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Public Impacts of Rural Water Systems: A Case Study

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PUBLIC IMPACTS OF RURAL WATER SYSTEMS: A CASE STUDY

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SUMMARY

A case study of the Brookings-Deuel Rural Water System was undertaken to estimate the effects of the system on the revenues and expenditures of the local governments which serve its members.

Government expenditures may increase if the rural water system prompts demographic changes which cause increased or changed demands for public services.

Results of a mail survey indicate that government units in the rural water system area experienced in-migration. However, only about 5% of the in-migrants gave "access to the rural water system or other utilities" as reason for their move into the region. Based on number of in-migrants only, evidence suggests there has been a slight increase in demand for public services because of the rural water system.

Government revenues may increase if the rural water system induces property value increases, additional building, or improvements to existing buildings. The changes and the degree to which they were influenced by the rural water system were secured from a survey of members of the system.

A simulation model was developed to incorporate additional expenditures and revenues for several selected government units in the Brookings-Deuel Rural Water System area. All government units except one experienced net gains in the simulation. Local governments will only realize these gains, however, if the increases in value (as perceived by the respondents to the survey) are translated into increased property assessments.

With proper coefficients the model may be used as a planning tool for other regions and other rural water systems.

The study indicates that tax revenues may increase and, over time, equal the amount of the grants and subsidies received by the system. However, the sources of the grants are usually not the recipients of the increased tax revenues. Thus, income redistribution occurs.

None of the study findings indicates that existing rural water system development is a catalyst in overall regional development. However, most findings indicate that the rural water system is associated with other factors in the development of the region.

This bulletin is a condensed version of the completion report of Project B-056-S.Dak. funded by the United States Department of the Interior, Office of Water Research and Technology. A copy of the complete report, Effects of Rural Water Systems in Local Government Revenues and Expenditures in Selected Counties of South Dakota, may be obtained from the Water Resources Institute at Brookings, South Dakota.

PUBLIC IMPACTS OF RURAL WATER SYSTEMS: A CASE STUDY

Ardelle A. Lundeen and Larry L. Janssen*

The growth of large scale rural water systems during the 1970's has been a major rural development in South Dakota and surrounding states. This rapid development has been attributed to the desire of farm residents to increase their quality of life and productivity, the increased movement of nonfarm families to rural areas, and the availability of grants and low-cost loans from Farmers Home Administration (FmHA) and other sources.

Whatever the cause, the number of rural water systems in South Dakota has increased from 9 in 1970 to 30 in 1980. Another 20 or more are under development or proposed. Six of the early systems have less than 25 hookups, while many of the newer systems have 1,000 hookups. Because of their size and large capital costs, the newer systems have the potential to affect nonmembers and the public generally.

This study focuses on public sector impacts, changes in government expenditures and revenues. Government expenditures may increase if the rural water system serves as a catalyst for population growth in the rural area and new families demand increased or changed public services. Government revenues may change if the rural water system induces change in population, property, or incomes.

If we examine the impacts of functioning rural water systems, we can adjust to future systems more easily. We can better judge the desirability and cost of taxpayer subsidies to the systems. And local governments can anticipate certain revenues and expenditures and consequently plan more realistically.

Several studies (Toman, Nelson et al, Nelson and Hoffman) of the first North Dakota rural water system, the Grand Forks-Traill Water Association, reported substantial economic impacts on the private sector. A South Dakota study (Young et al) reported on the impact of a rural water system on property values and population growth. No previous study has explicitly addressed the impacts of rural water systems on the public sector.

Brookings-Deuel Rural Water System

The organization and development of the Brookings-Deuel Rural Water System typify many systems constructed in South Dakota since 1970. Rural residents encountered problems in the quantity and quality of their water supplies. They met, formed a nonprofit corporation, and organized the rural water system.

The system, located on the middle-eastern border of South Dakota adjacent to Minnesota, serves 10 townships in Brookings County, all of Deuel County, and 3 townships in Grant County (Figure 1). The system is located in the Big Sioux River Basin and secures water at two locations from a large aquifer in the Basin. The Brookings-Deuel Rural Water System owns approximately 630 miles of pipeline averaging 1.67 hookups per mile. There are 2,000 square miles included in the region served by the system with one hookup per 1.9 square miles. There are approximately 1,050 individual service connections. Three towns are served on a bulk basis.

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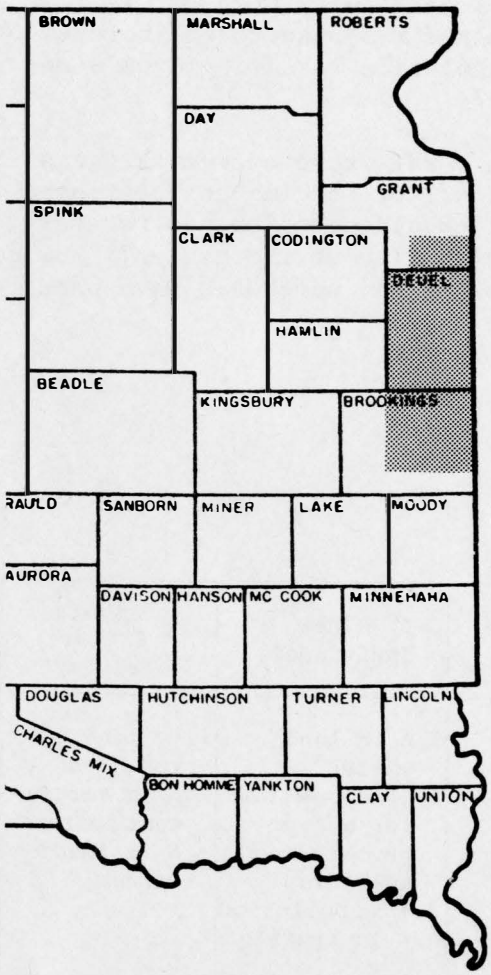

Fig 1. Geographical boundaries of Brookings Deuel Rural Water System.

In number of customers, the Brookings-Deuel Rural Water System is an average larger system in South Dakota.

Members of the system include the primary water users found in rural eastern South Dakota: small-town residents and farm and non-farm rural residents. The system also serves seasonal lake cottages on two lakes, mobile home courts, subdivisions, and pasture taps. Water is not used for crop irrigation.

Construction of the system was financed by member contributions, a loan of $3.4 million from the FmHA, a $954,000 grant from the FmHA, and a $300,000 grant from the state of South Dakota.

IDENTIFICATION OF POTENTIAL IMPACTS

Such a major development may have far reaching impacts on the public sector if it changes expenditures and revenues of local governments serving the community in which the system is located.

A change in government expenditures can be traced to the rural water system if its installation triggers a change in population numbers, density, or composition which, in turn, leads to a change in demand for public services. The affected public services include roads, snow removal, fire and police protection, schools, and waste removal. Normally, demand for these services will increase as population level or density increases in a region, resulting in increased public expenditures.

If increases in population also increase the demand for land or change it to a higher valued use and if these changes translate into an increase in land values and their assessments, public sector revenues could increase.

The rural water system may contribute to increases in other property or sales taxes. Because of the added convenience and security of a constant supply of water, homes hooked up to the rural water system may command a higher price than homes which are not. There may be remodeling or improvements to take advantage of the availability of water.

If these higher prices or improvements result in increased assessed valuation, the public sector can benefit by increased revenues.

South Dakota levies a state sales tax, and some municipalities levy a city sales tax. Sales tax receipts may rise because of purchases of new water-using equipment and appliances and additional expenditures by in-migrants. And if personal incomes rise due to additional industry or increased farm productivity, retail sales will increase.

In conjunction with other units of local governments, schools will experience an increased demand for services if additional students move into the area. The

schools also would share in increased tax revenues that may result from increased property values. In addition, schools may experience an increase in state and federal aid that is dispensed on a per student basis when new students enter the school district.

These impacts on the public sector are brought together in Figure 2. Several questions remain.

Does a rural water system attract residents to a particular area, or is the system merely a response to an increase or shift in population resulting from some other cause?

If the rural water system triggers the change, can all of the impacts be traced to the system? Would some demands for public services arise without the system? Would some remodeling and purchases have occurred without the system?

Fig 2. Impact matrix.

Water Use \ Impacted Group	Local Government	School District	State Government	Other Individuals	Private Sector Economy
Household	1.Δ in real property base 2.Δ in demand for public service	1.Δ in real property base 2.Δ in demand for public service 3.Δ in # of students 4.Δ in state aid for sch.	1.Δ in sales tax	1.Δ in land values 2.↓ in business for water haulers & well drillers 3.↑ in pollution 4.↑ in traffic	1.Ag land to res. land 2.Δ in settlement patterns 3.Δ in land values
Livestock				1.Δ in land use 2.↑ in pollution	1.Δ in land use 2.Δ in personal income
Industrial	1.Δ in real property base	1.Δ in real property base	1.↑ payroll => ↑ sales tax	1.Δ in land use 2.Δ in employment 3.↑ in pollution	1.Δ in labor force 2.Δ in personal income

Explanation of symbols:

Δ = change
↑ = increase
=> = implies

Respondents to questionnaires were asked to identify their activities which resulted from installation of the rural water system. Realtors and appraisers were asked to evaluate similar real estate properties with and without the rural water system. Public officials were asked their perception of the effect of the rural water system on revenues and expenditures. From all of these sources, impacts which were attributable to the rural water system were separated from those which were not.

SIMULATION MODEL

In 1976, economists at SDSU introduced a simulation model to assess economic and public finance impacts of industrial development on a community (Morse, et al). The model was modified to simulate the impacts of the rural water system on the public sector.

The rural water system model is divided into five parts, each corresponding to one unit of government (county, township, municipal, state, and school district). Each part is further subdivided into three sections -- benefits, costs, and net gains. (The complete model is found in Appendix I.)

Public Sector Benefits

For the counties, townships, municipalities, and school districts, property tax revenues are included in benefits. Utilities and sales tax revenue are also included in the benefits for municipalities. For school districts, federal and state aid for schools and gross receipts tax provide additional benefits.

Since the state does not levy a property tax, the only source of benefits for the state included in this model is sales revenue. Miscellaneous tax revenues are included for all units except the state.

Property taxes

In the model the following three steps are carried out to estimate additional revenue from each type of property for each government unit.

1. Determine the full and true value of the additional property or the full amount of the change in the value of the property for each governmental unit.

2. Multiply the full and true value by the taxable valuation rate to find the taxable value, which is the value of the property for taxation purposes.

3. Multiply the taxable value by the mill levy. The resulting figure is the tax revenue.

In each type of change, only that portion of the change which respondents indicated was attributable to the rural water system is used to estimate benefits and/or costs in the model. The types of property taxes which are included in the model are:

1. Residential property which will change through additions or deletions to the physical quantities of housing units or lots or through changes in the value of existing property. The four types of residential property changes included are:
   a. New housing units
   b. New lots
   c. Increases in the value of existing property
   d. Improvements to existing property.

2. Agricultural property tax in which changes will occur through:
   a. General increases in the value of farm buildings
   b. General increases in the value of farm land
   c. Improvements to the buildings.

3. Industrial and/or business property tax in which changes will occur through:
   a. New business or industries
   b. Improvements to existing property
   c. Increases in value of existing property.

Miscellaneous tax revenues from new residents

The average per capita miscellaneous tax revenue multiplied by the number of in-migrants estimates the potential increase in miscellaneous tax revenues from new residents moving into each governmental unit.

Utilities revenue

The municipal utilities charge per housing unit is multiplied by the number of new housing units to estimate the increase in utilities revenue emanating from the rural water system. The additional revenue from new residences is added to the additional industrial utilities revenue to obtain the total increase in utilties revenue.

Sales tax

The number of in-migrant residents times the per capita sales tax collection estimates the potential annual increase in sales tax collections.

The value of one-time purchases of water-related equipment multiplied by the appropriate sales tax rate is an estimate of the sales tax revenue which will accrue to the city or state as a result of appliance and equipment purchases. This revenue will be realized only once, not annually.

Change in state and/or federal aid for schools

The per student state or federal aid received by each school is multiplied by the number of new students to estimate the increase in benefits resulting from additional students.

Gross receipts tax for rural water system

Non-profit rural water systems are taxed 2% of their gross receipts in lieu of real property taxes. The gross receipts tax is apportioned to each school district on the basis of the percentage of the system which is found within that district. The amount of the sales tax revenue can be obtained from the respective county auditors.

For each part of the model, all benefits appropriate to that part are summed to obtain the estimate of total benefits.

Public Sector Costs

In the county, township, and municipal parts of the model, costs or additional expenses include public services that must be provided for new residents.

The municipal part also includes the cost of providing utility services to new residents and industries. School district costs include operating and capital outlay expenses of the school district. No costs are included in the state part of the model.

New resident services

The cost of providing public services to new residents of each unit of government is obtained by dividing total property taxes for that unit by the current population of that unit for per capita property tax revenues. The per capita figure is multiplied by the number of in-migrants to each unit to estimate the cost of providing services for new residents whose movement to the community was induced by the rural water system.

The assumption is that costs of providing public services are equal to the property tax collected to pay for those services. Implicit in this procedure is the assumption that per capita cost for providing public services to in-migrants is equal to the average per capita cost for current residents. Public officials who were interviewed concurred.

Utilities cost

Municipal utilities cost per housing unit is multiplied by the number of new housing units to find the total cost of providing utilities to new homes. This figure is added to the cost of providing utilities to industries for the total additional cost of providing utilities for each municipal unit.

Operating costs and capital outlay for new students

For both of these costs, the assumption is made that marginal cost for new students equals average cost for current students. Thus, to estimate total additional costs, the average operating expense per student and average capital outlay per student for each school are multiplied by the number of new students entering the school because of the rural water system.

For each part of the model, all costs appropriate to that part are summed to obtain the estimate of total costs.

Net Gains to Public Sector

For each part of the model, total costs are subtracted from total benefits to obtain net gains.

Variables in Model

In Table 1, all 46 variables are listed by name in the order in which they appear in the model. In column B, the parts (units of government) of the model in which each variable is used are listed; column C lists the source(s) of information on the coefficient for each variable.

Table 1. Variables used in simulation model.

(A) Name of Variable	(B) Part[a] of Model	(C) Source[b] of Information
1. Number of new housing units	C,M,T,Sc	PS,MSL
2. Average Value of housing unit	C,M,T,Sc	PS,MSL
3. Taxable Valuation rate	C,M,T,Sc	CO
4. County Mill levy	C	CO
5. Number of older homes	C,M,T,Sc	PS,MSL
6. Average increase in value of older homes	C,M,T,Sc	PS,MSL
7. Number of home improvements	C,M,T,Sc	PS,MSL
8. Average value of home improvement	C,M,T,Sc	MS,MSL
9. Number of new residential lots	C,T,Sc	PS
10. Average value of residential lot	C,T,Sc	PS
11. Average number of acres/ residential lot	C,T,Sc	PS,MSL
12. Average value of agricultural land/acre	C,T,Sc	PS
13. Number of acres of agricultural land	C,T,Sc	PS
14. Average increase in value of agricultural land/acre	C,T,Sc	PS
15. Number of farmsteads	C,T,Sc	PS
16. Average increase in value/ farmstead	C,T,Sc	PS
17. Number of improved farmsteads	C,T,Sc	PS
18. Average value of improvement/ farmstead	C,T,Sc	PS
19. Number of new industries	C,M,T,Sc	CO,MO
20. Average investment/industry	C,M,T,Sc	CO,MO
21. Number of inmigrant residents	C,M,T,S,Sc	MS,MSL
22. Average/capita misc. other tax revenue	C,M,T,Sc	CO,MO,ED,STD
23. Total county property tax	C	CO,STD
24. County population	C	CP
25. Municipal mill levey	M	CO,MO,STD
26. Municipal utilities charge/ housing unit	M	MO
27. Add. utilities revenue from industries	M	MO

Most of the variables are used in the model for more than one unit of government with the coefficient for the variables different from unit to unit. For example, for the county the "number of new housing units" includes all homes constructed in the county because of the rural water system. For a particular township, that same variable will include only those new homes constructed in the township. For variables such as mill levy, population, or total property tax, the figure used in each part of the model is the one applicable to that specific government unit.

28.	Per capita city sales tax collections	M	STD
29.	Value of one-time purchases of water related equipment	M,S	PS
30.	Sales tax rate	M,S	STD
31.	Total municipal property tax	M	CO,MO,STD
32.	Municipal population	M	CP
33.	Municipal utilities cost/ housing unit	M	MO
34.	Industrial utilities cost	M	MO
35.	Township mill levy	T	CO
36.	Total township property tax	T	CO
37.	Township population	T	CP
38.	Per capita sales tax collections in county	S	STD
39.	School mill levy (ag.)	Sc	CO
40.	School mill levy (non-ag.)	Sc	CO
41.	Gross receipts tax for rural water system	Sc	CO
42.	Change in state aid for schools	Sc	ED,ScO
43.	Change in federal aid for schools	Sc	ED, ScO
44.	Number of new students	Sc	MS
45.	Ave. per student operating expense	Sc	ED
46.	Average annual school capital outlay/student	Sc	ED

[a] C = County
M = Municipal
T = Township
S = State
Sc = School

[b] CO = County official
MO = Municipal official
ScO = School district official
PS = Personal survey of township residents
MS = Mail survey of township residents
MSL = Mail survey of lake home residents
ED = South Dakota Department of Education and Cultural Affairs. Educational Statistics Digest. 1977-78, (Pierre, South Dakota: n.p., 1978).
STD = South Dakota Department of Revenue, Annual Statistical Report FY 1978, (Pierre, South Dakota: n.p., November 1, 1978).
CP = U.S. Department of Commerce, Bureau of the Census Current Population Reports, Population Estimates and Projections, (Washington, D.C.: Government Printing Office), Series P-25, No. 689, April, 1977.

There were three main sources of information for the coefficients:

1. Publications
2. Government officials
3. Personal and mail surveys of members of the Brookings-Deuel Rural Water System.

Publications, such as statistical reports, furnished much factual information on tax receipts and government expenditures. Government officials provided information on policy variables and revenues and expenditures not available from published sources.

Information from these two sources is easily accessible and relatively inexpensive to collect. Anyone contemplating use of the model in the future could secure this information quickly.

Three surveys[1] were conducted to obtain key information:

a. Mail survey of township and municipal residents.
b. Personal interview survey of a subsample of respondents and non-respondents to the mail survey of township and municipal residents.
c. Mail survey of residents of Lake Hendricks and Lake Cochrane homes.

Data on new construction, improvement to existing buildings, number of in-migrants, and changes in property values were obtained from the surveys. Each respondent was asked to identify the portion of each of these changes which was attributable to the rural water system.

Data obtained from mail and personal surveys must be converted for use as coefficients in the simulation model.

Two modifications are necessary:

1. Sample data must be expanded to population data, and
2. The portion of the data attributable to the influence of the rural water system must be identified.

The procedures for adjusting the sample data can be found in Appendix II.

SIMULATION MODEL RESULTS

Simulations were run for the state of South Dakota, all counties located within the Brookings-Deuel Rural Water System, four school districts, a small municipality (Goodwin) and two townships, including one township which had experienced considerable growth and in-migration and one which had not. Together these government units encompass all of the land contained within the rural water system and provide examples of different kinds of growth.

The results, showing additional revenues, additional expenditures, and net gains, are summarized in Table 2.

Local Government Units

Additional revenues were largely composed of increased property taxes. These resulted from increases in value of property or improvements to property which were induced by the existence of the rural water system.

In relation to total property tax revenues for each government unit, the simulated increases were small, ranging from .01% for Grant County to 5.6% for Deuel County. Simulated gains for school districts ranged from a low of .66% for the Brookings School District to a high of 8.2% for the Lake Hendricks School District.

Additional expenditures consisted entirely of the cost of increased public services for in-migrants to the various local government units.

Results of the mail survey indicated that local governments experienced in-migration, but only about 5% of the in-migrants gave "access to the rural water system" as one of the reasons for their move into the region. Only this group was included in the simulation model.

All government units except Grant County experienced positive simulated net

[1]For details of population, sample selection, survey design, and response rate see, Lundeen, Ardelle, and Larry Janssen. Completion Report WRI Project B-056-S.Dak., Brookings, S.D., December 1979.

Table 2. Summary of Impact of Brookings-Deuel Rural Water System on Selected Government Units

Government Unit	Additional Revenues	Additional Expenditures	Net Gains
Counties			
Brookings	8,622.00	254.22	8,367.77
Deuel	31,572.42	996.29	30,576.13
Grant	78.48	100.21	- 21.73
Townships			
Sterling	859.45	34.14	825.31
Lowe	393.06	17.36	375.70
Municipality			
Goodwin	73.99	30.00	43.99
School Districts			
Brookings	22,628.18	0.00	22,628.18
Clear Lake	55,337.70	3,036.00	52,301.70
Deubrook	18,052.31	0.00	18,052.31
Lake Hendricks	3,670.10	0.00	3,670.10
State			
South Dakota	9,240.00	0.00	9,240.00

impacts. The negative impact for Grant County occurred because of a large number of in-migrants and because relatively little property in the area of the county was served by the rural water system. Brookings and Deuel counties both had positive net gains, with that of Deuel over three times that of Brookings. Considerably more acreage is included in the Deuel County model.

Sterling Township, which experienced much economic activity and in-migration, had more than twice the net gains of Lowe Township. The municipality of Goodwin had rather small net gains, perhaps because it consists of only residential property.

The school districts experienced substantial net gains. This was because much land area and property is included in each district and the mill levies are the highest of any government unit.

Generally, additional expenditures (which were entirely of new student costs) were small because families moving into the community did not contain a large number of school-age children.

The gross receipts tax for the school is one additional revenue that can be traced directly to the rural water system. The model in this study included approximately $3,700 in gross receipts tax distributed to the various school districts. While the exact amount may vary, the proceeds from the tax will be received each year.

Separate simulations were run to estimate the impacts of Lake Hendricks and Lake Cochrane residents on their respective counties and the Lake Hendricks School District, but the net gains are included with their respective government units in Table 2.

Estimates for Lake Hendricks revealed a contribution of $70.68 to Brookings County and $333.19 to Lake Hendricks School District revenues. The changes in property values in Lake Cochrane added $284.19 to Deuel County. The additional revenues of approximately $688 generated by lakeshore members of the Brookings-Deuel Rural Water System are attributable to increases in property values as perceived by respondents.

Added expenditures consisted almost exclusively of costs of public services to in-migrants, and there are few in-migrants. Most lake residents are not permanent residents and thus are not counted as in-migrants who increase the cost of providing public services. For some public services such as schools and welfare, this is a valid assumption. For other services, such as roads and waste disposal, the assumption may be more tenuous.

For most local governments, additional revenues and expenditures are of a recurring nature; changes in property values, once established, will hold for future years. As long as in-migrants remain in the community, public service expenditures for them will recur annually. Changes in the mill levy, taxable valuation rate, utility rates, and per capita school aid in future years could alter the exact amount of the additional expenditures and revenues.

State Government

There are two types of changes in sales tax included in the model: the recurring tax which results from in-migrants and the one-time sales tax which results from purchases of appliances and equipment to use with the new water system.

The net gain for the state, as estimated in the model, was $9,240 for one year. Assuming no other changes, receipts of $1,680 will recur each year, but the state could expect to receive $7,560 only for the year in which the appliances were purchased.

No additional expenditures for the state were included in the model because few state expenditures are based solely on number of persons. School aid is one exception, but that expenditure was included in the school district model. The other major source of state expenditure (highways) is not influenced by a few new in-migrants.

Simulation Model Results and Uses

Under the conditions outlined, the model simulates a positive net gain for the public sector from installation of the rural water system. However, there is a wide difference between units of government.

A simulation is not reality. Have these net gains actually occurred? Will they?

The estimates are based on people's perceptions of increases in value. Actual increases in tax revenues can only occur if increases in value are translated into increases in assessed valuation of that property.

Assessors do not appear to be considering the absence or presence of the rural water system in their assessment procedures, nor are they incorporating increases in value attributable to the rural water system in their assessments.

However, over time, as property is sold, increased assessments may occur.

Thus, while the simulation models reveal the increases in revenues that could occur because of the existence of the rural water system in the area, they do not reveal what has actually happened.

The results of the simulation model are applicable for a point in time or for assessing changes over a period of time. Changes will continue to occur in population, policy, and values. Thus, while the main purpose of the model in this project was to assess the dollar amount of the impacts of the Brookings-Deuel Rural Water System, a corollary and perhaps more important use is for planning purposes.

The model can easily be run with several different coefficients to assess "if" and "then" situations. Public officials and rural water system officials who are familiar with an area could estimate a range of reasonable coefficients.

The model provides a framework to assemble and evaluate impacts of rural water systems and can be used for other water systems and other geographic regions if proper coefficients are used.

POLICY IMPLICATIONS AND CONCLUSIONS

Policy Implications

Because the study covers the first years of the organization and existence of the rural water system, only early impacts have been assessed. Policy implications are based on these early impacts and possible later impacts if present trends continue.

Most rural water systems are subsidized by the public sector through low-interest loans and grants from government agencies. The study indicates that tax revenue for the public sector can increase and may, over time, equal the amount of the grants received by the system.

However, most grants and loans are made by state governments or state and federal agencies. The largest increased revenues accrue to school districts and county governments, not the grantor units. The income redistribution which may occur raises equity considerations, and policy makers must decide if the resulting redistribution is desirable.

Any increases in property values must translate into increased assessments if additional tax revenues are to be realized. This is not happening.

Assessors should be aware of possible increases in property values following installation of a rural water system and then consider changing assessment procedures to correspond with the new values.

While local governments have little control over the installation of a rural water system, planning boards or commissions should be kept informed of organizational efforts and be involved in the planning process. This is especially true near growing population centers. Cooperation between planning boards and rural water systems could diminish negative and enhance positive impacts.

None of the policy implications discussed requires substantial changes in procedures or policy. All that is needed is an awareness of potential impacts of the rural water system in local government policy procedures.

Conclusions

All major findings in this study indicate that, as of late 1979, the rural water system is only one of several factors involved in the social and economic development of its service territory.

None of the study findings indicates that existing rural water system development is a catalyst in overall regional development. However, most findings indicate the rural water system is associated with other factors in the development of the region.

APPENDIX I

SIMULATION MODEL

I. Net Gains to the County Government Sector

Benefits: Additional Tax Revenues

1. Residential Property Tax

a. Number of new housing units
X Average value of new housing units
X Taxable valuation rate
X county mill levy ÷ 1000
= (1-a)

b. Number of older homes
X Average increase in value of older homes
X Taxable valuation rate
X County mill levy ÷ 1000
= (1-b)

c. Number of home improvements
X Average value of home improvement
X Taxable valuation rate
X County mill levy ÷ 1000
= (1-c)

d. Number of new residential lots
X Average value of residential lot
X Taxable valuation rate
X County mill levy ÷ 1000
- (Average # acres/res lot
X Number of new res lots
X Average value of agricultural land/acre
X Taxable valuation rate
X County mill levy ÷ 1000)
= (1-d)

2. Agricultural Property Tax

a. Number of acres of agricultural land
X Average increase in value of agricultural land/acre
X Taxable valuation rate
X County mill levy ÷ 1000
= (2-a)

b. Number of farmsteads (over 10,000 assessed valuation-excluding house & garage)
X Average increase in value/ farmstead
X Taxable valuation rate
X County mill levy ÷ 1000
= (2-b)

c. Number of improved farmsteads (over 10,000 assessed valuation-excluding house & garage)
X Average value of improvement/ farmstead
X Taxable valuation rate
X County mill levy ÷ 1000
= (2-c)

3. Industrial and/or Business Property Tax

a. Number of new industries
X Average investment/industry
X Taxable valuation rate
X County mill levy ÷ 1000
= (3-a)

4. Miscellaneous Tax Revenue from New Residents

a. Number of in-migrant residents
X Average/capita miscellaneous other tax revenue
= (4-a)

Additional Tax Revenues
(add 1 a-d, 2 a-c, 3a,4a)

Costs: Additional Public Expenditures

1. New Resident Public Services

a. Total County p operty taxes
÷ County Population
X Number of in-migrant residents
= (1-a)

Additional County Expenses (1a)

NET GAINS TO THE COUNTY SECTOR

Additional Tax Revenues
- Additional County Expenses

= **Net gains to the county sector**

II. Net Gains to the Municipal Government Sector

Benefits: Additional Tax and Utilities Revenues

1. Residential Property Tax

a. Number of new housing units
X Average value of new housing unit
X Taxable valuation rate
X Municipal mill levy ÷ 1000
= (1-a)

b. Number of older homes
X Average increase in value of older homes
X Taxable valuation rate
X Municipal mill levy ÷ 1000
= (1-b)

c. Number of home improvements
X Average value of home improvement
X Taxable valuation rate
X Municipal mill levy ÷ 1000
= (1-c)

2. Industrial and/or Business Property Tax

a. Number of new industries
X Average investment/industry
X Taxable valuation rate
X Municipal mill levy ÷ 1000
= (2-a)

3. Miscellaneous Tax Revenue from New Residents

a. Number of in-migrant residents
X Average per capita miscellaneous other tax revenue
= (3-a)

4. Utilities Revenue

a. Number of new housing units
X Municipal utilities charge/ housing unit
= (4-a)

b. Additional utilities revenue from industries
= (4-b)

5. Sales Tax (if city has sales tax)

a. Number of in-migrant residents
X Per capita city sales tax collection
= (5-a)

b. Value of one-time purchases of water-related equipment
X Sales tax rate
= (5-b)

Additional Tax and Utilities Revenues (add 1 a-c,2a,3a,4 a-b,5 a-b)

Costs: Additional Public Expenditures

1. New Resident Public Services

a. Total municipal property tax
÷ Municipal population
X Number of in-migrant residents
= (1-a)

2. Utilities Costs

a. Number of new housing units
X Municipal utilities charge/ housing unit
= (2-a)

b. Industrial utilities cost = (2-b)

Additional Municipal Expenses (add 1a, 2 a-b)

NET GAINS TO THE MUNICIPAL SECTOR

Additional Tax and Utilities Revenue
- Additional Municipal Expenses

= Net gains to the municipal sector

III. Net Gains to the Township Government Sector

Benefits: Additional Tax Revenues

1. Residential Property Tax

a. Number of new housing units
X Average value of new housing unit
X Taxable valuation rate
X Township mill levy ÷ 1000
= (1-a)

b. Number of older homes
X Average increase in value of older homes
X Taxable valuation rate
X Township mill levy ÷ 1000
= (1-b)

c. Number of home improvements
X Average value of home improvement
X Taxable valuation rate
X Township mill levy ÷ 1000
= (1-c)

d. Number of new residential lots
X Average value of residential lot
X Taxable valuation rate
X Township mill levy ÷ 1000
- (Average # acres/res lot
X Number of new res lots
X Average value of agricultural land/acre
X Taxable valuation rate
X Township mill levy ÷ 1000)
= (1-d)

2. Agricultural Property Tax

a. Number of acres of agricultural land
X Average increase in value of agricultural land/acre
X Taxable valuation rate
X Township mill levy ÷ 1000
= (2-a)

b. Number of farmsteads (over 10,000 assessed valuation- excluding house & garage)
X Average increase in value/ farmstead
X Taxable valuation rate
X Township mill levy ÷ 1000
= (2-b)

c. Number of improved farmsteads (over 10,000 assessed valuation excluding house & garage)
X Average value of improvement/ farmstead
X Taxable valuation rate
X Township mill levy ÷ 1000
= (2-c)

3. Industrial and/or Business Property Tax

a. Number of new industries
X Average investment/industry
X Taxable valuation rate
X Township mill levy ÷ 1000
= (3-a)

4. Miscellaneous Tax Revenue from New Residents

a. Number of in-migrant residents
X Average per capita miscellaneous other tax revenue
= (4-a)

Additional Tax Revenues (add 1 a-d, 2 a-c, 3a, 4a)

Costs: Additional Public Expenditures

1. New Resident Public Services

a. Total township property tax
÷ Township population
X Number of in-migrant residents
= (1-a)

Additional Township Expense (1a)

NET GAINS TO THE TOWNSHIP SECTOR

Additional Tax Revenues
- Additional Township Expense

= Net Gains to the township sector

IV. Net Gains to the State Government Sector

Benefits: Additional Tax Revenues

1. State Sales Tax

a. Number of in-migrant residents
X Per Capita sales tax collections in county
= (1-a)

b. Value of one-time purchases of water-related equipment
X Sales tax rate
= (1-b)

NET GAINS TO THE STATE GOVERNMENT SECTOR (add 1 a-b)

V. Net Gains to the School District

Benefits: Additional Tax Revenues

1. Residential Property Tax

a. Number of new housing units
X Average value of new housing unit
X Taxable valuation rate
X School mill levy (non-ag) ÷ 1000
= (1-a)

b. Number of older homes
X Average increase in value of older homes
X Taxable valuation rate
X School mill levy (non-ag) ÷ 1000
= (1-b)

c. Number of home improvements
X Average value of home improvement
X Taxable valuation rate
X School mill levy (non-ag) ÷ 1000
= (1-c)

d. Number of new residential lots
X Average value of res lot
X Taxable valuation rate
X School mill levy (non ag ÷ 1000
- (Average # acres/res lot
X Number of new res lots
X X Average value of agricultural land/acre
X Taxable valuation rate
X School mill levy (ag) ÷ 1000)
= (1-d)

2. Agricultural Property Tax

a. Number of acres of agricultural land
X Average increase in value of agricultural land/acre
X Taxable valuation rate
X School mill levy (ag) ÷ 1000
= (2-a)

b. Number of farmsteads (over 10,000 assessed valuation-excluding house & garage)
X Average increase in value/farmstead
X Taxable valuation rate
X School mill levy (ag) ÷ 1000
= (2-b)

c. Number of improved farmsteads (over 10,000 assessed valuation-excluding house & garage)
X Average value of improvement/farmstead
X Taxable valuation rate
X School mill levy (ag) ÷ 1000
= (2-c)

3. Industrial and/or Business Property Tax

a. Number of new industries
X Average investment/industry
X Taxable valuation rate
X School mill levy (non-ag) ÷ 1000
= (3-a)

4. Miscellaneous Tax Revenue from New Residents

a. Number of in-migrant residents
X Average per capita miscellaneous other school tax revenue
= (4-a)

5. Gross Receipts Tax

a. Gross receipts tax for rural water system =
(5-a)

6. Change in State Aid for New Students

a. Change in state aid for schools =
(6-a)

7. Change in Federal Aid for New Students

a. Change in federal aid for schools =
(7-a)

Additional Tax and Aid Revenues (add 1 a-d, 2 a-c, 3a, 4a, 5a, 6a, 7a)

Costs: Additional School Expense

1. Operating Costs for New Students

a. Number of new students
X Average/student operating expense
= (1-a)

2. Capital Outlay for New Students

a. Number of new students
X Average annual school capital outlay/student
= (2-a)

Additional School Expense (add 1a, 2a)

NET GAINS TO SCHOOL DISTRICT

Additional Tax Revenues
- Additional School Expense

= Net gains to the school district

APPENDIX II

PROCEDURES FOR ADJUSTING
SAMPLE DATA

Estimation of Population Expansion Factor and Survey Response Rate

Sample data obtained from mail and personal surveys must be converted for use as coefficients in the simulation model. Two modifications are necessary:

1. Sample data must be expanded to population data, and
2. The portion of the data attributable to the influence of the rural water system must be identified.

In this study, the following procedures was used:

$$\begin{pmatrix}\text{No. of responses from the } m^{th} \text{ survey for the } j^{th} \text{ variable in the } k^{th} \text{ government unit}\end{pmatrix} \times \begin{pmatrix}\text{Population Expansion Factor for } k^{th} \text{ government unit for } m^{th} \text{ survey}\end{pmatrix} \times \begin{pmatrix}\text{Survey Response Rate for } j^{th} \text{ variable}\end{pmatrix} = \begin{pmatrix}\text{Coefficient for use in simulation model for } j^{th} \text{ variable for } k^{th} \text{ government unit}\end{pmatrix} \quad (1)$$

where

$$\text{Population expansion factor} = \frac{1}{\text{sampling rate for members in } k^{th} \text{ government unit for } m^{th} \text{ survey}} \quad (2)$$

$$\text{Survey response rate} = \frac{\sum_{i}^{n} \text{influence weights}}{\text{number of positive responses in total sample}} \quad (3)$$

The population expansion factor which is used to expand sample data to population data was developed for each government unit for each survey. An overall sampling rate for members in each government unit for each survey is available from sample selection information. The reciprocal of the appropriate sampling rate is then used as the factor to expand the sample for each survey to the population for the appropriate government unit.

A survey response rate was also developed for each variable for which respondents were asked to evaluate the influence of the rural water system. The survey response rate identifies the estimated proportional influence of the rural water system on each of these variables as indicated by member responses to selected questions in each survey. The general procedure for developing each survey response rate was to ask each respondent if a particular change had occurred or action had taken place. If so, did the rural water system have no, some, or much influence on the change or on their decision to initiate the action? Responses were assigned weights of 0.0 for no influence, 0.5 for some influence, and 1.0 for much influence. For each question, these weights were summed and divided by the number of positive responses as shown in equation (3).

The use of the population expansion factor and survey response rate can be illustrated by application to a specific case. For example, in Brookings County for the personal survey, the overall sampling rate for members, new

and old combined, is 10.44%. The reciprocal, 9.58, is then used to expand any sample numbers from the personal survey to the population consisting of all rural water system members in Brookings County. Let's assume two Brookings County rural water members included in the sample report making home improvements. This sample number of home improvements is expanded to a population estimate by multiplying it by the Brookings County personal survey population expansion factor of 9.58. Thus, it is estimated that approximately 19 rural water system members in Brookings County remodeled their homes in the period covered by the survey.

The survey response rate is calculated for the home improvement variable. The number of members who indicated they had made home improvements is 27. Of these 27, one respondent said the rural water system had much influence on the decision to remodel and this response was assigned a weight of 1.0. Another respondent stated the rural water system had some influence and that response was assigned a weight of 0.5. The remaining 25 respondents stated the rural water system had no influence and these responses were assigned a weight of 0.0. The sum of the weights equals 1.5. Thus, for the home improvement variable:

$$\text{Survey response rate} = \frac{1.5}{27} = .055 \qquad (4)$$

The population estimate for Brookings County, 19, is multiplied by the survey response rate for the home improvement variable, .055, to extract the number of those home improvements attributable to the influence of the rural water system. Or combining all of the steps,

$$2 \times 9.58 \times .055 = 1.05 \qquad (5)$$

(coefficient used for the home improvement variable in the Brookings County simulation model)

This coefficient is used along with the value of the home improvement to estimate the change in assessed valuation in Brookings County which results from home improvements undertaken because of the installation of the rural water system. For instance, if the average value of home improvements is $3,250, the increase is assessed valuation is $3,250 times 1.05 or $3,412. From this change, increases in tax revenues are calculated.

Table 3 summarizes information information on the survey response rate. All variables obtained from either the mail or personal surveys in which the respondent was asked to evaluate the influence of the rural water system are included. The number of respondents in the entire sample who indicated a positive response to questions on each of the above variables are listed under "Number of positive responses." The third item in the table is the survey response rate for each of the variables along with the survey on which it is based.

Table 3. Summary of Survey Response Rates by Variables and Survey.

Variable	Number of Positive Responses	Survey Response Rate	Survey[a]
1. Number of new housing units	9	.220	PS
2. Number of older homes	38	.140	PS
	43	.700	MSL
3. Number of home improvements	27	.055	PS
	11	.500	MSL
4. Number of acres of agricultural land	47	.680	PS
5. Number of farmsteads	38	.550	PS
6. Number of improved farmsteads	25	.060	PS
7. Number of inmigrants	78	.051	MS
	0	.000	MSL

[a]Survey Instruments
MS = Mail Survey of Township Residents
PS = Personal Survey of Township Residents
MSL = Mail Survey of Lake Home Residents

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