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SOCIAL/ENVIRONMENTAL SYSTEMS FOR REGIONAL DEVELOPMENT PLANNING*

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This paper focuses 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.[1]

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 [28]. New organizational arrangements must be developed for resolving the inter-power cluster conflicts and, more importantly, for achieving important public purposes.[2]

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 area wide environmental management [43]. 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 three issue areas -- achieving balanced national growth, intervention in regional development processes aims to reduce regional disparities in employment, income and economic growth.[3] Metropolitan concentration

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*This paper is essentially a review and extension of work on regional development systems initiated at Iowa State University in the mid-1960's and subsequently carried on elsewhere by Barnard, MacMillan and others whose contributions are acknowledged generally.

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[1]Resource management is somewhat narrowly defined in this paper to include primarily natural resources and related environmental development.

[2]Conflict resolution implies the workings of some sort of concensus model, which is not necessarily accepted in this paper.

[3]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 [40].

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 [27]. 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 [8]. 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 [3, 10, 15].

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 [34]. On-site operating costs are balanced with off-site user costs in the determination of an optimal system size for minimizing social costs [38]. In addition, alternative means of improving service access for all residents of a service delivery area are being examined in terms of associated costs and benefits.[4]

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 area wide 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 [35].

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 system orientation and with the technical capabilities currently deployed in the preparation and application of large-scale computer programming models of regional economic systems [7, 12, 19, 22]. 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;

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[4] 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.

(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.[5]

A series of activity components (AC) are presented, first, as interdependent elements of a regional system; these elements are identified as follows: (1) population, (2) demand, (3) output and employment, (4) earnings and income, (5) capital improvements and financing, (6) facility location, (7) land use, (8) environmental management, (9) public financing and (10) public policy. In the regional model, population change is viewed as an intervening variable that triggers a series of subsequent changes in demand, output and employment, and other activity components. Research teams are organized around each of the activity components and inter-relationships between components are derived quantitatively. The total quantitative system of relationships is tested in terms of its predictive capabilities.

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 correspond closely encough 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 [20]. For the total subregion, over ninety

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[5]Minnesota Agricultural Experiment Station Project 14-94, "Regional Rural Development Potentials."

per cent of export-producing activities are farm-related and much of the employment change, therefore, is related to agricultural change. Because of its spatial position -- roughly 200 miles from two large 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 activites 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 [18]. The sixty-equation series has been regrouped according to the activity components cited earlier (Table 1). Because of 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 exogenous variables (Figure 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.

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 [25]. The second stage estimation procedures were approached, initially, in the context of an expanded input-output framework. Ten research areas (RA) are identified as follows: (1) input-output relations, (2) land and water supply and use, (3) processing and manufacturing requirements and outputs, (4) infrastructure and services, (5) employment and income, (6) environmental management, (7) investment and financing, (8) population and consumption, (9) trade and transportation, and (10) public policy. However, because of the conceptual and operational limitations of the input-output framework, a research design is specified for the second stage which is a composite of activity components. These components are inter-related in such a way that a change in one component results in successive changes in other components. The interrelationships become clear when the individual components are specified.

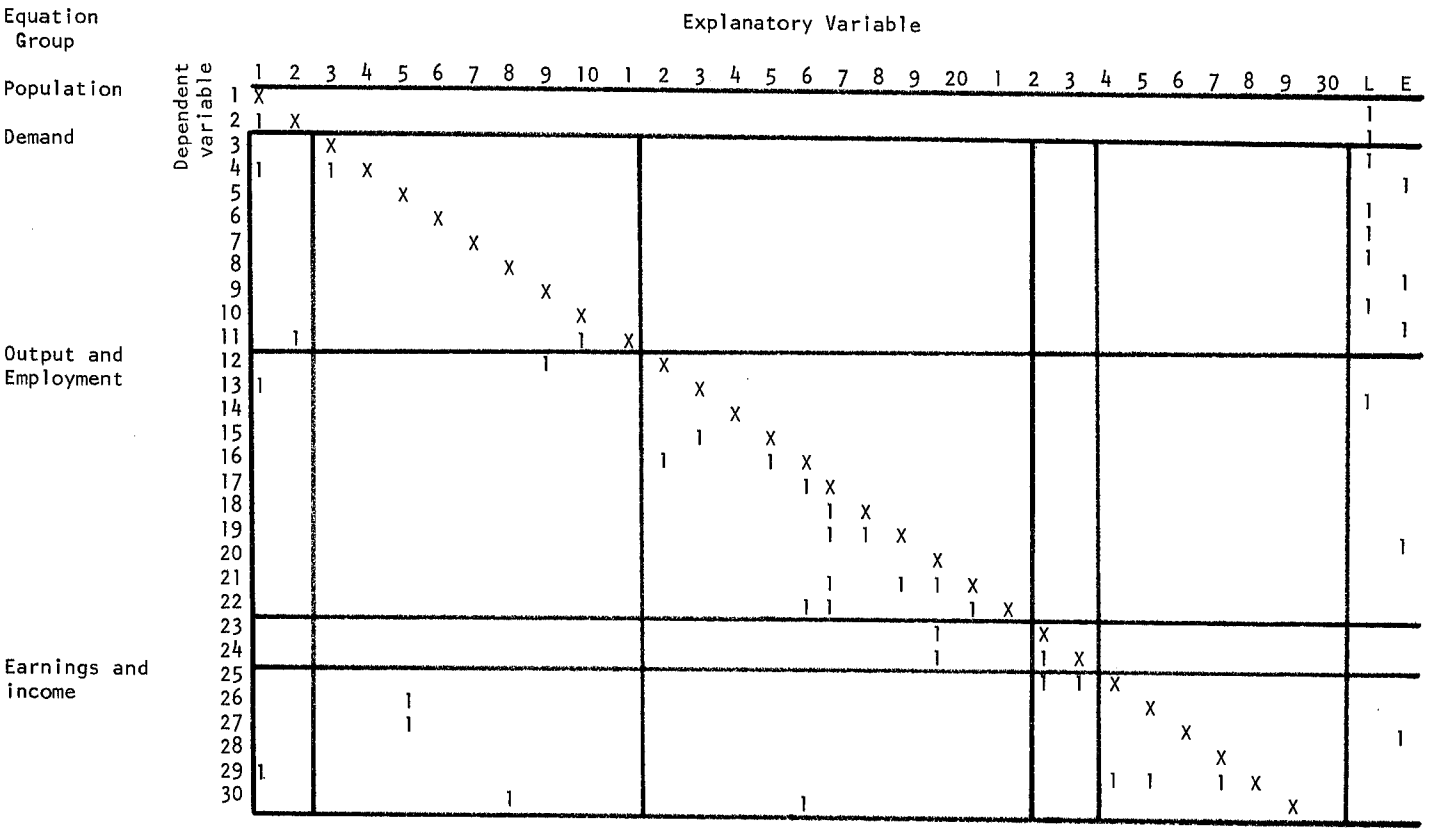
TABLE 1: Selected Equations and Variables in a Regional System Model*

Group	Equation No. Current	Equation No. Initial	Symbol	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
	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	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 1: (Continued)

Group	Equation No. Current	Equation No. Initial	Symbol	Description of Variables: Dependent	Description of Variables: Explanatory
	29	32a	Y^P	Personal income, region	G^W Y^B, 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, T^S, 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	Exogenous
Public financing	42	16	G_1^I	Indirect taxes, region	I, X^R
	43	17	T^P	Property taxes, region	Growth rate
	44	18	G^F	Federal indirect tax collections	G_1^I, T^P
	45	19	G_1^F	Federal personal income taxes	Y^P
	46	20	G_2^F	Federal corporation income taxes	V
	47	21	G_3^F	Total federal 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_3^S, G_4^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

FIGURE 1: Causal Ordering of Variables in a Regional System Model*



*From J. A. MacMillan [18], Equations 1-30[a]

[a]Symbols used in matrix are defined as follows: lagged variable, L; exogenous variables, E; dependent variable, X.

First, however, the ten research areas and the ten 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 one 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 classification must conform with prevailing standards [13, 39, 41, 42]. A computer program for a two-region version of the 1963 eighty-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]. Initially, an eighteen-sector input-output model is being used as a prototype for developing the computer modeling capabilities that will relate directly to the data and information needs in regional development planning [25].

Inputs and outputs in the subregional input-output model 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 and research areas (RA) 1 and 5 (part).

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 [17]. 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) is being differentiated according to spatial position, soil and vegetation attributes, and present and projected uses.

Data sources for the land allocation submodel include (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 surfacial 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.

Of primary importance in the private investment and financing (AC5, or RA3 and RA7) 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 [24]. 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 [32]. 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 payments. This submodel, in the economist's view, is demand, rather than supply, oriented. Employment depends upon output 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 prepared for projecting future employment levels that are influenced also by population supply (as well as labor demand) considerations [20]. Inter-area migration within the subregion and the Upper Midwest region is 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 [4].

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, includes geocoded public facility input-output coefficients and constraints.

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

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 [33]. 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 [4].

In addition, trade and transportation activities (RA9) link the input-output submodel to export markets. Transportation services are used in moving subregional products to demand centers outside the subregion. 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.

Consumer/User System

Consumer/use system submodels include the behavioral relations accounting for changing consumer and user responses to the outputs of the 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 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 [5].

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.

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 reallocation and income redistribution.

Regional Development Planning

Because a variety of institutions are moving toward cooperative, inter-governmental approaches to economic and environmental planning, some justification exists for modeling a regional development system in which a higher degree of foresight is anticipated than is the case, presently [1, 7, 13]. 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.

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 [2].

The regional-share effect for each industry is linked to appropriate national policy assumptions pertaining to the regional distribution of national economic growth. 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 wherein 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 market studies. In these studies energy requirements are associated with given sets of assumptions about national environmental standards and use of pollution-reducing technologies and consumption-reducing pricing practices.

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. 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 business enterprises [31]. 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 subregional producer/provider system. Eventually, such inputs will be included 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, which is directed towards the improvement of consumer/user access to essential public services. Effective resolution of these management concerns may require the existence of some form of multi-county councils of government for coordinating the public management activities on an area wide basis [8, 29, 38].

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. For example, 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 successful.

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 in the study area. 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 will eventually include several watersheds and municipalities [34].

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 area wide residuals management systems. Institutional, professional and personal obstacles to community and area wide 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 [37].

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 submodel are needed, also.

Capital budgeting. Area wide capital budgeting decisions are linked, potentially, to federal and state facility location decisions. A capability for area wide coordination, not only of local government, but, also, of federal and state government, capital improvement programs is essential for effective area resource management [11, 24].

To achieve area wide 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 area wide capital budgeting function is asserted.

The area wide 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. To implement this function, additional data are needed from the consumer/user category of submodels. These data would help establish appropriate community and area objectives for cost-benefit studies and social cost analyses [3].

Land control. Area environmental management is concerned, also, about land control. But land control is a municipal, township or county government 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 area wide resource management agency [14].

Development of an effective land control function on an area wide scale involves a reallocation of certain powers now residing with local and state governments. In terms of systems modeling, transfer of power to an area management agency would involve use of the distributive submodels cited earlier and, also, producer/provider submodels, such as the one for land allocation [8].

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. Also lacking is a capability for establishing 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 [44]. 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 goals 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

The broad set of constraints imposed upon the social/environmental systems modeling implies a territorial organization for functional regionalism [1]. 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 function community.

Development region

Export-base expansion is optimally a function of the multi-state development region, like the Upper Midwest. 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, Fargo-Moorhead, Duluth-Superior, Sioux Falls and Green Bay. These centers are approaching a minimum viable size for self-sustaining urban-industrial growth [27, 36].

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. 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. 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/use 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 an approach towards the formulation of 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.

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