NITROGEN	3.399	3.928	4.599	4.590	48.431	5.502	5.662	20.700
3.SULFIDE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4.FLORIDE	0.000	0.000	0.063	0.000	0.063	0.000	0.000	0.000
5.PHOSPHATE	1.420	1.160	1.440	2.200	12.670	1.770	5.280	8.820
6.ZINC	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7.CADMIUM	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.IRON	0.149	0.000	0.000	0.003	0.000	0.000	0.000	0.000
9.CHROMIUM	0.915	0.000	0.007	0.000	0.006	0.000	0.000	0.000
10.ALUMINUM	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.COPPER	0.054	0.000	0.003	0.001	0.000	0.000	0.000	0.000
12.NICKEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13.LEAD	0.077	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.BOD	4.697	5.680	6.663	5.799	114.701	6.071	11.300	62.464
15.SUSPENDED SOLIDS	53.173	5.680	7.113	13.135	148.901	6.071	14.630	56.724
16.OIL & GREASE	9.891	1.095	1.262	0.170	39.262	0.356	3.855	18.277
17.PHENOLS	0.693	0.002	0.001	0.000	0.000	0.000	0.000	0.000
18.ORGANIC CARBON	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19.NITROGEN OXIDE	357.373	1259.849	523.898	5974887.083	238.310	22.840	7.520	1964.630
20.SULFUR OXIDE	638.337	3145.680	322.600	89184.560	561.330	37.850	13.210	4501.040
21.CARBON MONOXIDE	32.906	2751.361	2267.184	145890.560	21.560	2.620	0.700	153.640
22.PARTICULATES	169.014	476.424	239.245	5021.890	93.520	8.910	1.900	614.810
23.ALDEHYDES	1.715	21.138	31.786	84.490	3.130	0.200	0.200	47.720
24.TOTAL HYDROCARBONS	12.015	224.224	241.461	9141.239	12.880	7.900	0.460	103.650
25.SOLID WASTE	6729.930	5779.523	7131.541	3307.695	94060.254	8050.441	4605.870	43186.817

Environmental Factors

Table 1 (Cont)

	25	26	27	28
1.WASTE WATER (MGY)	3385.135	29.910	5205.740	1088683.180
2.NITROGEN	90.572	16.579	1089.643	2743.142
3.SULFIDE	0.000	0.000	0.000	3964.716
4.FLORIDE	0.000	0.000	0.000	260.392
5.PHOSPHATE	1.960	5.266	254.010	484.899
6.ZINC	0.000	0.000	0.000	40.591
7.CADMIUM	0.000	0.000	0.000	2.087
8.IRON	0.000	0.000	0.000	52.457
9.CHROMIUM	0.000	0.000	0.000	49.777
10.ALUMINUM	0.000	0.000	0.000	111.959
11.COPPER	0.000	0.000	0.000	11.713
12.NICKEL	0.000	0.000	0.000	2.175
13.LEAD	0.000	0.000	0.000	0.086
14.BOD	429.440	19.602	1542.750	10520.835
15.SUSPENDED SOLIDS	429.410	19.592	6244.551	3008348.912
16.OIL & GREASE	211.740	1.871	320.961	1040.083
17.PHENOLS	0.000	0.000	0.000	56.609
18.ORGANIC CARBON	0.000	0.000	0.000	488.006
19.NITROGEN OXIDE	18.240	823.400	20281.006	6020025.321
20.SULFUR OXIDE	30.810	2465.610	889.850	123227.404
21.CARBON MONOXIDE	1.990	55.460	232433.575	422685.363
22.PARTICULATES	4.460	299.940	2600.262	18806.786
23.ALDEHYDES	0.190	15.600	2.180	358.937
24.TOTAL HYDROCARBONS	1.030	41.320	30962.538	46157.309
25.SOLID WASTE	5240.764	17149.930	351451.920	879464.626

Table 2

Environmental Factors Per Thousand Dollars of Output

	1	2	3	4	5	6	7	8	9
1.WASTE WATER	0.000000	0.000000	0.000000	0.005606	0.000000	0.013782	0.001791	0.047566	0.005843
2.NITROGEN	0.000053	0.000000	0.000000	0.000000	0.000000	0.000005	0.000021	0.001476	0.000080
3.SULFIDE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
4.FLORIDE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
5.PHOSPHATE	0.000018	0.000000	0.000000	0.000000	0.000000	0.000002	0.000007	0.000005	0.000013
6.ZINC	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000012
7.CADMIUM	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
8.IRON	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
9.CHROMIUM	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000012
10.ALUMINUM	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
11.COPPER	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
12.NICKEL	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
13.LEAD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
14.BOD	0.000053	0.000000	0.000000	0.000000	0.000000	0.000005	0.000021	0.002811	0.000160
15.TSS	0.000053	3.173824	3.786369	91.519581	0.000000	0.002470	0.000359	0.004874	0.000411
16.OIL & GREASE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001259	0.000000
17.PHENOLS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
18.ORG CARBON	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
19.NITR OXIDE	0.102454	0.041232	0.002401	0.019836	0.000000	0.001947	0.002887	0.001807	0.003405
20.SULFUR OXIDE	0.098042	0.000521	0.000272	0.001496	0.000000	0.004483	0.000186	0.006714	0.002917
21.CARBON MONOX	0.040291	1.431050	0.025066	0.117995	0.000000	0.003425	0.034255	0.000148	0.000027
22.PARTICULATES	0.000000	0.175883	0.003903	0.009910	0.000000	0.000551	0.000273	0.003485	0.000267
23.ALDEHYDES	0.000000	0.000000	0.000096	0.000745	0.000000	0.000337	0.000102	0.000047	0.000022
24.HYDROCARBONS	0.015495	0.245363	0.001170	0.006914	0.000000	0.000548	0.001466	0.000095	0.000024
25.SOLID WASTE	0.000000	0.000000	1.191705	0.000000	0.000000	0.000467	0.010518	0.320917	0.019540

Table 2 (Cont)

Environmental Factos Per Thousand Dollars of Output

	10	11	12	13	14	15	16	17	18
1.WASTE WATER	0.009994	0.129436	0.000256	1.382221	0.072747	0.022756	0.533521	0.005865	0.000122
2.NITROGEN	0.000228	0.002143	0.000037	0.000579	0.000072	0.000282	0.000006	0.000020	0.000027
3.SULFIDE	0.000000	0.000001	0.000000	0.000852	0.000000	0.000000	0.000000	0.000000	0.000000
4.FLORIDE	0.000000	0.000000	0.000000	0.000522	0.000066	0.000000	0.000000	0.000000	0.000000
5.PHOSPHATE	0.000012	0.000152	0.000012	0.000101	0.000005	0.000109	0.000002	0.000008	0.000008
6.ZINC	0.000000	0.000044	0.000000	0.000035	0.000000	0.000013	0.000004	0.000000	0.000000
7.CADMIUM	0.000000	0.000000	0.000000	0.000001	0.000000	0.000023	0.000000	0.000000	0.000000
8.IRON	0.000000	0.000000	0.000000	0.000100	0.000000	0.000044	0.000000	0.000001	0.000000
9.CHROMIUM	0.000043	0.000083	0.000000	0.000015	0.000001	0.000007	0.000001	0.000005	0.000000
10.ALUMINUM	0.000000	0.000000	0.000000	0.000212	0.000000	0.000112	0.000000	0.000000	0.000000
11.COPPER	0.000146	0.000000	0.000000	0.000000	0.000000	0.000012	0.000000	0.000000	0.000000
12.NICKEL	0.000000	0.000000	0.000000	0.000001	0.000000	0.000027	0.000000	0.000000	0.000000
13.LEAD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
14.BOD	0.001753	0.015242	0.000037	0.001910	0.000798	0.000014	0.000067	0.000028	0.000040
15.TSS	0.002095	0.026881	0.000037	0.003329	0.038941	0.000545	0.000088	0.000313	0.000040
16.OIL & GREASE	0.000122	0.000007	0.000000	0.000359	0.000265	0.000256	0.000001	0.000058	0.000008
17.PHENOLS	0.000003	0.000125	0.000000	0.000061	0.000000	0.000000	0.000000	0.000005	0.000000
18.ORG CARBON	0.000904	0.000029	0.000000	0.000829	0.000000	0.000000	0.000000	0.000000	0.000000
19.NITR OXIDE	0.002574	0.008495	0.001111	0.012375	0.022692	0.001602	0.003882	0.002101	0.008779
20.SULFUR OXIDE	0.002820	0.020316	0.001663	0.014548	0.060653	0.001640	0.000424	0.003752	0.021920
21.CARBON MONOX	0.000323	0.000860	0.000069	0.000497	0.001541	0.000066	0.000009	0.000193	0.019172
22.PARTICULATES	0.009471	0.004448	0.000258	0.002528	0.034438	0.004016	0.000034	0.000993	0.003320
23.ALDEHYDES	0.000034	0.000072	0.000033	0.000032	0.000104	0.000015	0.000001	0.000010	0.000147
24.HYDROCARBONS	0.000155	0.000296	0.000900	0.000958	0.000620	0.000037	0.000005	0.000071	0.001562
25.SOLID WASTE	1.514366	0.040584	0.025712	0.071422	0.067132	0.666305	0.054974	0.051316	0.040273

Table 2 (Cont)

Environmental Factors Per Thousand Dollars of Output

	19	20	21	22	23	24	25	26
1.WASTE WATER	0.000074	0.000162	0.000932	0.000012	0.000810	0.001448	0.014004	0.000073
2.NITROGEN	0.000033	0.000017	0.000074	0.000012	0.000074	0.000102	0.000375	0.000041
3.SULFIDE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
4.FLORIDE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
5.PHOSPHATE	0.000010	0.000008	0.000019	0.000004	0.000069	0.000043	0.000008	0.000013
6.ZINC	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
7.CADMIUM	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
8.IRON	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
9.CHROMIUM	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
10.ALUMINUM	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
11.COPPER	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
12.NICKEL	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
13.LEAD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
14.BOD	0.000048	0.000021	0.000174	0.000013	0.000149	0.000308	0.001777	0.000048
15.TSS	0.000051	0.000047	0.000226	0.000013	0.000192	0.000280	0.001776	0.000048
16.OIL & GREASE	0.000009	0.000001	0.000060	0.000001	0.000051	0.000090	0.000876	0.000005
17.PHENOLS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
18.ORG CARBON	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
19.NITR OXIDE	0.003765	21.603682	0.000362	0.000049	0.000099	0.009683	0.000075	0.002015
20.SULFUR OXIDE	0.002318	0.322469	0.000852	0.000081	0.000174	0.022183	0.000127	0.005887
21.CARBON MONOX	0.016437	0.327503	0.000033	0.000006	0.000009	0.000757	0.000068	0.000136
22.PARTICULATES	0.001719	0.018158	0.000142	0.000019	0.000025	0.003030	0.000018	0.000734
23.ALDEHYDES	0.000228	0.000305	0.000005	0.000000	0.000003	0.000235	0.000001	0.000038
24.HYDROCARBONS	0.001765	0.033052	0.000020	0.000017	0.000006	0.000511	0.000004	0.000101
25.SOLID WASTE	0.051251	0.011960	0.142787	0.017175	0.360542	0.212847	0.021888	0.041966

Table 3

Environmental Interdependence Matrix I

	1	2	3	4	5	6	7	8	9
1.WASTE WATER	0.253146	0.058976	0.120918	0.242360	0.079696	0.063968	0.096276	0.188552	0.136853
2.NITROGEN	0.000177	0.000049	0.000355	0.000168	0.000198	0.000055	0.000151	0.002076	0.000255
3.SULFIDE	0.000758	0.000326	0.000606	0.001347	0.000397	0.000272	0.000493	0.000565	0.000705
4.FLORIDE	0.000049	0.000021	0.000040	0.000088	0.000026	0.000018	0.000035	0.000038	0.000046
5.PHOSPHATE	0.000034	0.000007	0.000016	0.000023	0.000018	0.000009	0.000025	0.000034	0.000036
6.ZINC	0.000005	0.000002	0.000003	0.000006	0.000004	0.000001	0.000003	0.000006	0.000020
7.CADMIUM	0.000001	0.000000	0.000000	0.000000	0.000000	0.000000	0.000001	0.000000	0.000000
8.IRON	0.000010	0.000004	0.000008	0.000017	0.000005	0.000004	0.000008	0.000008	0.000009
9.CHROMIUM	0.000003	0.000001	0.000003	0.000004	0.000006	0.000001	0.000005	0.000007	0.000020
10.ALUMINUM	0.000022	0.000009	0.000017	0.000030	0.000011	0.000008	0.000018	0.000017	0.000019
11.COPPER	0.000001	0.000000	0.000001	0.000001	0.000001	0.000001	0.000011	0.000002	0.000001
12.NICKEL	0.000001	0.000000	0.000000	0.000000	0.000000	0.000000	0.000001	0.000001	0.000000
13.LEAD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
14.BOD	0.000487	0.000183	0.000954	0.000855	0.001093	0.000224	0.000621	0.004783	0.000976
15.SUSPENDED SO	0.437995	10.618461	31.717710	55.634261	18.440140	0.138117	0.310526	12.590329	0.259511
16.OIL & GREASE	0.000391	0.000035	0.000288	0.000139	0.000067	0.000050	0.000122	0.001686	0.000088
17.PHENOLS	0.000001	0.000001	0.000002	0.000002	0.000007	0.000001	0.000002	0.000008	0.000005
18.ORGANIC CARB	0.000082	0.000035	0.000067	0.000145	0.000051	0.000032	0.000114	0.000068	0.000079
19.NITROGEN OXI	0.645261	0.200427	0.570201	0.645975	0.244360	0.613215	0.444888	0.838339	0.664967
20.SULFUR OXIDE	0.016727	0.004838	0.012657	0.014245	0.006264	0.015234	0.011686	0.026116	0.016354
21.CARBON MONOX	0.056461	1.492104	0.080388	0.142112	0.033112	0.021194	0.058084	0.048883	0.022473
22.PARTICULATES	0.001356	0.182912	0.009087	0.011940	0.003210	0.001797	0.005007	0.008436	0.002263
23.ALDEHYDES	0.000027	0.000084	0.000369	0.000812	0.000176	0.000366	0.000135	0.000207	0.000056
24.TOTAL HYDROC	0.016899	0.254221	0.050065	0.008807	0.002532	0.001827	0.004386	0.005552	0.002138
25.SOLID WASTE	0.060935	0.031870	1.400162	0.067046	0.063866	0.027257	0.174428	0.595537	0.067541

Table 3 (Cont)

Environmental Interdenpendence Matrix I

	10	11	12	13	14	15	16	17	18
1.WASTE WATER	0.094490	0.331234	0.114363	1.821398	0.174969	0.090651	0.746664	0.162775	0.044421
2.NITROGEN	0.000394	0.003019	0.000634	0.000910	0.000260	0.000394	0.000096	0.000190	0.000077
3.SULFIDE	0.000441	0.000888	0.000464	0.010544	0.000501	0.000313	0.000207	0.000792	0.000193
4.FLORIDE	0.000029	0.000058	0.000030	0.000684	0.000103	0.000021	0.000014	0.000052	0.000013
5.PHOSPHATE	0.000029	0.000275	0.000069	0.000145	0.000026	0.000132	0.000019	0.000032	0.000016
6.ZINC	0.000003	0.000003	0.000013	0.000047	0.000005	0.000017	0.000008	0.000005	0.000001
7.CADMIUM	0.000000	0.000000	0.000000	0.000002	0.000000	0.000025	0.000002	0.000001	0.000000
8.IRON	0.000006	0.000011	0.000006	0.000132	0.000007	0.000053	0.000006	0.000013	0.000003
9.CHROMIUM	0.000059	0.000116	0.000022	0.000023	0.000007	0.000010	0.000005	0.000011	0.000001
10.ALUMINUM	0.000013	0.000024	0.000013	0.000279	0.000014	0.000133	0.000013	0.000025	0.000005
11.COPPER	0.000193	0.000015	0.000003	0.000001	0.000002	0.000014	0.000003	0.000003	0.000000
12.NICKEL	0.000000	0.000000	0.000000	0.000001	0.000000	0.000030	0.000002	0.000001	0.000000
13.LEAD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
14.BOD	0.002753	0.021036	0.004007	0.003404	0.001889	0.000403	0.000427	0.000808	0.000232
15.SUSPENDED SO	0.427985	0.507752	0.173468	0.418057	0.169425	0.098252	0.131295	1.551508	0.092946
16.OIL & GREASE	0.000222	0.000129	0.000056	0.000575	0.000358	0.000343	0.000085	0.000169	0.000049
17.PHENOLS	0.000006	0.000169	0.000031	0.000006	0.000007	0.000002	0.000001	0.000009	0.000001
18.ORGANIC CARB	0.001242	0.000225	0.000073	0.001092	0.000064	0.000040	0.000038	0.000097	0.000022
19.NITROGEN OXI	0.953938	1.022421	0.825177	1.054414	1.255098	0.869647	0.541472	0.694176	0.499453
20.SULFUR OXIDE	0.014467	0.045431	0.020426	0.037056	0.386742	0.017872	0.010579	0.017561	0.032872
21.CARBON MONOX	0.234192	0.057343	0.027332	0.034359	0.037099	0.025818	0.017231	0.023795	0.036630
22.PARTICULATES	0.040343	0.012115	0.003297	0.005740	0.039272	0.006876	0.002008	0.003423	0.004633
23.ALDEHYDES	0.000090	0.000147	0.000081	0.000112	0.000170	0.000064	0.000023	0.000055	0.000198
24.TOTAL HYDROC	0.038485	0.007304	0.012976	0.004093	0.003338	0.001975	0.001506	0.002092	0.002883
25.SOLID WASTE	2.034944	0.250393	0.092452	0.137471	0.121055	0.776647	0.164438	0.135382	0.067659

Table 3 (Cont)

Environmental Interdependence Matrix I

	19	20	21	22	23	24	25	26
1.WASTE WATER	0.108046	0.034931	0.036860	0.030510	0.085767	0.060635	0.060877	0.072008
2.NITROGEN	0.000133	0.000069	0.000158	0.000067	0.000175	0.000186	0.000471	0.000127
3.SULFIDE	0.000560	0.000185	0.000175	0.000153	0.000464	0.000324	0.000180	0.000388
4.FLORIDE	0.000037	0.000012	0.000012	0.000010	0.000030	0.000021	0.000012	0.000026
5.PHOSPHATE	0.000024	0.000016	0.000027	0.000010	0.000084	0.000052	0.000019	0.000026
6.ZINC	0.000003	0.000001	0.000001	0.000001	0.000003	0.000002	0.000002	0.000002
7.CADMIUM	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
8.IRON	0.000007	0.000002	0.000002	0.000002	0.000006	0.000004	0.000003	0.000005
9.CHROMIUM	0.000002	0.000001	0.000002	0.000001	0.000002	0.000001	0.000002	0.000002
10.ALUMINUM	0.000015	0.000005	0.000005	0.000004	0.000013	0.000009	0.000006	0.000011
11.COPPER	0.000001	0.000001	0.000001	0.000001	0.000001	0.000000	0.000001	0.000002
12.NICKEL	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
13.LEAD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
14.BOD	0.000428	0.000232	0.000584	0.000256	0.000606	0.000630	0.002259	0.000402
15.SUSPENDED SO	0.340040	0.064321	0.164833	0.772962	0.168410	0.270197	0.302782	0.150936
16.OIL & GREASE	0.000054	0.000054	0.000135	0.000061	0.000133	0.000161	0.000963	0.000085
17.PHENOLS	0.000001	0.000001	0.000002	0.000001	0.000002	0.000001	0.000002	0.000001
18.ORGANIC CARB	0.000062	0.000023	0.000021	0.000021	0.000052	0.000036	0.000022	0.000055
19.NITROGEN OXI	0.859366	24.910392	0.782251	0.490295	0.905867	1.149383	1.686593	2.912230
20.SULFUR OXIDE	0.017643	0.373287	0.013977	0.008350	0.015958	0.040602	0.026739	0.051412
21.CARBON MONOX	0.042431	0.611644	0.020820	0.016471	0.024498	0.030720	0.043237	0.082749
22.PARTICULATES	0.003334	0.021451	0.001232	0.001009	0.001442	0.004470	0.002027	0.004496
23.ALDEHYDES	0.000273	0.000377	0.000026	0.000027	0.000030	0.000266	0.000040	0.000120
24.TOTAL HYDROC	0.003633	0.038464	0.001508	0.001205	0.001746	0.002597	0.003412	0.005575
25.SOLID WASTE	0.090333	0.036908	0.164697	0.044197	0.092183	0.239068	0.053393	0.094628

Table 4

Environmental Interdependence Matrix II

	1	2	3	4	5	6	7	8	9
1.WASTE WATER	0.339727	0.103904	0.174717	0.297359	0.131134	0.101317	0.148187	0.251566	0.200622
2.NITROGEN	0.000775	0.000524	0.000923	0.000749	0.000742	0.000453	0.000699	0.002742	0.000929
3.SULFIDE	0.001027	0.000542	0.000862	0.001609	0.000642	0.000450	0.000740	0.000865	0.001009
4.FLORIDE	0.000067	0.000036	0.000057	0.000105	0.000042	0.000030	0.000052	0.000058	0.000066
5.PHOSPHATE	0.000189	0.000130	0.000163	0.000173	0.000159	0.000111	0.000167	0.000206	0.000211
6.ZINC	0.000007	0.000003	0.000005	0.000008	0.000006	0.000003	0.000005	0.000008	0.000022
7.CADMIUM	0.000001	0.000000	0.000000	0.000000	0.000000	0.000000	0.000001	0.000001	0.000000
8.IRON	0.000014	0.000007	0.000011	0.000021	0.000008	0.000006	0.000011	0.000012	0.000013
9.CHROMIUM	0.000005	0.000003	0.000005	0.000006	0.000008	0.000003	0.000007	0.000009	0.000022
10.ALUMINUM	0.000030	0.000016	0.000024	0.000044	0.000018	0.000013	0.000025	0.000026	0.000028
11.COPPER	0.000002	0.000001	0.000002	0.000002	0.000003	0.000002	0.000012	0.000003	0.000002
12.NICKEL	0.000001	0.000000	0.000000	0.000000	0.000000	0.000000	0.000001	0.000001	0.000000
13.LEAD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
14.BOD	0.001666	0.001120	0.002076	0.001801	0.002165	0.001003	0.001703	0.006097	0.002305
15.TSS	0.971616	11.042199	32.225090	96.152967	18.925255	0.490355	0.800106	13.184616	0.860925
16.OIL & GREASE	0.000352	0.000242	0.000536	0.000393	0.000304	0.000222	0.000361	0.001976	0.000382
17.PHENOLS	0.000003	0.000002	0.000003	0.000003	0.000009	0.000002	0.000003	0.000009	0.000006
18.ORG CARBON	0.000118	0.000063	0.000161	0.000179	0.000063	0.000056	0.000146	0.000108	0.000119
19.NITR OXIDE	2.193868	1.430101	2.042676	2.151319	1.652218	1.635445	1.865657	2.563025	2.410337
20.SULFUR OXIDE	0.045314	0.026000	0.037937	0.040093	0.030435	0.032784	0.036080	0.055726	0.046319
21.CARBON MONOX	0.208956	1.613192	0.229385	0.290345	0.171746	0.121855	0.197993	0.218715	0.194342
22.PARTICULATES	0.004994	0.185800	0.012546	0.015476	0.006517	0.004198	0.008344	0.012487	0.006362
23.ALDEHYDES	0.000096	0.000134	0.000428	0.000873	0.000227	0.000407	0.000192	0.000276	0.000127
24.HYDROCARBONS	0.034412	0.268159	0.021694	0.025869	0.018269	0.013414	0.020490	0.025100	0.021921
25.SOLID WASTE	0.307375	0.227554	1.634484	0.306597	0.287925	0.189930	0.400528	0.869994	0.345290

Table 4 (Cont)

Environmental Interdependence Matrix II

	10	11	12	13	14	15	16	17	18
1.WASTE WATER	0.136079	0.372797	0.157756	1.669365	0.227269	0.138646	0.797438	0.220223	0.084732
2.NITROGEN	0.000834	0.003458	0.001092	0.001417	0.000812	0.000901	0.000632	0.000797	0.000503
3.SULFIDE	0.000639	0.001066	0.000671	0.010773	0.000750	0.000542	0.000449	0.001065	0.000385
4.FLORIDE	0.000342	0.000071	0.000044	0.000699	0.000120	0.000036	0.000030	0.000070	0.000026
5.PHOSPHATE	0.000143	0.000389	0.000188	0.000276	0.000169	0.000263	0.000157	0.000189	0.000126
6.ZINC	0.000004	0.000065	0.000014	0.000049	0.000006	0.000018	0.000010	0.000007	0.000003
7.CADMIUM	0.000000	0.000000	0.000000	0.000002	0.000000	0.000026	0.000002	0.000001	0.000000
8.IRON	0.000009	0.000014	0.000005	0.000135	0.000010	0.000056	0.000009	0.000016	0.000005
9.CHROMIUM	0.000060	0.000120	0.000024	0.000024	0.000009	0.000011	0.000006	0.000013	0.000002
10.ALUMINUM	0.000019	0.000030	0.000019	0.000286	0.000022	0.000140	0.000020	0.000033	0.000011
11.COPPER	0.000194	0.000016	0.000004	0.000002	0.000003	0.000015	0.000005	0.000005	0.000001
12.NICKEL	0.000000	0.000000	0.000000	0.000002	0.000001	0.000030	0.000002	0.000001	0.000000
13.LEAD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
14.BOD	0.003620	0.021903	0.004914	0.004305	0.002979	0.001404	0.001485	0.002006	0.001072
15.TSS	2.820215	0.899736	0.582704	0.870630	0.662668	0.550894	0.610147	2.093305	0.473123
16.OIL & GREASE	0.000414	0.000321	0.000250	0.000797	0.000606	0.000564	0.000319	0.000434	0.000235
17.PHENOLS	0.000007	0.000176	0.000032	0.000008	0.000008	0.000003	0.000003	0.000011	0.000002
18.ORG CARBON	0.001264	0.000251	0.000100	0.001122	0.000097	0.000071	0.000070	0.000134	0.000048
19.NITR OXIDE	1.692232	2.160000	2.012826	2.367830	2.686542	2.183264	1.931153	2.266530	1.602770
20.SULFUR OXIDE	0.034010	0.064961	0.040816	0.059606	0.111317	0.040424	0.034437	0.044555	0.051814
21.CARBON MONOX	0.346261	0.169362	0.144282	0.163693	0.178055	0.155171	0.154075	0.178627	0.145275
22.PARTICULATES	0.043217	0.014787	0.006086	0.008825	0.042034	0.009962	0.005273	0.007116	0.007224
23.ALDEHYDES	0.000136	0.000153	0.000129	0.000165	0.000227	0.000117	0.000080	0.000119	0.000242
24.HYDROCARBONS	0.051387	0.020198	0.026437	0.016980	0.019563	0.016864	0.017258	0.019914	0.015388
25.SOLID WASTE	2.216086	0.431423	0.281449	0.346481	0.346847	0.985689	0.385585	0.385598	0.243235

Table 4 (Cont)

Environmental Interdependence Matrix II

	19	20	21	22	23	24	25	26	27
1.WASTE WATER	0.163930	0.073753	0.091932	0.058307	0.149940	0.129056	0.124128	0.133865	0.097991
2.NITROGEN	0.000724	0.000479	0.000740	0.000361	0.000853	0.000909	0.001139	0.000780	0.001035
3.SULFIDE	0.000827	0.000370	0.000437	0.000286	0.000770	0.000656	0.000481	0.000683	0.000467
4.FLORIDE	0.000055	0.000025	0.000029	0.000019	0.000051	0.000043	0.000032	0.000046	0.000031
5.PHOSPHATE	0.000176	0.000122	0.000177	0.000086	0.000260	0.000239	0.000192	0.000195	0.000268
6.ZINC	0.000005	0.000002	0.000003	0.000002	0.000005	0.000004	0.000004	0.000004	0.000003
7.CADMIUM	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000001	0.000000
8.IRON	0.000011	0.000005	0.000006	0.000004	0.000010	0.000009	0.000007	0.000009	0.000006
9.CHROMIUM	0.000004	0.000002	0.000004	0.000002	0.000005	0.000004	0.000004	0.000004	0.000004
10.ALUMINUM	0.000023	0.000011	0.000013	0.000008	0.000022	0.000018	0.000015	0.000020	0.000014
11.COPPER	0.000002	0.000002	0.000002	0.000001	0.000002	0.000002	0.000002	0.000004	0.000002
12.NICKEL	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000001	0.000000
13.LEAD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
14.BOD	0.001593	0.001041	0.001732	0.000835	0.001944	0.002057	0.003578	0.001692	0.002043
15.TSS	0.867158	0.430454	0.684225	1.035113	0.773635	0.915805	0.899307	0.734313	0.924163
16.OIL & GREASE	0.000352	0.000234	0.000389	0.000189	0.000429	0.000477	0.001255	0.000371	0.000452
17.PHENOLS	0.000002	0.000002	0.000003	0.000001	0.000004	0.000003	0.000004	0.000003	0.000002
18.ORG CARBON	0.000048	0.000048	0.000056	0.000038	0.000092	0.000079	0.000062	0.000094	0.000062
19.NITR OXIDE	2.388915	25.472950	2.289583	1.251086	2.666297	3.023011	3.417775	4.605254	2.682024
20.SULFUR OXIDE	0.044103	0.391530	0.039455	0.021411	0.045713	0.072769	0.056466	0.080478	0.046046
21.CARBON MONOX	0.193048	0.716276	0.169249	0.091387	0.197456	0.215219	0.213709	0.249463	0.264102
22.PARTICULATES	0.006927	0.023947	0.004773	0.002796	0.005568	0.008870	0.006094	0.008472	0.006300
23.ALDEHYDES	0.000335	0.000420	0.000086	0.000058	0.000101	0.000342	0.000110	0.000189	0.000108
24.HYDROCARBONS	0.020969	0.050508	0.018593	0.009832	0.021654	0.023834	0.023034	0.024764	0.030399
25.SOLID WASTE	0.334238	0.205598	0.434566	0.165266	0.371692	0.537227	0.328884	0.364046	0.426803

Table 5

Type I Environmental - Income Multipliers

	1	2	3	4	5	6	7	8	9
1.WASTE WATER	0.438417	0.126633	0.220245	0.431805	0.151825	0.167832	0.181738	0.293213	0.210296
2.NITROGEN	0.000307	0.000107	0.000647	0.000300	0.000376	0.000154	0.000285	0.003229	0.000392
3.SULFIDE	0.001312	0.000715	0.001104	0.002400	0.000756	0.000713	0.000930	0.000879	0.001084
4.FLORIDE	0.000085	0.000047	0.000072	0.000156	0.000049	0.000048	0.000067	0.000059	0.000071
5.PHOSPHATE	0.000059	0.000016	0.000029	0.000041	0.000035	0.000025	0.000047	0.000053	0.000056
6.ZINC	0.000009	0.000004	0.000006	0.000011	0.000008	0.000004	0.000006	0.000009	0.000030
7.CADMIUM	0.000001	0.000000	0.000000	0.000001	0.000000	0.000001	0.000002	0.000001	0.000000
8.IRON	0.000018	0.000009	0.000014	0.000030	0.000010	0.000010	0.000015	0.000012	0.000014
9.CHROMIUM	0.000005	0.000002	0.000005	0.000007	0.000011	0.000003	0.000010	0.000011	0.000031
10.ALUMINUM	0.000038	0.000020	0.000030	0.000064	0.000021	0.000021	0.000034	0.000026	0.000030
11.COPPER	0.000002	0.000001	0.000001	0.000002	0.000003	0.000002	0.000020	0.000002	0.000001
12.NICKEL	0.000001	0.000000	0.000000	0.000000	0.000000	0.000001	0.000002	0.000001	0.000000
13.LEAD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
14.BOD	0.000843	0.000400	0.001738	0.001167	0.002082	0.000589	0.001172	0.007439	0.001500
15.SUSPENDED SO	0.758551	23.159809	57.771898	170.388922	35.129193	0.362375	0.586176	19.578958	0.398778
16.OIL & GREASE	0.000157	0.000076	0.000524	0.000248	0.000128	0.000131	0.000230	0.002621	0.000135
17.PHENOLS	0.000002	0.000001	0.000004	0.000003	0.000014	0.000002	0.000003	0.000012	0.000007
18.ORGANIC CARB	0.000143	0.000076	0.000122	0.000258	0.000097	0.000085	0.000215	0.000106	0.000121
19.NITROGEN OXI	1.117500	0.437148	1.038588	1.150922	0.465516	1.608884	0.839804	1.303683	1.021823
20.SULFUR OXIDE	0.032432	0.010661	0.023054	0.025387	0.011934	0.039970	0.022060	0.040612	0.025130
21.CARBON MONOX	0.097763	0.254406	0.146423	0.253198	0.063060	0.055606	0.109643	0.076016	0.034533
22.PARTICULATES	0.032349	0.398946	0.016552	0.021274	0.006115	0.004714	0.009451	0.013118	0.003477
23.ALDEHYDES	0.000047	0.000163	0.000672	0.001446	0.000325	0.000960	0.000255	0.000321	0.000086
24.TOTAL HYDROC	0.029196	0.554478	0.009116	0.015691	0.004443	0.004794	0.008280	0.008633	0.003285
25.SOLID WASTE	0.105531	0.069512	2.550512	0.119453	0.121705	0.071513	0.329264	0.926107	0.103788

Table 5 (Cont)

Type I Environmental - Income Multipliers

	10	11	12	13	14	15	16	17	18
1.WASTE WATER	0.222635	0.780937	0.258263	3.719335	0.327831	0.185083	1.441028	0.277652	0.107982
2.NITROGEN	0.000929	0.007118	0.001431	0.001858	0.000487	0.000804	0.000185	0.000325	0.000186
3.SULFIDE	0.001039	0.002994	0.001048	0.021531	0.000936	0.000639	0.000399	0.001350	0.000470
4.FLORIDE	0.000069	0.000136	0.000068	0.001397	0.000194	0.000042	0.000027	0.000089	0.000031
5.PHOSPHATE	0.000368	0.000649	0.000157	0.000295	0.000350	0.000269	0.000036	0.000055	0.000038
6.ZINC	0.000007	0.000149	0.000029	0.000096	0.000009	0.000034	0.000016	0.000009	0.000003
7.CADMIUM	0.000001	0.000001	0.000001	0.000004	0.000001	0.000052	0.000003	0.000002	0.000000
8.IRON	0.000014	0.000027	0.000014	0.000269	0.000013	0.000108	0.000011	0.000021	0.000006
9.CHROMIUM	0.000138	0.000279	0.000050	0.000046	0.000013	0.000020	0.000009	0.000018	0.000002
10.ALUMINUM	0.000031	0.000058	0.000030	0.000570	0.000027	0.000272	0.000026	0.000043	0.000013
11.COPPER	0.000035	0.000036	0.000007	0.000002	0.000004	0.000029	0.000007	0.000006	0.000001
12.NICKEL	0.000001	0.000001	0.000001	0.000003	0.000001	0.000061	0.000004	0.000002	0.000000
13.LEAD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000001	0.000000
14.BOD	0.006487	0.049597	0.009053	0.006748	0.003539	0.000824	0.000823	0.001379	0.000564
15.SUSPENDED SO	5.720762	1.197138	0.391736	0.853683	0.617443	0.200601	0.253394	2.646468	0.225939
16.OIL & GREASE	0.000524	0.000364	0.000204	0.001175	0.000671	0.000700	0.000164	0.000287	0.000120
17.PHENOLS	0.000014	0.000395	0.000069	0.000013	0.000312	0.000004	0.000003	0.000016	0.000002
18.ORGANIC CARB	0.002927	0.000530	0.000165	0.002230	0.000120	0.000082	0.000073	0.000166	0.000055
19.NITROGEN OXI	1.305175	2.410523	1.863467	2.153138	2.351613	1.775565	1.045018	1.184084	1.214108
20.SULFUR OXIDE	0.034087	0.107110	0.046127	0.075670	0.162524	0.036489	0.020417	0.029954	0.079908
21.CARBON MONOX	0.551798	0.135195	0.061724	0.070162	0.069511	0.052713	0.033255	0.040588	0.089042
22.PARTICULATES	0.065526	0.028563	0.007445	0.011721	0.073582	0.014039	0.003876	0.005839	0.011261
23.ALDEHYDES	0.000212	0.000348	0.000182	0.000229	0.000318	0.000131	0.000045	0.000095	0.000480
24.TOTAL HYDROC	0.090677	0.017220	0.029302	0.006358	0.006254	0.004033	0.002907	0.003569	0.007008
25.SOLID WASTE	1.794688	0.990346	0.208782	0.280719	0.226815	1.585687	0.317359	0.230926	0.164471

Table 5 (Cont)

Type I Environmental - Income Multipliers

	19	20	21	22	23	24	25	26
1.WASTE WATER	0.139455	0.088170	0.065585	0.107557	0.130964	0.086796	0.094313	0.114073
2.NITROGEN	0.000734	0.000175	0.000281	0.000237	0.000267	0.000266	0.000729	0.000201
3.SULFIDE	0.000982	0.000467	0.000311	0.000540	0.000709	0.000464	0.000278	0.000615
4.FLORIDE	0.000065	0.000031	0.000021	0.000036	0.000046	0.000030	0.000019	0.000041
5.PHOSPHATE	0.000041	0.000040	0.000048	0.000036	0.000125	0.000075	0.000030	0.000040
6.ZINC	0.000005	0.000003	0.000003	0.000003	0.000004	0.000003	0.000003	0.000003
7.CADMIUM	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
8.IRON	0.000613	0.000006	0.000004	0.000007	0.000009	0.000006	0.000004	0.000008
9.CHROMIUM	0.000003	0.000002	0.000003	0.000004	0.000004	0.000002	0.000003	0.000003
10.ALUMINUM	0.000027	0.000013	0.000009	0.000016	0.000020	0.000013	0.000009	0.000018
11.COPPER	0.000001	0.000002	0.000001	0.000003	0.000001	0.000001	0.000001	0.000004
12.NICKEL	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000001
13.LEAD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
14.BOD	0.000751	0.000585	0.001040	0.000902	0.000925	0.000902	0.003500	0.000637
15.SUSPENDED SO	0.596339	0.162354	0.293291	2.724931	0.257157	0.386776	0.469083	0.239108
16.OIL & GREASE	0.000166	0.000137	0.000241	0.000215	0.000203	0.000230	0.001492	0.000135
17.PHENOLS	0.000002	0.000001	0.000003	0.000003	0.000003	0.000002	0.000004	0.000002
18.ORGANIC CARB	0.000109	0.000059	0.000038	0.000073	0.000079	0.000051	0.000034	0.000087
19.NITROGEN OXI	1.506874	62.876791	1.391675	1.728442	1.389344	1.645296	2.612944	4.613446
20.SULFUR OXIDE	0.031287	0.962221	0.024157	0.029435	0.023756	0.058120	0.041425	0.081445
21.CARBON MONOX	0.074402	1.543862	0.037043	0.058065	0.037408	0.043975	0.066984	0.131087
22.PARTICULATES	0.005845	0.054144	0.002192	0.003556	0.002202	0.006398	0.003141	0.007122
23.ALDEHYDES	0.000479	0.000953	0.000046	0.000098	0.000046	0.000381	0.000062	0.000190
24.TOTAL HYDRO	0.006370	0.037088	0.002683	0.004263	0.002666	0.003718	0.005285	0.008831
25.SOLID WASTE	0.159274	0.092151	0.293049	0.155810	0.140761	0.342216	0.082719	0.149905

Table 6

Type II Environmental - Income Multipliers

	1	2	3	4	5	6	7	8	9
1.WASTE WATER	0.351703	0.148589	0.208656	0.347388	0.163795	0.174291	0.183408	0.256498	0.202132
2.NITROGEN	0.000883	0.000747	0.001103	0.000875	0.000926	0.000780	0.000866	0.002796	0.000936
3.SULFIDE	0.001167	0.000775	0.001030	0.001880	0.000802	0.000774	0.000916	0.000882	0.001017
4.FLURIDE	0.000076	0.000051	0.000068	0.000123	0.000053	0.000052	0.000064	0.000059	0.000067
5.PHOSPHATE	0.000214	0.000186	0.000195	0.000202	0.000198	0.000192	0.000207	0.000210	0.000212
6.ZINC	0.000008	0.000005	0.000006	0.000010	0.000008	0.000005	0.000006	0.000008	0.000022
7.CADMIUM	0.000001	0.000000	0.000000	0.000001	0.000000	0.000001	0.000002	0.000001	0.000000
8.IRON	0.000016	0.000010	0.000013	0.000024	0.000011	0.000011	0.000014	0.000012	0.000013
9.CHROMIUM	0.000006	0.000004	0.000005	0.000007	0.000010	0.000004	0.000009	0.000009	0.000022
10.ALUMINUM	0.000034	0.000022	0.000029	0.000051	0.000022	0.000023	0.000031	0.000026	0.000028
11.COPPER	0.000003	0.000002	0.000002	0.000003	0.000003	0.000003	0.000015	0.000003	0.000002
12.NICKEL	0.000001	0.000001	0.000000	0.000001	0.000000	0.000001	0.000002	0.000001	0.000000
13.LEAD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
14.BOD	0.001692	0.001532	0.002479	0.002104	0.002704	0.001726	0.002108	0.006217	0.002323
15.SUSPENDED SO	1.103293	15.790971	38.484839	112.323662	23.638854	6.843536	6.990274	13.443139	0.867404
16.OIL & GREASE	0.000430	0.000346	0.000640	0.000459	0.000380	0.000382	0.000447	0.002015	0.000385
17.PHENOLS	0.000003	0.000002	0.000004	0.000003	0.000011	0.000003	0.000004	0.000010	0.000006
18.ORGANIC CARB	0.000134	0.000091	0.000120	0.000209	0.000104	0.000096	0.000181	0.000110	0.000120
19.NITROGEN OXI	2.491213	2.045126	2.439468	2.513121	2.063726	2.813390	2.309133	2.613281	2.428476
20.SULFUR OXIDE	0.051456	0.037181	0.045306	0.046836	0.038015	0.056398	0.044655	0.056818	0.046668
21.CARBON MONOX	0.237275	2.306956	0.269166	0.339175	0.214522	0.209621	0.245051	0.223003	0.195804
22.PARTICULATES	0.005671	0.265703	0.014983	0.018079	0.008140	0.007221	0.010327	0.012732	0.006410
23.ALDEHYDES	0.000102	0.000191	0.000512	0.001019	0.000204	0.000700	0.000238	0.000282	0.000128
24.TOTAL HYDROC	0.039070	0.363482	0.025989	0.030220	0.022845	0.023075	0.025360	0.025592	0.022086
25.SOLID WASTE	0.349032	0.325415	1.951984	0.358180	0.359637	0.326727	0.495725	0.887053	0.347889

Table 6 (Cont)

Type II Environmental - Income Multipliers

	10	11	12	13	14	15	16	17	18
1.WASTE WATER	0.210223	0.576281	0.233583	2.502680	0.279196	0.185601	1.009078	0.246295	0.135049
2.NITROGEN	0.001248	0.005346	0.001617	0.001697	0.000998	0.001206	0.000800	0.000891	0.000802
3.SULFIDE	0.000987	0.001679	0.000994	0.014423	0.000921	0.000725	0.000568	0.001191	0.000614
4.FLORIDE	0.000065	0.000110	0.000065	0.000937	0.000148	0.000048	0.000038	0.000079	0.000041
5.PHOSPHATE	0.000220	0.000601	0.000278	0.000369	0.000208	0.000352	0.000199	0.000211	0.000201
6.ZINC	0.000057	0.000100	0.000021	0.000065	0.000008	0.000024	0.000013	0.000008	0.000004
7.CADMIUM	0.000001	0.000001	0.000001	0.000003	0.000001	0.000034	0.000002	0.000001	0.000000
8.IRON	0.000013	0.000022	0.000013	0.000181	0.000012	0.000075	0.000011	0.000018	0.000008
9.CHROMIUM	0.000093	0.000185	0.000035	0.000033	0.000011	0.000015	0.000008	0.000014	0.000004
10.ALUMINUM	0.000329	0.000047	0.000028	0.000383	0.000027	0.000187	0.000026	0.000037	0.000018
11.COPPER	0.000306	0.000025	0.000306	0.000003	0.000004	0.000021	0.000006	0.000005	0.000002
12.NICKEL	0.000001	0.000001	0.000001	0.000002	0.000001	0.000040	0.000003	0.000002	0.000000
13.LEAD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000001	0.000000
14.BOD	0.005592	0.033858	0.007275	0.005764	0.003660	0.001880	0.001879	0.002243	0.001709
15.SUSPENDED SO	1.320832	1.390639	0.862787	1.165666	0.814076	0.737466	0.772081	2.341131	0.754080
16.OIL & GREASE	0.000640	0.000496	0.000430	0.001067	0.000737	0.000755	0.000404	0.000485	0.000375
17.PHENOLS	0.000111	0.000263	0.000047	0.000010	0.000010	0.000004	0.000003	0.000012	0.000003
18.ORGANIC CARE	0.001960	0.000388	0.000149	0.001503	0.000119	0.000094	0.000088	0.000149	0.000076
19.NITROGEN OXI	2.614259	3.338995	2.980310	3.170237	3.300370	2.922677	2.443684	2.534864	2.554550
20.SULFUR OXIDE	0.052540	0.100419	0.060434	0.079805	0.136751	0.054115	0.043577	0.049830	0.082583
21.CARBON MONOX	0.534956	0.261804	0.213632	0.219165	0.218738	0.207724	0.194966	0.199775	0.231544
22.PARTICULATES	0.066764	0.022856	0.009012	0.011815	0.052375	0.015335	0.006672	0.007959	0.011514
23.ALDEHYDES	0.000210	0.000299	0.000191	0.000221	0.000279	0.000157	0.000101	0.000133	0.000386
24.TOTAL HYDROC	0.079365	0.031222	0.039144	0.025412	0.024033	0.022576	0.021638	0.022272	0.024527
25.SOLID WASTE	1.423538	0.666907	0.916729	0.463656	0.428553	1.319516	0.487919	0.431249	0.387676

Table 6 (Cont)

Type II Environmental - Income Multipliers

	19	20	21	22	23	24	25	26	27
1.WASTE WATER	0.188468	0.122054	0.107251	0.134771	0.150117	0.121158	0.126087	0.139043	0.064249
2.NITROGEN	0.000852	0.000793	0.000663	0.000834	0.000854	0.000853	0.001157	0.000810	0.000679
3.SULFIDE	0.000950	0.000613	0.000516	0.000661	0.000771	0.000610	0.000489	0.000710	0.000306
4.FLORIDE	0.000063	0.000041	0.000034	0.000044	0.000051	0.000040	0.000033	0.000047	0.000020
5.PHOSPHATE	0.000263	0.000202	0.000207	0.000199	0.000260	0.000225	0.000195	0.000202	0.000176
6.ZINC	0.000005	0.000004	0.000004	0.000004	0.000005	0.000004	0.000004	0.000004	0.000002
7.CADMIUM	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000001	0.000000
8.IRON	0.000012	0.000008	0.000007	0.000009	0.000010	0.000008	0.000007	0.000010	0.000004
9.CHROMIUM	0.000005	0.000004	0.000004	0.000005	0.000005	0.000004	0.000004	0.000004	0.000002
10.ALUMINUM	0.000027	0.000018	0.000015	0.000019	0.000022	0.000017	0.000015	0.000021	0.000009
11.COPPER	0.000002	0.000003	0.000002	0.000003	0.000002	0.000002	0.000002	0.000004	0.000001
12.NICKEL	0.000000	0.000000	0.000000	0.000001	0.000000	0.000000	0.000001	0.000001	0.000000
13.LEAD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
14.BOD	0.001852	0.001723	0.002021	0.001931	0.001946	0.001931	0.003634	0.001757	0.001339
15.SUSPENDED SO	0.596937	0.712389	0.798240	2.392576	0.774548	0.859534	0.913500	0.762714	0.605940
16.OIL & GREASE	0.000405	0.000380	0.000454	0.000437	0.000430	0.000448	0.001275	0.000385	0.000297
17.PHENOLS	0.000003	0.000003	0.000004	0.000003	0.000004	0.000003	0.000004	0.000003	0.000002
18.ORGANIC CARB	0.000112	0.000079	0.000065	0.000088	0.000092	0.000074	0.000063	0.000097	0.000040
19.NITROGEN OXI	2.746566	42.964494	2.671105	2.891780	2.669446	2.857264	3.471715	4.783370	1.758504
20.SULFUR OXIDE	0.050705	0.647970	0.046030	0.049456	0.045767	0.068298	0.057351	0.083591	0.030191
21.CARBON MONOX	0.221943	1.185416	0.197451	0.211233	0.197689	0.201995	0.217081	0.259111	0.173162
22.PARTICULATES	0.007964	0.039631	0.005568	0.006462	0.005574	0.008325	0.006190	0.008800	0.004131
23.ALDEHYDES	0.000485	0.000696	0.000101	0.000134	0.000101	0.000321	0.000111	0.000196	0.000071
24.TOTAL HYDROC	0.024108	0.083589	0.021691	0.022727	0.021630	0.022369	0.023397	0.025722	0.019932
25.SOLID WASTE	0.384269	0.340259	0.471981	0.381998	0.372131	0.504217	0.334075	0.378126	0.279839

III. EVALUATION OF THE MODEL

This report is the product of a joint effort undertaken by two separate groups in Mississippi and Alabama. Each unit constructed its own input-output model and environmental model. These are the ingredients necessary for the third phase, the linkage between them. Information from both efforts was then combined to produce an evaluation of an economic-ecologic structure of the Mississippi-Alabama Coastal counties.

A reader interested in pursuing the detailed work in both regions can refer to [10,]], and 12] for the Mississippi Coastal Region and [6 and 7] for the Alabama Coastal region. These reports contain information regarding methodologies, sources of data and assumptions made. They also include a variety of proposals for their use.

Many uses of economic-environmental input-output studies have been suggested by other researchers interested in regional analysis. Blaylock and Jones [1] used their study of the Lower Rio Grande Region of Texas to examine the impact of various alternatives for economic growth. They projected the environmental repercussions which would accompany an increase in output equivalent to that which would be necessary to achieve regional self-sufficiency in certain candidate sectors, regional export potential in other sectors, and alternatives of attracting new industries. Loehman and McElroy [4] used their model of Lee County, Florida, to examine the impact of industrial growth and expansion on economic accounts (exports, total output, imports, and gross regional product), social accounts (employment and income), and environmental accounts. They also examined the effects of new residents and suggested applications for their study in community development planning.

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