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SOCIAL/ENVIRONMENTAL SYSTEMS FOR REGIONAL DEVELOPMENT PLANNING

by
Wilbur R. Maki

Department of Agricultural and Applied Economics

University of Minnesota
Institute of Agriculture
St. Paul, Minnesota 55101

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SOCIAL/ENVIRONMENTAL SYSTEMS FOR REGIONAL DEVELOPMENT PLANNING [1]

Wilbur R. Maki
University of Minnesota

In this paper, we focus upon information needs for implementing public programs of resource use and control. Economic models for producing the needed data are presented as activity components of an extensive computer modeling capability. The activity components are building blocks in the construction of a workable system for relating research findings to management and policy questions in regional development.[2]

Resource use conflicts emerge as significant social concerns when a given power cluster is unable to resolve its resource use conflicts internally, which usually means that decisions made within the power cluster have significant external impacts.[3] New organizational arrangements must be developed for resolving the inter-power cluster conflict and, more importantly, for achieving important public purposes.[4]

Major issue areas associated with current efforts to achieve certain public goals are described in terms of (1) balanced national growth, (2) optimal management scale of service delivery systems, and (3) citizen participation in areawide environmental management. In each of the broad issue areas, resource use conflicts are not being resolved; rather, new points of conflict are emerging which require new approaches for relating what we know about public program potentials to what we want in the way of regional development and quality of life.

In the first of three issue areas -- achieving balanced national growth, intervention in regional development processes aims to reduce

regional disparities in employment, income and economic growth.[5] Metropolitan concentration and rural-to-urban migration have become the special concern of current efforts in regional development. Both phenomena are contributing to increasing social costs of private sector production and public sector service delivery.[6] Public control of land use and land values is viewed as one means of restraining, not migration, but its consequences in the rising social costs of rapid outward expansion of the metropolitan community.[7] Other means of public intervention, such as the channeling of public expenditures into intermediate size cities, focus directly upon the factors accounting for the migration to metropolitan areas.[8]

To achieve an optimum scale for managing public services, existing services operated on a municipal or county level are being consolidated on a multi-county level to reduce management costs and improve service delivery.[9] On-site operating costs are balanced with off-site user costs in the determination of an optimal system size for minimizing social costs.[10] In addition, alternative means of improving serviee access for all residents of a service delivery area are being examined in terms of associated costs and benefits.[11]

The third major issue area -- achieving widespread citizen participation and involvement in resolving environmental management conflicts -- calls for a variety of new institutional arrangements for sharing political and economic control on an areawide scale. Popular participation, in this case, is viewed as a fundamentally democratic approach for reducing social inequities in the incidence of costs and benefits associated with national and regional economic growth.

Knowledge needs

Examination of social/environmental issue areas uncovers several deficiencies in current capabilities for conflict resolution in regional economic development and area environmental management. These deficiencies, which are the focus of the model-building efforts discussed in this paper, are approached from a social systems orientation and with the technical capabilities currently deployed in the preparation and application of large-scale computer programming models of regional economic systems.[12/] Hence, specific information-producing capabilities examined relate to procedures and data for:

(1) Identifying (a) participant power clusters in regional economic development and area environmental management and (b) regional and area goals and targets;

(2) Formulating strategies for achieving given goals and targets, including setting of regional and area priorities among program (i.e., goal) areas and projects;

(3) Impact analysis (i.e., measuring social and spatial incidence of benefits and costs) of selected programs and projects; and

(4) Designing optimal information systems that would facilitate conflict resolution among social/environmental issue areas.

Development of the listed information-producing capabilities for dealing with critical knowledge gaps is the major thrust of the research effort in modeling social/environmental systems for regional development planning discussed in this paper. This effort is by no means completed, nor will it be completed in the context of an already established research design. But a research framework for organizing a first-stage of research activities

is completed.[13]

A two-way table is used to illustrate inter-relationships among activity components in a regional systems model for regional development planning (table 1). In the regional model, population change is viewed as the causal factor that triggers a series of subsequent changes in demand, output and employment, and other activity components. Research teams are organized to deal with each of the activity components and inter-relationships between components are represented quantitatively. The total quantitative system of relationships is tested in terms of its predictive capabilities.[14]

Social/Environmental System

The pilot-study subregion is centered on the Fargo-Moorhead metropolitan area and includes seven environmental planning areas in western Minnesota and eastern North Dakota. The seven planning areas in total are somewhat more extensive in geographical coverage than the Red River drainage system encompassed within the Red River basin delineation used in water resource planning. However, the population and economy of the pilot-study subregion correspond closely enough to the Red River Basin population and economy for viewing the two geographical delineations as one in the interpretation and extension of study findings.

The population and economy of the study area in which the regional systems model is being tested limits the variety and scale of activities for analysis and evaluation. The study area is really a subregion of the Upper Midwest which has a high dependence upon agriculture and agriculturally-related processing and service activities.[15] For the total subregion, over 90 percent of export-producing activities are farm-related and much of the employment change, therefore, is related to agricultural change. Because

Table 1. Equation groups in regional system model for development planning and environmental management.

Equation description	Group number	Population 1	Demand 2	Output and employment 3	Earnings and income 4	Capital improvements and financing 5	Facility location 6	Land use 7	Environmental management 8	Public financing 9
Population	1	1.1								
Demand	2	2.1	2.2							
Output and employment	3	3.1	3.2	3.3						
Earnings and income	4	4.1	4.2	4.3	4.4					
Capital improvements and financing	5		5.2		5.4	5.5				
Facility location	6	6.1				6.5	6.6			
Land use	7	7.1		7.3	7.4	7.5	7.6	7.7		
Enrivonmental management	8	8.1		8.3			8.6	8.7	8.8	
Public financing	9	9.1	9.2		9.4		9.6	9.7	9.8	9.9
Public policy	10	10.1	10.2	10.3	10.4	10.5	10.6	10.7	10.8	10.9

of its spatial position -- roughly 200 miles from two larger metropolitan centers -- agriculture is likely to remain its major economic base in the next few decades.

Of particular concern in this paper are the internal linkages of three subregional service systems -- the producer/provider system, the consumer/user system, and the distribution system. These three systems can be, and are being, stimulated by public intervention. They are strongly dependent, however, upon the agriculturally-related activities in the subregion. Both dispersed agricultural activities and concentrated manufacturing activities are identified, therefore, in considerable spatial and sectoral detail in the subregional models.

Internal linkages in a producer/provider system are illustrated by a system of equations prepared by MacMillan to represent a regionalized version of a state economy (table 2).[16/] The 60-equation series has been regrouped according to the activity components cited earlier. Because of the Macmillan's emphasis on public schools, the model includes only six of the 10 activity components. Locational relationships in both the private and public sectors, for example, are omitted. Nonetheless, the equation series illustrates the specific elements of an activity component.

For each equation in the Macmillan model, the explanatory variables are current values of other dependent variables, lagged values of the dependent (or other dependent variables), or exogeneous variables (fig. 1). Thus, the equations are solved recursively, with the dependent variable of the first equation being an explanatory variable of the second equation, and so on. The schematic diagram of the causal ordering of the variables thus illustrates the recursive nature of the equation system.[17/]

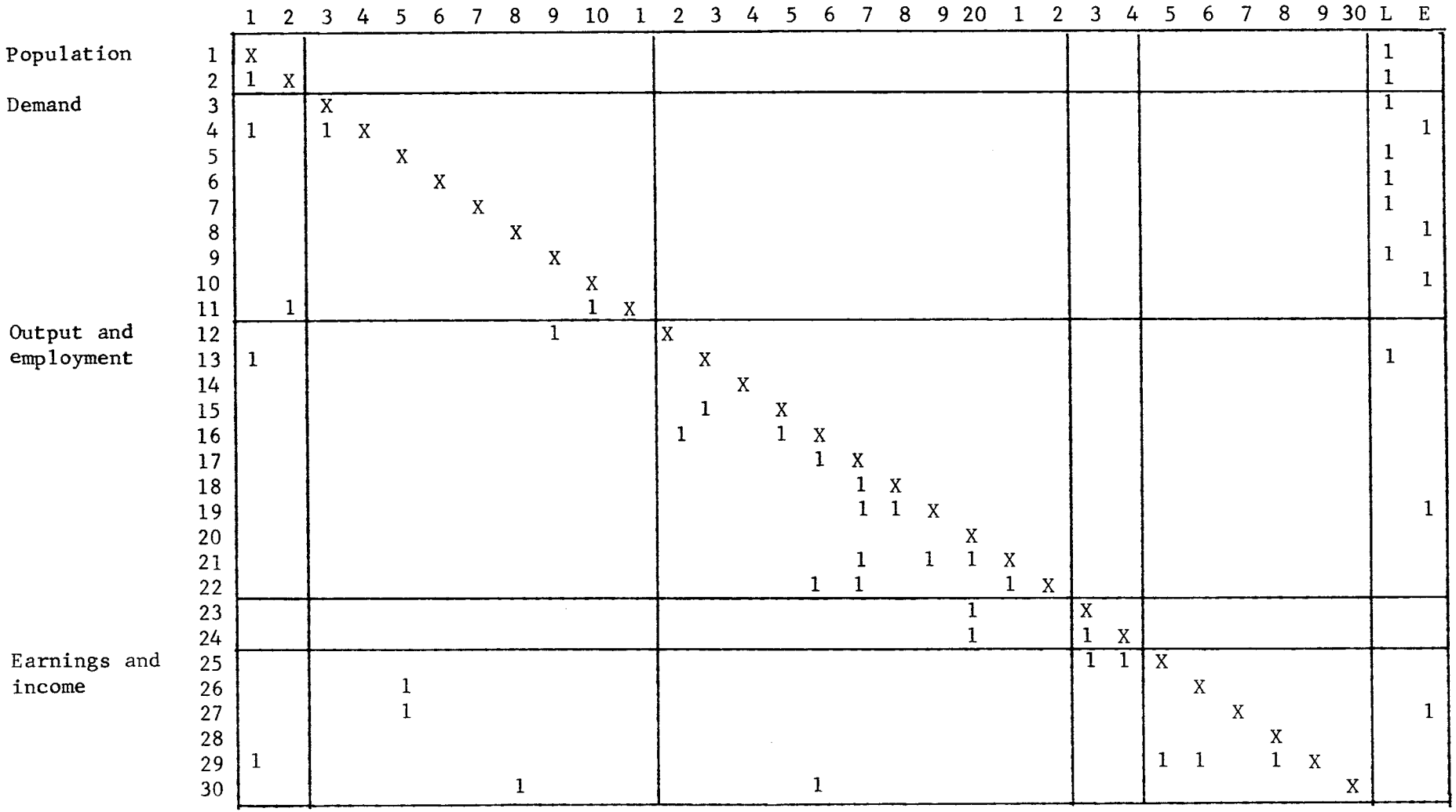
Table 2. Selected equations and variables in a regional system model (from J.A. MacMillan, 1968).

Group	Equation No. Current	Equation No. Initial	Symbol Current	Symbol Initial	Description of variables: Dependent	Description of variables: Explanatory
Population	1	15	P		Total population, region	Lagged
	2	59	PA		Total population, area	Lagged
Demand	3	1	H^1		Household purchases, per capita	Lagged
	4	2	H		Household purchases, total	P, H^1
	5	3	GE		Local and state government purchases	Growth rate, Lagged, T^S
	6	4	iGE		Upper limit	Lagged, T^S
	7	5	FGE		Federal government purchases	Lagged, T^F
	8	6	I		Business capital expenditure	X^R
	9	8	Z		Final demands, region	H,GE,FGE,I, exports
	10	51	HA^1		Household purchases, per capita	Lagged
	11	52	HA		Household purchases, total	PA, HA^1
Output and employment	12	9	X^D		Output demanded, region	Z
	13	12	L		Labor force, region	P
	14	13	L_L		Upper and lower limits	Lagged, L
	15	10	X^L		Output maximum, region	L
	16	11	X^R		Output realized, region	Min (X^L, X^D)
	17	14	L^E		Equilibrium employment, region	X^R
	18	28	L^W		Wage and salary employment, region	L^E
	19	29	L^P		Proprietorial employment, region	L^E, L^W
	20	38	LA		Labor force, area	PA
	21	36	XA^R		Realized output, area	X^R, LA
	22	37	LA^E		Equilibrium employment, area	XA^R, L^E
	23	39	LA^W		Wage and salary employment, area	LA^E, L^W
	24	40	LA^P		Proprietorial employment, area	LA^E, LA^W
Earnings and income	25	27	Y^B		Participation income, region	L^W, L^P
	26	30	G^W		Wage rate, government	GE
	27	31	L^G		Employment, government	GE
	28	32	Y^R		Non-labor income, region	Growth rate

Table 2. (Continued)

Group	Equation No.		Symbol		Description of variables	
	Current	Initial	Current	Initial	Dependent	Explanatory
	29	32a	Y^P		Personal income, region	$G; ^W Y^B_i Y^R$
	30	35	N		Value added, region	$I; ^R$
	31	34	X^G		Gross regional product	$V; G^W$
	32	41	YA^B		Participation income, area	$LA^W LA^P$
	33	43	LA^G		Government employment, area	Lagged, TS, TA^P, PA
	34	42	GA^W		Wage rate, government	L^G, LA^G, G^W
	35	44	YA^R		Non-labor income, area	Growth rate; PA
	36	45	YA^P		Personal income, per capita	YA^R, YA^B; PA
	37	47	YA^M		Median income, area	YA^P
	38	46	YKA		Cumulative income, area	YA^M
	39	58	$VA_$		Value added, area	V, L^E, LA^E, W
	40	57	XA^G		Gross area product	VA, GA^W
Capital Improv.	41	7	K^D		Private assets, region	Exogeneous
Public financing	42	16	G^I		Indirect taxes, region	I, X^R
	43	17	T^P		Property taxes, region	Growth rate
	44	18	G_1^F		Federal indirect tax collections	G^I, T^P
	45	19	G_2^F		Federal personal income taxes	Y^P
	46	20	G_3^F		Federal corporation income taxes	V
	47	21	T^F		Total dederal government revenue	G_1^F, G_2^F, G_3^F
	48	22	G_1^S		State sales tax	H
	49	23	G_2^S		State personal income tax	Y^P
	50	24	G_3^S		State corporation income tax	V
	51	25	G_4^S		State federal aid	Y^P
	52	26	T^S		Total state government revenue	G_1^S G_2^S G_3^S G_4^S G^I
	53	33	Y^D		Disposable income per capita	G^W, Y^B, Y^R, G^S, G^F
	54	52	TA^{P*}		Assessed valuation of real estate, area	Exogenous, HA; VA
	55	53	TA^P		Property tax, area	TA^{P*}
	56	55	EA		Local government expenditures, area	TA^P
	57	56	$GEA_$		LG expenditures, by function	EA
	58	48	TYA^F		Federal income tax, per capita, area	YKA
	59	49	TYA^S		State income tax, per capita, area	YKA
	60	50	YA^D		Disposable income, per capita, area	YA^P, TYA^F, TYA^S

Fig. 1. Causal ordering of variables in a regional system model (from J.A. MacMillan, 1968), Equations 1-30.



Producer/provider system

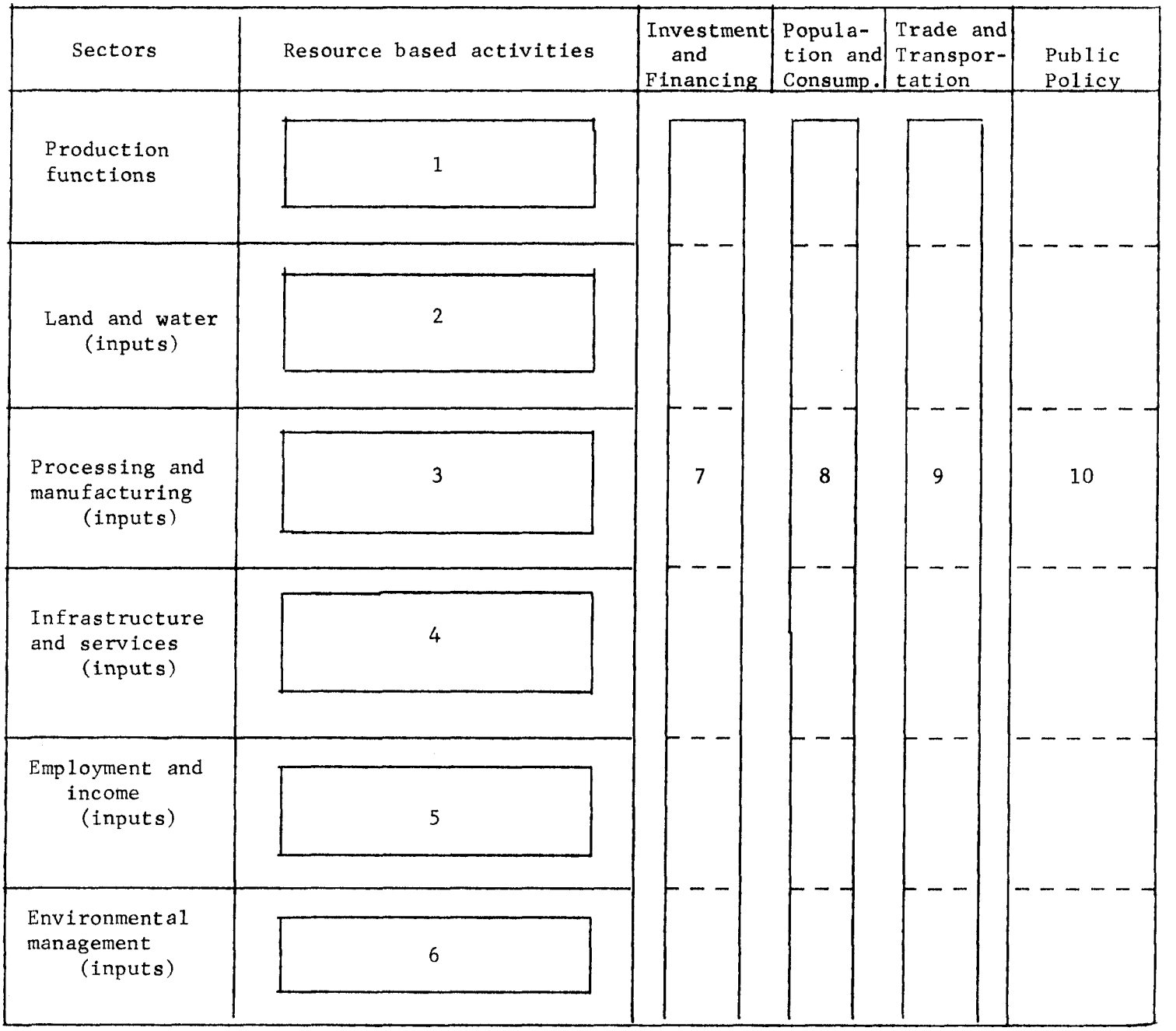
The producer/provider system, in total, includes the agricultural and other export-producing activities and all the residentiary activities which are dependent upon the export-producing activities. Estimation of the individual elements in the producer/provider model of the development subregion is being handled in two stages.

In the first stage of model construction, an input-output submodel provides a framework for estimation of all relationships within the producer/provider model.[18] Available input-output studies, including a Minnesota-North Dakota input-output model based on secondary data and national input-output coefficients, are being consulted in the preparation of first-stage estimates.[19] Base-year estimates from the input-output submodel are being evaluated in the light of reported subregional levels of outputs and earnings.

The second-stage estimation procedures were approached, initially, in the context of an expanded input-output framework (fig. 2). Ten research areas were identified, which represented logical extensions of a primarily resource-oriented approach to regional development planning. However, because of the conceptual and operational limitations of the input-output framework, the prescribed approach unnecessarily fragments a total research effort. The individual researcher becomes, essentially, a data collector for the input-output technicians.

A regional research design was outlined earlier in terms of activity components which are inter-related in such a way that a change in one component results in successive changes in other components. The activity components are inter-related in a special way that becomes clear when the individual relationships are specified. First, however, the 10 research

Figure 2. Research areas in first-stage research design for Fargo-Moorhead development subregion pilot-study.



areas and the 10 activity components are described in terms of three broad groups of producer/provider submodels, the first of which is the input-output submodel.

Input-output submodel. In the revised research design, the input-output table represents only a skeletal segment of the total regional system, and even then, the representation is quite partial for development planning purposes. To the extent that the preparation of a subregional input-output table depends upon low-cost access to an existing regional or national input-output study, the industry classificatiom must conform with prevailing standards. In this study, the 1963 U.S. input-output table and the employment projection series to year 2020, which were prepared by the Office of Business Economics, U.S. Department of Commerce, provide the criteria for delineating a 40-sector input-output submodel.[20/] A computer program for a two-region version of the 1963 80-sector U.S. input-output model is being modified to include additional detail in the agricultural sectors of the two-states economy of which the development subregion is a part.[21/] Subsequently, the 40-sector subregional input-output submodel will be prepared. Initially, a 13-sector input-output model is being used as prototype for developing the computer modeling capabilities that will relate directly to the data and information needs in regional development planning.

Inputs and outputs in the 40-sector submodel are linked to income, employment and population estimates generated by other submodels. Output per worker estimates in the base year, 1963, are extended to 1967 -- a secondary base year -- and 1980, which is the year of the first projection series derived with the subregional models. Thus, the input-output submodel encompasses, essentially, activity component (AC) 3 in table 1, and

research areas (RA)1 and 5 (part) in figure 2.

Resource access submodels. The next five submodels listed earlier are grouped together because of their close association with the input side of the input-output submodel. Each of the five submodels focuses upon the flow of production inputs from resource owners to the producer/provider system and the flow of income payments from the producer/provider system to resource owners.

The land allocation submodel (AC7 or RA2), when finally completed, will provide for two patterns of land allocation -- a rural and an urban. In the pilot-study, only the rural (i.e., non-urbanized and primarily agricultural and open space) land will be differentiated according to spatial position, soil and vegetation attributes, and present and projected uses.[22/]

Important data sources for the land allocation submodel are (1) the recently completed Minnesota Department of Natural Resources land use inventory, which shows current land use, by 40-acre unit, and (2) the University of Minnesota area land type survey, which delineates key surficial and subsoil characteristics of land for urban and rural development.[23/] Thus, the submodel provides a framework for relating existing land use inventories to projected future land use patterns associated with projected future product output levels for the pilot-study subregion.

In the private investment and financing (AC5, or RA3 and RA7) submodel, individual establishments are geocoded and grouped into four-digit industry classifications for analytical purposes.[24/] Because standard disclosure rules must be followed, a higher level of aggregation is necessary than in the analysis of expansion potentials for processing and manufacturing activities in the pilot-study subregion.

Of primary importance in the private investment and financing submodel is the specification and estimation of capital, labor and entrepreneurial inputs into primarily export-producing activities. This submodel, therefore, is closely linked to other resource access submodels and to the private investment and financing submodel.

The public facilities location (CA6, or RA4) submodel relates primarily to the location of public facilities in an urban-centered agriculturally-dominant subregion.[25/] Hence, linkages between the transportation-communication networks and the size and spacing of area facilities are important considerations in accounting for emerging patterns of rural land use and its conversion into urban-industrial uses in the periphery of urban centers.

Public facility location is a key policy instrument in the subregionalization of state and federal service delivery systems. Federal-state cooperation is envisioned in the channeling of public facility expenditures to a limited number of local, area and subregional service centers. However, such cooperation will require a convincing case for public inter-agency collusion in the preparation and implementation of area infrastructure budgets. The area budgeting process would implement the future development role of many of the urban places in the subregion.

In addition, public facility location influences the spatial distribution of private sector services, particularly medical and other professional services. Thus, the level and range of service inputs flowing into the input-output submodel will depend upon the data and procedures of the infrastructure and services submodel.

The earnings and income (CA4, or RA5, part) submodel translates output levels into corresponding levels of labor earnings and other income pay-

ments.[26] This submodel, in the economist's view, is demand, rather than supply, oriented. Employment depends upon output and, indeed, it is derived from output by using output-employment relationships. And, the level of total income payments depends upon the level of employment in each sector. Thus, market-based input-output projections of future output levels determine the corresponding future levels of earnings and income.

A population (AC1) submodel for generating area population distributions, by age and sex, is being used in projecting future employment levels that are influenced also by population supply (as well as labor demand) considerations.[27] Inter-area migration within the subregion and the Upper Midwest region are influenced by relative employment, income and consumption prospects. Hence, demand-based output projections are constrained by consumer considerations outside the conceptual and factual domain of the subregional input-output submodel.

The environmental management (AC8, or RA6) submodel deals largely with environmental services inputs for other resource access submodels. Data on residuals recycling and disposal are processed by this submodel, which, also, will include geocoded public facility input-output coefficients and constraints.

Communities grouped into several subareas in one of the three Minnesota environmental planning areas in the subregion are being contacted and survey data are being collected for use in the modeling of the environmental management subsystems.[28] Currently, the subarea and area study focus is on the financing of water resource development. One facet of the current study calls for the preparation of an environmental management game which involves role-playing in the mobilization of community resources for organizing and financing water pollution abatement projects. Later, the water pollution abatement activities will be linked with the industry location activities

of a prototype subregional development organization. Thus, the gaming approach will bring together elements of the two submodels for assessing the environmental impacts of projected processing and manufacturing activities in the subregion.

Service delivery submodels. The remaining submodels listed earlier are primarily demand-oriented. They are concerned with service delivery linkages within the producer/provider system.

In contrast with the resource access submodels, the service delivery submodels are influenced greatly by national considerations rather than local considerations. Hence, the explanatory variables accounting for subregional shifts in levels of investment, population, trade and public policy are dominantly exogeneous to the pilot-study subregion.

The private investment and financing (AC5, or RA7) submodel cited earlier includes the capital and institutional accounts of the subregional economy. Flow of funds data provide an indication of the net savings position of the subregion.[29/] Private capital formation is the demand-oriented component of the submodel. Private financing institutions establish investment constraints on the supply side. In subsequent years the current year's private capital formation will produce capital services for the agricultural, processing, manufacturing and other sectors of the subregional economy.

Other demand-oriented components of the producer-provider system are represented by the population and consumption (AC1 and CA2, or RA8) submodel. Projected subregional household consumption depends upon projected population, earnings per worker, and persons supported per worker. Hence, the population-consumption submodel is linked to the employment-income submodel through earnings and labor force participation ratios.

A subregional household expenditure function is derived as a means

of allocating a portion of total subregional income to given producing sectors in the form of household expenditures for a specified mix of consumer goods and services. Thus, an additional series of consumption accounts are introduced into the producer/provider model through the population-income submodel.

In addition, trade and transportation activities (RA9) link the input-output submodel to export markets. Transportation services are provided to move subregional products to demand centers outside the subregion. Thus, the demand-oriented trade-transportation activities are linked directly to the supply-oriented public facility location submodel.

Finally, a public program (AC10, or RA10) submodel introduces current and projected public policy considerations into the overall producer/provider model. The public program impacts originate largely from outside the region; they, too, relate to demand-oriented dimensions of the subregional model.

Linkage and feedback. Linkages among the 10 submodels are illustrated in figure 3, (following tables 1 and 2). Each of the 10 submodels is a building block in the construction of the subregional producer-provider model. Feedback from one stage to the preceeding stage is obtained by use of iterative procedures that correspond to management and policy guides for directing the producer/provider system toward predetermined goals and targets.

The extended system of equations represented by the 10 submodels is described in table 3. The equation system is based on a producer/provider-directed economy that is guided by wage and price incentives rather than quality of life considerations in their fullest sense.

Consumer/user system

Consumer/user system submodels include the behavorial relations accounting for changing consumer and user responses to the outputs of the

Figure 3. Causal ordering of variables in regional systems model (following J.A. Macmillan).

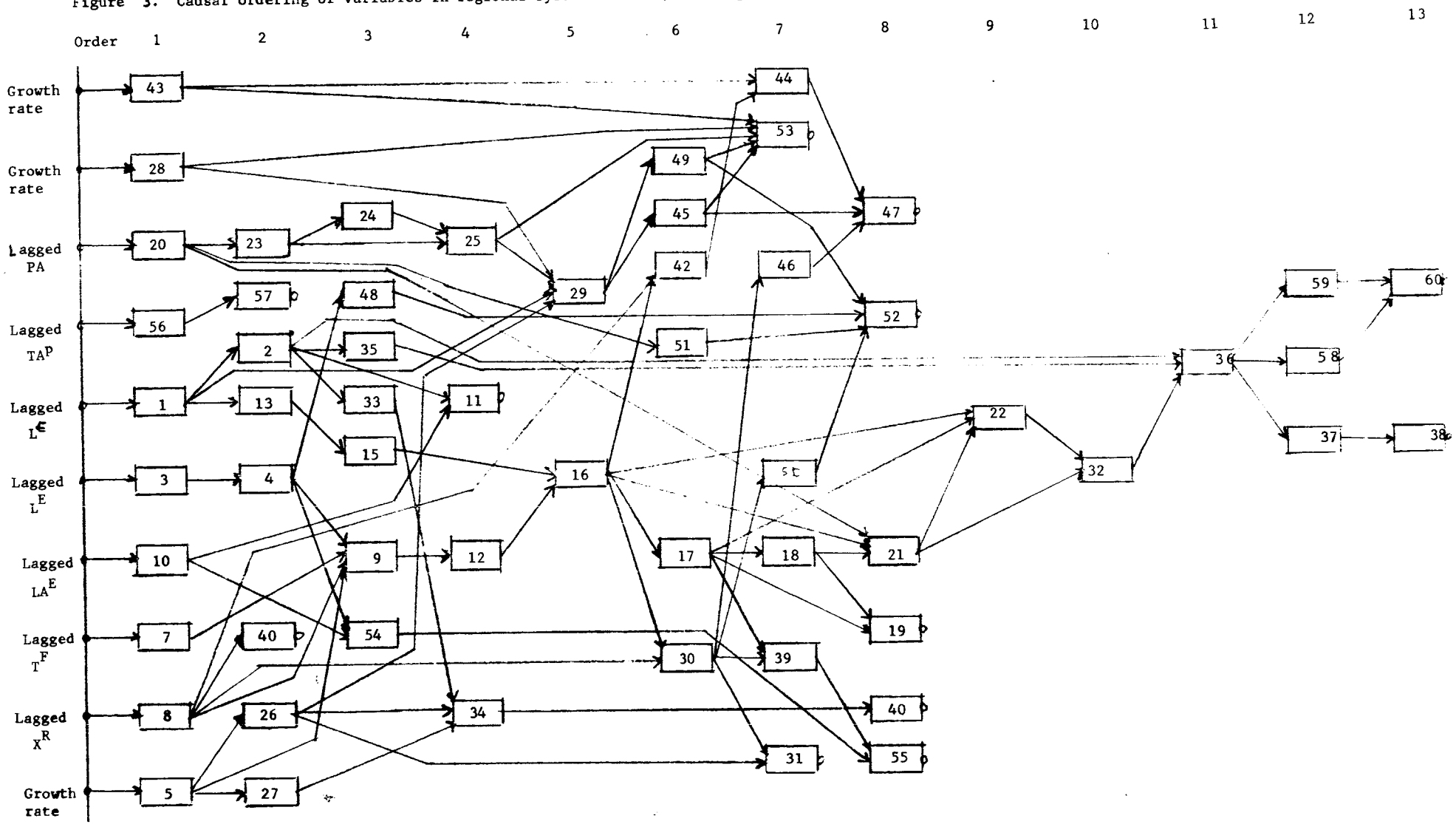


Table 3. Relation of social/environmental systems submodels and regional development planning to regional systems design.[1/]

Social/environmental systems submodels	Regional Development Planning							
	Export Base Expansion			Social/environmental Services Delivery				
	Agricultural and industrial production	Energy production	Public entrepreneurship	Residuals recycling and disposal	Public facility location	Capital budgeting	Land control	Social priority setting
A. Producer/provider system								
1. Input-output submodel	DR	DR	DR					
2. Resource access submodels	DR	DR	DR					
3. Service delivery submodels	DR	DR	DR					
4. Linkage and feedback	DR	DR	DR	EA	EA	EA	EA	FC
B. Consumer/user system								
1. Input-output submodel				EA	EA	EA	EA	
2. Service access submodels				EA	EA	EA	EA	
3. Outcome delivery submodel				EA	EA	EA	EA	
4. Linkage and feedback	DR	DR	DR	EA	EA	EA	EA	FC
C. Distribution system								
1. Economic control	DR	DR	DR					F/S/L
2. Political control				EA	EA	EA	EA	F/S/L

1/ Individual cell entries refer to: Development region, DR; environmental area, EA; functional community, FC; federal, state and/or local, F/S/L.

producer/provider system. Involved in the transformation of producer outputs for consumer use is the end-in-view of the consumption process -- measurable outcomes that add up to improvements in the quality of life attainable by all residents in the pilot-study development subregion. Hence, a third-stage consumer "input-output" submodel is envisioned in the research design that relates a "service access" submodel to an "outcome delivery" submodel.

Logistics of moving goods and services to the consumer/user in the producer/provider system are covered in the discussion of service delivery submodels. Service access submodels are the consumer/user system counterparts of the service delivery submodels. Hence, the two systems and the two series of submodels parallel each other in their function and performance. But the consumer/user orientation of the service access submodels emphasizes consumer goals and behavior and consumer strategies for optimizing service access subsystems performance. 30/

Finally, achievement of a quality environment and an improved quality of life depends upon individual and institutional capabilities for assessing the appropriate mix of services to attain preferred quality-of-life targets. Outcome delivery submodels therefore must include consideration of priority-setting procedures and facilitative institutional arrangements for broad and effective citizen involvement and participation in regional development planning.

A model for community resource mobilization to support citizen efforts in developing alternative financing arrangements for water pollution abatement is being developed in one of the six environmental planning areas in the pilot-study subregion.31/ A citizen task force for the area is envisioned which has representation from groupings of municipalities that make up functional

(subarea) communities. The functional communities thus become the primary social units for achieving popular participation in area resource management and planning.[32]

Distribution system

A third major component of subregional social-environment systems is the distribution system. This system determines the incidence of benefits and costs of subregional growth and development.

Presently, subregional institutions, primarily local governments, are engaged in limited income re-distribution. Only to the extent that public and quasi-public institutions localized in the metropolitan core area of the development subregion share in the distributive functions performed by local and national governments, and engage in concerted efforts to channel public capital outlays to the core area, or, alternatively, to local service centers within the development subregion, can we identify a truly subregional distribution system. Such a system would have components that relate to (1) economic control and (2) political control.

First, economic control is asserted on a subregional scale through river basin planning.[33] Within the study subregion, federal and state funds are being used for comprehensive river basin planning, which supports future funding of new irrigation and flood control projects. If, however, the river basin agency were authorized to undertake a comprehensive environmental management function, including urban-industrial development and water pollution abatement, elements of an enlarged subregional distribution system would exist to provide an institutional framework for resource re-allocation within the subregion.[34] But the total resource management budget for this system still would be determined outside the subregion, either at the national or the regional level of fiscal management. Hence, an intermediate

level of economic control is envisioned in a decentralized system of regional resource management. The subregional distribution system would become part of a regional resource management function which would be implemented on a subregional scale through multi-purpose river basin planning organizations.

Further, if a system of multi-state development regions were established, economic control would be asserted through a regional capital budgeting process, which would establish overall resource development targets. Because the regional development organization would be engaged primarily in financing export-base expansion, projections of subregional development potentials for the exporting-producing activities would be needed. Future capital expenditures for related infrastructure and social services would be anticipated as a necessary condition for subregional development.[35/]

Second, broad citizen participation in setting program and project priorities will involve extensive sharing of political power within the large development region. Decentralization of federal control in financing regional economic development, for example, involves a shift in certain fiscal management responsibilities from a national to a regional level of decision making. Decentralization of state control in providing environmental services also involves shifts in certain capital budgeting responsibilities from a state to an area level of decision making.

A division of responsibility is envisioned within the subregional distribution systems. Implementation of a regional growth policy would require a national approach to achieve a redistribution of the regional and subregional impacts of national economic growth. Implementation of an area environmental policy would require a state or inter-state approach

to achieve a redistribution of area and subarea impacts of state environmental controls. Local coordination of the two approaches would be achieved at the area level.

Trial-and-error approaches to inter-governmental cooperation are implied in modeling the subregional component of a regional distribution system. Of considerable significance in the modeling, however, is the incorporation of institutional learning functions, which relate economic and political inputs to certain social outcomes. Not simply time, but, also, real effort, measured in terms of certain social opportunity costs, are involved in the achievement of a functional subregional component in a cooperative federal-state approach to fiscal re-allocation and income redistribution.

Regional Development Planning

Regional development planning is widely discussed but seldom practiced. In the Upper Midwest, the Minneapolis Federal Reserve District is involved in research that provides some information for community development and the Upper Midwest Research Council sponsors an occassional conference or research study on regional problems. The land-grant universities, also, are geared to provide limited understanding and foresight on a multi-state regional scale of public resource management.

Yet, a variety of institutions are moving toward cooperative, intergovernmental approaches to economic and environmental planning that provide some justification for modeling a regional development system in which a higher degree of foresight is exercised than is the case, presently. Such a regional system is outlined in terms of three related activities -- export base expansion, social/environmental services delivery, and social priority setting.

Export base expansion

At the subregional level, export-base expansion is primarily demand generated. Agricultural and industrial development, energy use and production, and public enterprise development, which are three important program areas for achieving export-base expansion, are triggered by new markets for primary products and manufactured goods.

Each of the three program areas are restricted on the supply side. Hence, at least one of the program areas -- public enterprise development -- is viewed as a supply-generating form of public intervention in regional development processes.

Agricultural and industrial development. Subregional impacts of agricultural and industrial development forces operating at the development region level are simulated by means of a multi-state input-output model. This model includes the Upper Midwest Region as one of the two regions of the United States. Hence, national growth targets for each sector of the subregional economy are obtained first.

Base-year and target-year national outputs to the two regions on the basis of given levels of regional output demand and supply.[35/] Thus, both market demand and resource supply considerations are introduced into the two-region programming procedures on a regional scale of research and analysis.

Finally, a subregional input-output model is implemented using the two-region programming procedures. In the subregional case, the rest-of-nation component includes the rest-of-region component.

Use of the two-region programming procedures in deriving industry outputs for each subregion of the Upper Midwest Region eventually exhausts the total regional industry outputs, but the total net

subregional exports exceed the total net regional exports. Additional programming procedures must be introduced to account for the net trade between a given subregion and the rest-of-region.

Export-producing industries for the Upper Midwest are identified and the market demand and resource supply outlook for these industries is evaluated in the first-stage programming procedures. The same industries are identified and the corresponding demand and supply outlook is evaluated for each subregion in the second-stage programming procedures. Differences between the regional totals and the subregional totals accumulated on a regional scale again are attributed to trade between a given subregion and the rest-of-region.

Regional demand projections are derived from the first-stage research design. National employment, income and population projections are allocated tentatively to the two regions on the basis of a national shift-share model.[37/] The regional-share effect for each industry is linked to appropriate national policy assumptions pertaining to the regional distribution of national economic growth.[38/] The tentative employment population and income projections are revised after completion of the first-round regional input-output projections.

At the regional level, a second-stage research design is implemented in which the regional economic growth is distributed among subregions on the basis of the projected subregional share effects for each industry. These effects are correlated directly with regional policy assumptions. Again, the tentative subregional shift-share employment, income and population projections are revised after completion of the first-round subregional input-output projections.

Energy use and production. Another social/environmental issue area cited earlier is energy use and production. Energy requirements of projected output, population and income levels are based on energy demand studies.[39] Eventually, the energy requirements are associated with given sets of assumptions about national environmental standards and use of pollution-reducing technologies and consumption-reducing pricing practices.[40]

Subregional energy production depends only partly upon subregional energy requirements. Because of new energy transfer systems, the location of energy production is a variable subject to environmental management constraints asserted at a subregional and area level of development planning. Hence, the energy use and production subsystem in regional development planning must interact with the environmental management submodel in regional conflict resolution and the environmental impacts of energy production must be specified for an entire planning area as well as particular points within the area.

Public enterprise development. To achieve regional targets in a national program of balanced urban-regional growth, public entrepreneurship, including the provision of technical skills and financial support, becomes a critical development input for export-producing industries in the private sector.[41] Private capital formation in the subregional producer/provider system, especially among small businesses, depends upon the relaxation of supply constraints on output expansion. Thus, given levels of public entrepreneurship, represented by an appropriate mix of technical know-how, capital improvements and manpower skills for each level, are associated with certain levels of regional development and growth resulting from the expansion of small businesses enterprise. Thus, changes in public entrepreneurship inputs

would be associated with corresponding changes in levels of regional production and employment.

Regional systems modeling capabilities are severely limited with reference to the inclusion of public enterprise inputs in the sub-regional producer/provider system. Such inputs would be included, most likely, in the private investment and financing, output and employment, earnings and income, public facility location, and public expenditures and financing submodels.

Social/environmental services delivery

Unlike export-base expansion, public service delivery is primarily an area management function in regional development planning. For purposes of social/environmental systems design, the area management function deals with (1) residuals recycling and disposal, (2) public facility location, (3) capital budgeting, and (4) land control.

Each of the four management concerns relate to the decentralization of state government activities and, thus, the improvement of consumer/user access to essential public services. Effective resolution of these management concerns is likely to require the existence of some form of multi-county councils of government for coordinating the public management activities on an areawide basis.[42/]

Residuals recycling and disposal. Area environmental management is almost synonymous with water pollution abatement, which comes under the rubric of residuals recycling and disposal. In the development subregion, residuals management is a powerful policy tool for guiding land use and population distribution on a subregional scale.[43/]

Several units of local government in the pilot-study subregion are

involved in the residuals management process. One group of townships and municipalities organized an extended municipal sewer district covering four townships and all or parts of several lakes and small watersheds. Because of the objections of local residents to a field irrigation system for sewage recycling, the proposed plan is in limbo.

Another community, however, acquired broad community support and technical assistance. A watershed district was organized, which included the sources of pollution and the pollution impact areas. Because of effective involvement of typical third-party interests, the community effort has been successfull.

A third form of organization is represented by a multi-county environmental management agency that may or may not function as an arm of an area council of government. Alternatively, the management agency may or may not function in behalf of an association of local sewer districts. Whatever the organizational form, the territorial jurisdiction of the agency includes several watersheds and municipalities.

Simulation-gaming models of alternative organizational structures and their particular operating practices are being developed as one means of coping with the uncertainties of organizing areawide residuals management systems. Institutional, professional and personal obstacles to community and areawide efforts are discovered by observation of the role-playing activities of the game participants. Limits to the use of simulation modeling approaches are illustrated, incidentally, in the game exercises.

Public facility location. Location of sewage treatment plants, garbage dumps and other facilities for residuals recycling and disposal are largely public facilities. Most public facilities are "noxious" facilities.[44/]

Earlier, public facility location was related to the infrastructure

and services submodel in the producer/provider system. Because of the interdependence of land-use and transportation, and transportation and urban growth, both the spatial allocation and the trade and transportation submodels are needed, also.

Capital budgeting. The capital investment decision is closely related to the location decision. Hence, areawide capital budgeting decisions are linked, potentially, to federal and state facility location decisions. A capability for areawide coordination, not only of local government, but, also, of federal and state government, capital improvement programs is essential for effective area resource management.

To achieve areawide coordination of local, state and federal capital improvement programs, the area council of government (or area planning and development council) must review all capital budgets at a given time for ranking program areas. Thus, the priority-ranking for each special-purpose agency establishes a budget control. To the extent that all capital improvement programs are reviewed by the area council of government, an effective areawide capital budgeting function is asserted.

The areawide capital budgeting process is a generalist function when contrasted with the cost-benefit analysis associated with the priority ranking of individual projects under a given program area. Thus, data obtained from the producer/provider submodels is more complete for the generalist in areawide capital budgeting than the technician in the special-purpose district. In both cases, however, additional data is needed from the consumer/user category of submodels to establish appropriate community and area objectives for cost-benefit studies and social cost analyses.

Land control. Area environmental management is concerned, also, about land control. But land control is a municipal, township or county govern-

function when exercised in the form of zoning or subdivision control. Differential taxation of agricultural lands, or taxation of development gains, is typically a state government function. Outright fee simple purchase of private lands by any governmental or quasi-governmental agency may or may not require prior exercise of the right of eminent domain. Or alternatively, a limited property right, through an easement purchase or a leaseback arrangement, may be acquired by a local or state government agency. Thus, a wide array of policy instruments for limited land control are available, but not necessarily for an areawide resource management agency.[45]

Development of an effective land control function on an areawide scale involves a re-allocation of certain powers now residing with local and state governments. In terms of systems modeling, transfer of power to an area management agency would require the use of distributive submodels cited earlier and, also, producer/provider submodels, such as the one for land allocation.

Social priority setting

Of the three "cutting edges" of regional development, social priority setting may be the sharpest, but not the most frequently used. Social priority setting presents, indeed, a deeply troublesome dilemma for regional development planning. To what extent and for whom is the loss in local autonomy, if any, compensated by the gains in economy and access as a result of larger management systems for producing and providing essential social-environmental services?

The technical modeling capabilities outlined earlier provide only partial answers to the fundamental dilemma. We are trying to establish

the data base and the criteria for determining the economies of scale in social/environmental service delivery. But we lack the non-economic criteria for determining the non-economic or non-monetized costs of larger service delivery systems.

Even more serious is our inability to establish priorities between program areas, e.g., roads vs. schools. Disagreement over goals and values, however, becomes confused with data problems and communication difficulties. Not only more information but better communication is sought. More sophisticated information and communication systems are being developed, while we continue to disagree even more strongly than before because of fundamental conflicts, implicitly if not explicitly, in goals and values. In this paper, therefore, social priority setting is viewed as a three-fold task: First, identifying and delineating broad goal areas sought by citizens of a region; second, relating the goal areas to program areas which are ranked in terms of their perceived or expected contribution to their respective goal areas and, thus, to the quality of life in the region; and, third, seeking program area agreement on specific projects that best meet given program area objectives.

Regional Systems Design

Given currently insurmountable difficulties in resolving conflicts in social priority setting, we might agree that the art of "muddling through" and the science of "fragmented incrementalism" really aren't so bad after all when we consider the alternative. But is the alternative a refined social calculus that would require a small elitist group to maximize a certain "social welfare" function; or, is the alternative more like the invention of alternatives?

To invent alternative futures we need the sorts of technical capabilities and social sensitivities outlined earlier, which now are summarized in matrix form (table 4). In effect, we now impose a certain set of constraints in the modeling of social/environmental systems by relating each submodel to the tasks and tools of regional development planning.

The broad set of constraints imposed upon the social/environmental systems modeling implies a territorial organization for functional regionalism. The functional "region" will vary in size depending upon the particular function. For example, the export-base expansion is handled optimally by a multi-state, metropolitan-focused development region. The social/environmental services delivery function is handled optimally by a sub-state, multi-county environmental planning area. The social priority-setting function is handled optimally by the extended metropolitan neighborhood or the multi-nucleated rural functional community. The interaction of economic and political functionalism results in a particular regional systems design that is hierarchical in its economic structure but with a broad political base in the functional community.

Development region

Export-base expansion is optimally a function of the multi-state development region, like the Upper Midwest (fig. 4). Intermediate-size metropolitan centers are the subregional growth poles for strategies of focused decentralization of industry and population. Potential growth in the regional core area, i.e., the seven-county Twin Cities Metropolitan area, would be diverted to the smaller metropolitan centers, namely,

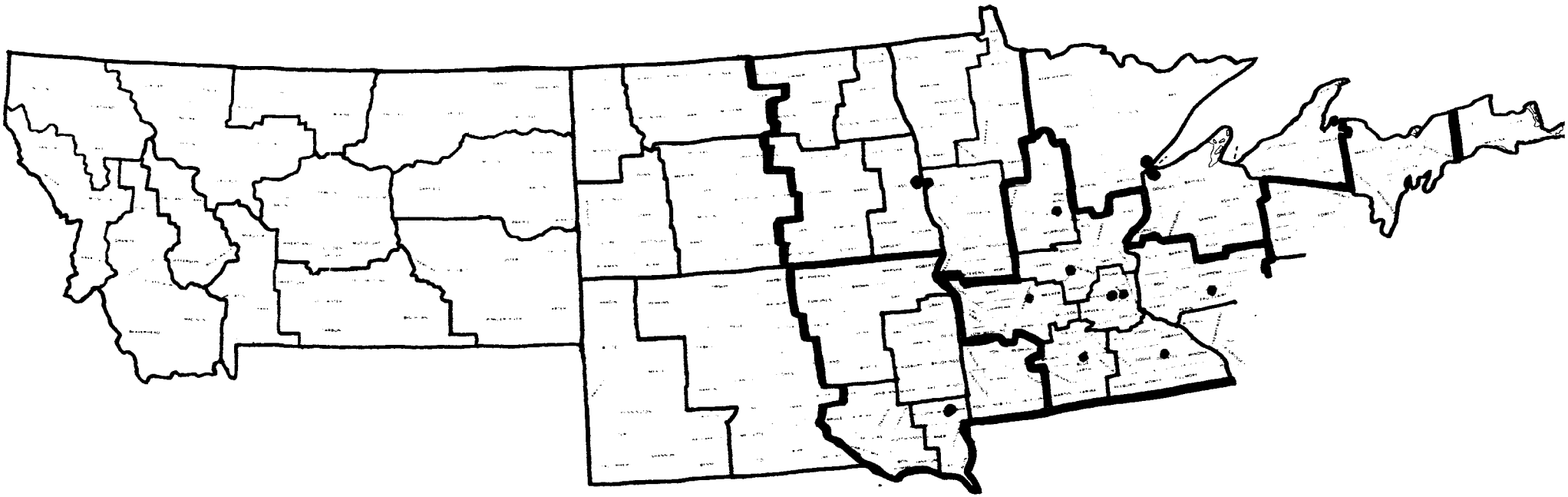


Fig. 6. Economic development subregions and state planning areas in Upper Midwest Region (Ninth Federal Reserve District).

Fargo-Moorhead, Duluth-Superior, Sioux Falls and Green Bay. These centers are approaching a minimum viable size for self-sustaining urban-industrial growth.

In addition, an intermediate zone of urban-industrial expansion is represented by the first ring of free-standing satellite cities located roughly 70 to 100 miles from the regional center. Each satellite city serves as a service center for a commuting area of roughly 50 miles radius. Thus, an extended regional core area, which includes the first ring of satellite cities, makes up the Minneapolis-St. Paul development subregion.

Producer-provider systems are being delineated and projected for the region and for each of the five metropolitan-centered subregions and the outlying territory outside the subregions.[46] Social/environmental issues pertaining to the achievement of balanced national growth are the problem focus of the regional and subregional models and analysis.

Environmental area

Each development subregion includes several environmental planning areas (as illustrated earlier in fig. 3). The planning areas are commuter "sheds" for the urban activities work force. Administratively, each area looks to its state government for some resources, e.g., police and taxing powers, and to the federal government for other resources, e.g., development grants. Each planning area is linked, also, to the development subregion and, thus, to the export-base functions of the development region.

For many public services, the environmental planning area is of optimal size for economy and diversity of choice and at the same time it remains accessible to a substantial majority of area residents. Because of the emphasis upon service delivery, however, the consumer/user orientation

becomes dominant in the provision of services, provided that appropriate arrangements have been made for broad citizen participation and involvement in the system management.

Optimizing management scale of service delivery systems is dominantly an environmental planning area concern, but it relates, also, to area potentials for export-base expansion. Under an alternative regional future of focused decentralization (as compared with metropolitan concentration) of population and industry, economic expansion potentials in the subregional growth nodes are strengthened as a result of improved service delivery, especially social services like housing, health and education. Each area service center thus performs a critical role in the regional development system because of the diversity of services and ease of access to these services.

Functional community

The multi-nucleated functional community has been identified as a subarea component of social/environmental services delivery system. Because the functional community is synonymous with a consumer/user advocate role in regional development planning, its organization and function is represented by the linkage and feedback elements in the producer/provider and consumer/user submodels.

In the early stages of optimizing management scale of service delivery, the functional community representation may favor small-scale to large-scale systems. In later stages, where effective citizen input and local control of service mix and costs is achieved, the functional community representation may opt for large-scale delivery systems. In either case, a research need is asserted for distribution system submodels that can be

used to work out the incidence of costs and benefits, and of economic and political control, for alternative sizes of area service delivery systems.

The concept of the functional community is introduced as an organizational bridge between the individual citizen and the public official and/or professional worker. It relates to one void in social priority setting, namely, the neighborhood or community level of citizen input. It relates, also, to the shift towards functional regionalism, particularly in the decentralization of state level functions to subregional and area centers.

Presented, therefore, is an outline of a research design for regional development and environmental management. Its primary purpose is to provide a research agenda that focuses on certain critical social/environmental issues. Part of the outline is being implemented; most of it, however, is open for discussion and later revision as a result of achieving a sharper focus and a wider concensus on the arrangements for dealing with a multiplicity of competing issues and priorities.

FOOTNOTES

1/ This paper is essentially a review and extension of work initiated at Iowa State University in the early 1960's and subsequently carried on elsewhere by MacMillan, Barnard and others whose contributions are acknowledged generally.

2/ Resource management is somewhat narrowly defined in this paper to include primarily natural resources and related environmental development.

3/ Daniel M. Ogden, Jr., The Political Economy of Environmental Control, (Berkeley: University of California Press, 1972).

4/ Conflict resolution implies the workings of some sort of concensus model, which is not necessarily accepted in this paper; rather, I'm still impressed by a colleagues comment that "candy is dandy, but faction brings action".

5/ Most regional development programs have been rationalized on equity grounds, i.e., reducing between region disparities in employment and income opportunities, and recently, inequities in access to essential social services.

6/ Advisory Commission on Intergovernmental Relations, Urban and Rural America: Policies for Future Growth, (Washington, D.C., April 1968).

7/ Regional Plan Association, The Region's Growth, A Report of the Second Regional Plan (New York, 1967).

8/ Niles M. Hansen, Intermediate-Size Cities as Growth Centers (New York: Praeger Publichers, 1971).

9/ Vincent Ostrem, "Public enterprise systems in the United States," Public Choice, Spring 1969.

10/ "Albert Lea-Austin Health Services Regionalization Study", Program in Hospital and Health Care Administration, School of Public Health, University of Minnesota, Minneapolis, August 3, 1970.

11/ An increased consumer input into the planning process is likely to modify the emphasis on "economy" and "quality," which support strong professional biases towards large-scale health care systems.

12/ M.L. Hayenga, T. J. Manetsch, and A. N. Halter, "Computer simulation as a planning tool in developing economies," Am. J. Agr. Econ., 50: 1755-1759, December 1968. See, Also: Wilbur R. Maki, Richard E. Suttor and Jerald R. Barnard, Simulation of Regional Product and Income with Emphasis on Iowa, 1954-1974, Iowa Agr. and Home Econ. Exp. Sta., Res. Bull. 548, September 1966.

13/ Minnesota Agr. Exp. Sta., Project 14-94, "Regional Rural Development Potentials".

14/ Additional detail used on the regional systems model is available from: Ronald G. Fraase, (ed.), A Study of the Economic Interdependence of Minnesota and North Dakota, Department of Agr. Econ. and Upper Great Plains Transportation Institute, N.D. State University, Fargo, and Dept. Agr. and Applied Econ., University of Minn., St. Paul, August 1971.