AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
http://ageconsearch.umn.edu
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

Staff Papers Series

P80-18 August 1980

ECONOMIC EFFECTS OF WETLAND

ACQUISITION ON RURAL ECONOMIES

Jay A. Leitch

Department of Agricultural and Applied Economics

University of Minnesota
Institute of Agriculture, Forestry and Home Economics
St. Paul, Minnesota 55108

ECONOMIC EFFECTS OF WETLAND ACQUISITION ON RURAL ECONOMIES

by

Jay A. Leitch

August 1980

Report to U.S. Fish and Wildlife Service, Mid-Continent Waterfowl Management Unit, Fergus Falls, Minnesota. Order Number 32582-0024-FY 80 of 3-11-80.

Staff papers are published without formal review within the Department of Agricultural and Applied Economics.

ACKNOWLEDGEMENTS

The author is most grateful to those who provided helpful comments and assistance in the preparation of this paper. Dr. K. William Easter, Dr. Wilbur Maki, Mr. Ron Dorf, and Dr. John Waelti, all of the Department of Agricultural and Applied Economics, University of Minnesota, reviewed drafts and provided constructive comments. Appreciation is also expressed to Mr. Carl Madsen of the U.S. Fish and Wildlife Service, Fergus Falls, Minnesota, for financial support and provision of data, in addition to his reviews and reviews he obtained from other FWS personnel. The author accepts responsibility for any errors that remain in logic, calculations, or text.

CONTENTS

ABSTRACT

The wetlands issue, in a three county portion of the prairie pothole region, as it relates to land-use decisions involving cropland and wetland habitat is discussed. An input-output framework is employed to assess the economic impacts of U.S. Fish and Wildlife Service wetland acquisition on rural economies. The local gross business volume resulting from an acre of cropland is estimated to be greater than for an equivalent sized wetland habitat parcel. However, the employment and personal income to households is larger for the wetland parcel. This is due to larger income multipliers in sectors serving wetland users than in agricultural sectors. These findings may be typical as long as wetland acquisition is not increased many times its current proportion of total land area. The results are most sensitive to the assumed personal disposition of land payments made by the FWS, and also to assumptions about use of privately owned wetland and local expenditures by users of public wetland. As such, conclusions drawn should be treated cautiously until more solid data are obtained.

ECONOMIC EFFECTS OF WETLAND ACQUISITION ON RURAL ECONOMIES

Jay A. Leitch

INTRODUCTION

The prairie pothole region of North America produces about one-half of this continent's waterfowl (Crissey, 1969). This region covers about 300,000 square miles in the prairie provinces of Canada and the upper midwest. About one-half of the duck production in the lower 48 states occurs in the prairie pothole region (Hammack and Brown, 1974). This area is also important for migration since it is in the center of the Central flyway, with the Mississippi flyway on its eastern fringe.

Within the state of Minnesota, the prairie pothole region coincides roughly with the area of tall grass prairie (Mann, 1955). An area of approximately 25,000 square miles in 28 counties, from Polk in the north to Murray in the south, remains important for waterfowl. The Minnesota prairie pothole region is generally important because of its location in waterfowl flyways. The state has also received attention regarding wetlands issues due to its inclusion in the federal Water Bank program, the Fish and Wildlife Service wetland easement and acquisition programs, and ASCS cost-sharing programs for drainage (Leitch and Danielson, 1979).

The prairie pothole region is also a highly productive agricultural area. The prairie pothole region is a part of the North American Great Plains agricultural region. Included in the landscape with potholes are a part of the corn belt, the Red River Valley, North Dakota's durum triangle, a bit of dairyland, and a lot of wheat growing country. These rich prairie soils produce some of the highest yields in the nation.

Minnesota ranks in the top 10 states in the production of many crop and livestock types (Minnesota Agricultural Statistics-1978). Prairie pothole counties rank in the top crop and livestock producers within the state. If adequately drained, many wetlands (potholes) in these counties can be at least as productive as adjacent upland cropland, and oftentimes more productive.

The incentives facing wetland owners to drain, namely for the production of income producing crops, usually outweigh the incentives for preservation. To society, the value of wetlands may be greater in their natural state, due to

the common property nature of the products and services of wetlands. In addition, the individual owner may have difficulty collecting payments for most of these recreational and amenity benefits.

Recognizing the social value of wetlands in their natural state, federal and state agencies have initiated programs that provide payments to maintain wetlands. Oftentimes, these incentive payments are greater than would be the net returns an owner could receive by draining, but due to social, political, and institutional pressures they choose not to participate in public preservation programs (Leitch and Danielson, 1979).

The decision by the land owner to drain or preserve a wetland is primarily based on a comparison of the net benefits of the alternatives. Although the owners may be faced with uncertainty regarding costs of drainage, net returns after draining, or potential sources of preservation payments, social pressures can sway the decision toward drainage. On the other hand, local government and business income flows may be a function of land use, especially in an area where extensive use of land in the form of crop and livestock production is the basis of the economy.

Objectives

The objectives of this paper are: 1) To investigate the extent to which cropland is taken out of production by wetland acquisition by the U.S. Fish and Wildlife Service (FWS); 2) To illustrate the regional income and expenditure flows that stem from natural wetlands and drained wetlands converted to cropland; 3) To critically evaluate the use of regional income and expenditure flows in assessing the economic effects of cropland conversion to wildlife habitat; and 4) To estimate the effects of such changes through application of an appropriate tool for regional economic analysis.

Study Area

Three west central Minnesota counties--Douglas, Grant, and Otter Tail--will be the focus of this paper (Figure 1). These three counties are in the prairie pothole region. They are primarily agricultural and have both drained and natural wetlands. The counties are in State Region Four, which will be a baseline area (Figure 2a). Mann (1979) identified significant portions of the three county area as "first priority for wetland preservations in the prime agricultural and agricultural-transition area with major wetland concentrations."

Several previous studies involving economic impacts have had as their study areas all or a portion of State Region Four or the current study area. Rife (1972) examined the WesMin RC&D. RC&D's were forerunners of State Planning Regions, and as indicated on Figure 2b, the WesMin RC&D had five counties in

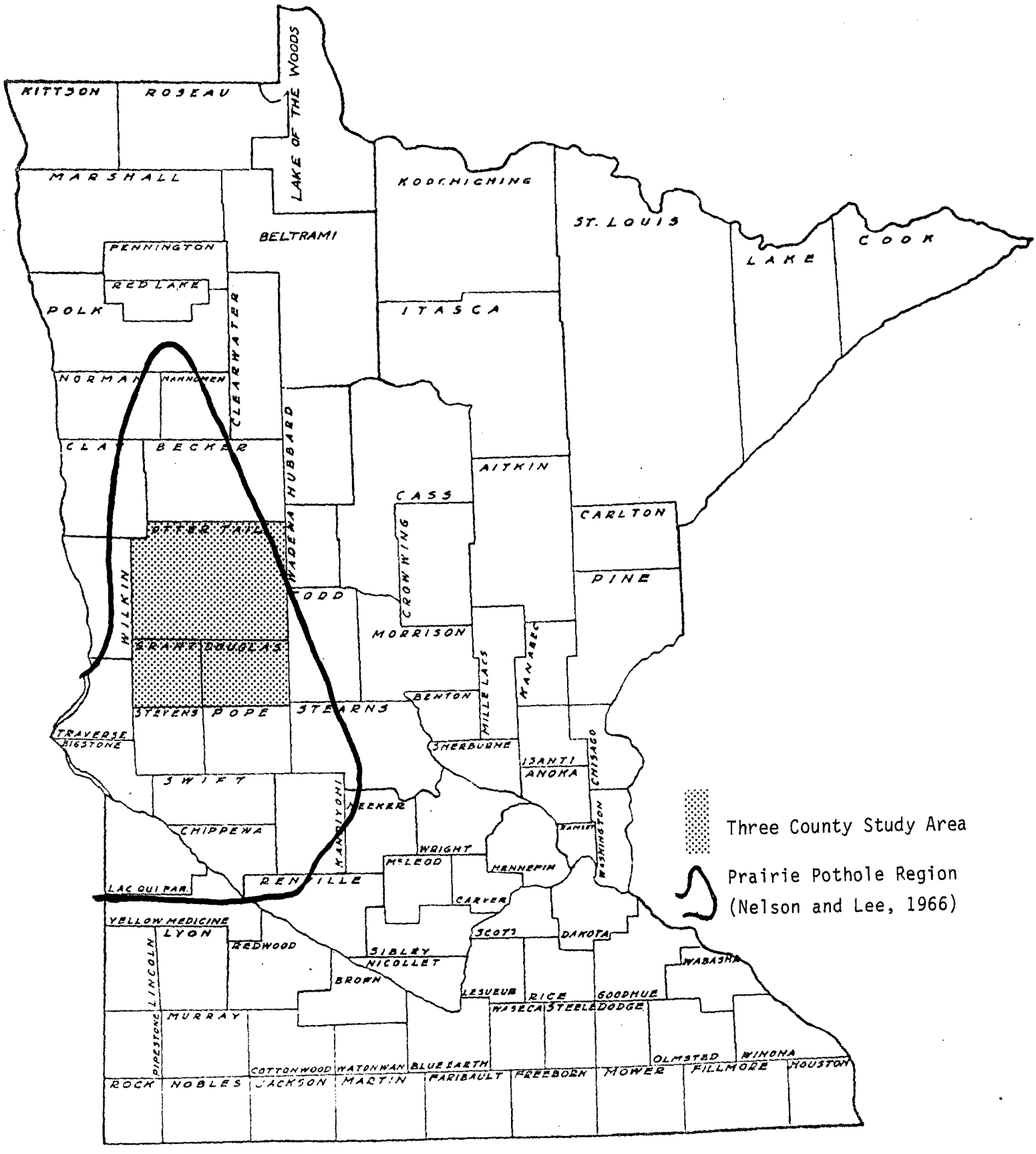

FIGURE 1. Three County Study Area

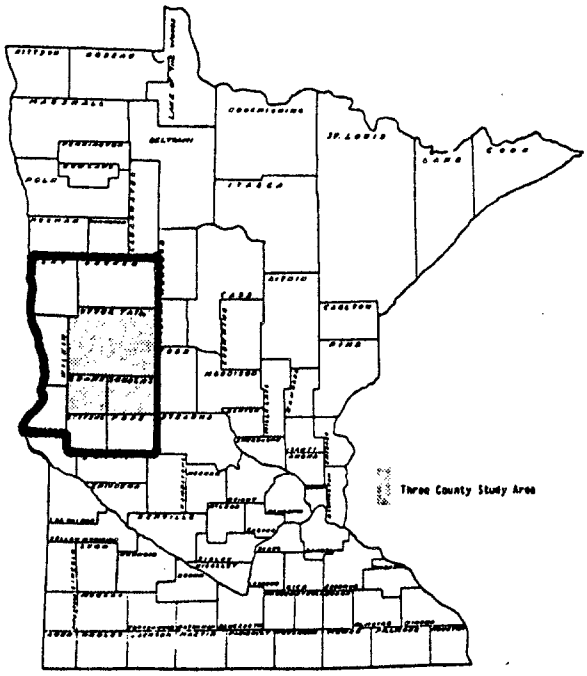

FIGURE 2a. State Region Four

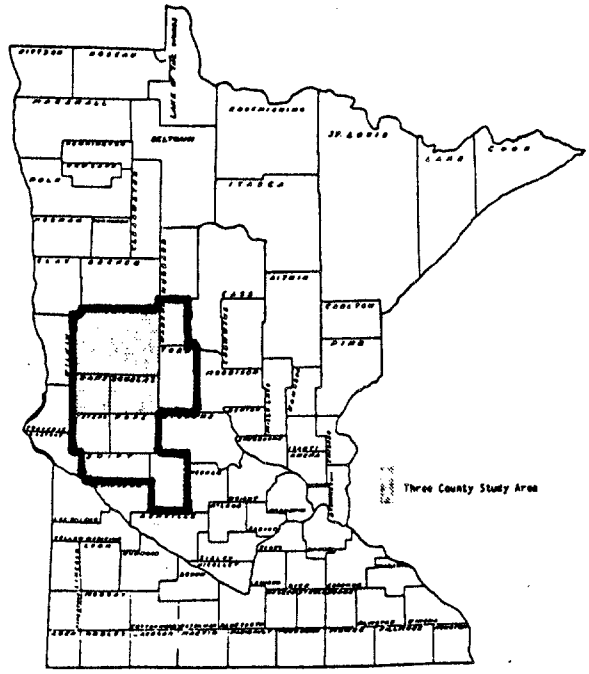

FIGURE 2b. WesMin RC&D

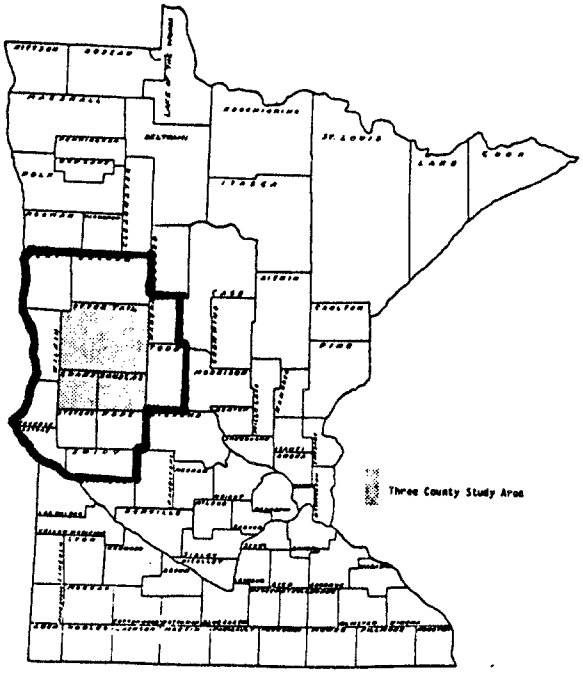

FIGURE 2c. Maki, 1978 Study Area

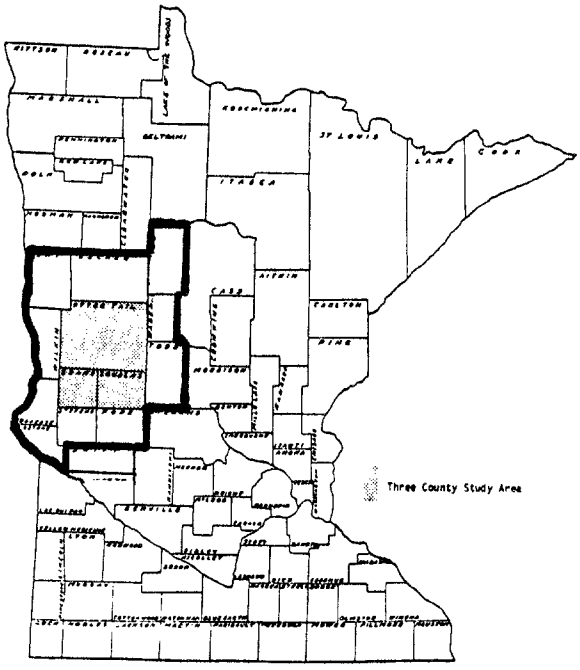

FIGURE 2d. Maki, 1974 Study Area

common with State Region Four, including the three study area counties. The WesMin Project Plan identifies agriculture as the main industry and employer of WesMin residents, followed by recreation, manufacturing, and forestry. The three counties were shown to have a total 1970 population of 76,451, down from 79,143 in 1960, a common trend in rural Minnestoa (Table 1). The three study area counties have a total land area of nearly 2 million acres, or about 4 percent of the state's area, while having only 2 percent of the population.

TABLE 1. Selected Statistics for Study Area Counties

County	Population 1960	Population 1970	Land Area (acres)	Water Area (acres)	Total Area (acres)
Douglas	21,313	22,892	397,201	65,519	462,720
Grant	8,870	7,462	342,778	24,582	367,360
Otter Tail	48,960	46,097	1,242,469	173,851	1,416,320
Percent of State	2	2	3.8		

SOURCE: Rife, 1972, WesMin Project Plan.

Maki (1979c) has estimated and projected total employment and earnings in specified industries in all Minnesota substate regions through the year 2020. Large reductions are projected in Region Four's agricultural employment (Appendix Table A1). Earnings, however, are projected to remain rather constant in the agricultural sector, while increasing in all other sectors except mining (Appendix Table A2). Population in Region Four is projected to increase from 186,000 in 1970 to 220,000 in 2020. This seems contrary to Rife's data showing declines in the study counties' population, and may be due to Region Four which includes the Minnesota portion of the Fargo-Moorhead SMSA.

Changes in Region Four's employment are expected to be largely determined by national forces (exogenous) such as total U.S. employment, earnings, and income; or specific industry shifts in demand and output (Maki, 1979c). Excess employment in a region is said to provide the export capability of the region, i.e., employment in a given industry within a region that is in excess of that considered normal for the region. Normal employment is that which is needed to support local consumption based on national industry employment levels. Agricultural excess employment in State Region Four accounts for 65 percent of total excess employment in that region (Table 2). This implies that regional export earnings are largely dependent upon agricultural activity.

TABLE 2. Excess Employment in State Region Four Industry

Industry Group	Percentage of Excess Employment
Ag, For, & Fish	65
Mining	0
Construction	1
Manufacturing	3
Trans, Comm, & Util	3
Trade	12
Finance, Insurance, and Real Estate	0
Services	16
	100

SOURCE: Maki, et al., 1979, p. 29.

The impact of irrigated agriculture on the study area economy was investigated by Maki, et al. (1978). Their findings include:

> Agriculture is the primary source of economic support for the study region. It is a dominant part of the economic base in both areas, although in the east it shares its dominance to an increasing extent with manufacturing and recreation-based trade and service industry. (p. 34)

> Agricultural employment accounted for 20.48 percent of total employment in West Minnesota as compared with 3.64 percent for the United States . . . . Thus, agriculture, state government and the resort industry account for practically all of the economic base of the region. (p. 27)

The counties included in this West Minnesota study relate to the three counties in this report (Figure 2c). Projections of land in farms and and cropland made in Maki's study imply an aggregate decrease in both in the three study area counties. Otter Tail County had a projected increase in cropland, while Douglas and Grant showed a decline.

Another study of this general area, including the three study area counties, dealt with area financing of water resources development (Maki, 1974). This study reaches the now common conclusion that the region is dependent economically upon agriculture and recreation. Even though the area is not exactly contiguous with those discussed above--it includes all of Region Four, plus five adjacent counties--the multipliers developed can be assumed to fit Region Four reasonably well.

This brief look at the economy of the study area and surrounding area--Region Four--illustrates the importance of agriculture and the increasing place recreation will play in the economy. The issue that this paper addresses is the regional economic impact of a land-use change from agricultural to recreational.

Acquisition Induced Land-Use Changes

The Duck Stamp Act of 1934 first authorized the U.S. FWS to improve and maintain wetland habitat for migratory birds. A 1958 amendment (PL 85-585) allowed purchase and lease of small wetlands and pothole areas. The first wetlands to be purchased in Minnesota were in 1962. Since that time and through 1978, 120,000 acres have been purchased by the U.S. FWS in the state. Over 29,000 acres have been purchased in the three county area (Table 3).

TABLE 3. U.S. FWS Acquisition, 1962-1977, Otter Tail, Grant, and Douglas Counties

County	Wetland Acreage	Adjacent Upland Acreage	Total Acreage	Number of Purchases	Average Size
Douglas	2,733	4,488	7,221	97	72 acres
Grant	3,178	4,545	7,773	120	65 acres
Otter Tail	4,938	9,100	14,038	172	82 acres
Totals	10,849	18,183	29,032	389	76 acres

SOURCE: U.S. FWS, office files, Fergus Falls, Minnesota, 1979.

A frequent complaint of local decision makers, primarily county commissioners and town board members, is that too much cropland is taken out of production by FWS habitat purchases. The data in Table 3 indicate that about 63 percent of total acreage purchased was adjacent upland. Conceivably, this upland was not all cropland, but a portion of the wetland purchased may have been converted to cropland had drainage not been precluded by FWS purchase. For the sake of exposition later in the paper, we will assume that the entire 76 acre average purchase would have been brought into production had not it been purchased by the FWS. This assumption will bias the outcome toward the cropland alternative, rather than the wetland option. The annual average amount of land purchased by the FWS has been about 2,000 acres in the three counties. As the number of available wetlands declines, due to purchase or alteration, this annual total will decline.

Staging or timing of FWS purchases has a two pronged effect. If purchases are delayed, the remaining wetlands may be drained, or be otherwise unavailable. If all purchases are made in a relatively short period by the FWS, it may have adverse short-run effects, greater than if purchases were spread

out over time. Perhaps if U.S. FWS acquisition goals by county were identified, an optimal, least-cost timing could be determined.

The significance of these FWS induced land-use changes seems small when compared to other ongoing changes in these counties. The Minnesota Conservation Needs Inventory (SCS, 1971) indicates a variety of land-use changes occurred between 1958 and 1967 (the time span covered by the CNI). Although this was during a period when the Soil Bank Program was winding down, the cropland acreage in Douglas and Otter Tail counties still declined. The 1978 Minnesota Agricultural Statistics shows that there is more cropland in these three counties than in either 1958 or 1967. This recent increase in cropland may have been stimulated by the high agricultural product prices in the early 1970's and the advent of bigger farm machinery, better suited for large-scale farming. At the same time as cropland was increasing, an interstate highway traversed the three county area, cities were growing, and new residences were being built in rural areas.

There are obviously factors affecting land use in these rural counties that overwhelm the effect of wetland purchases by the FWS. For example, interstate highway 94 took about 2,000 acres for its construction and right-of-way (25 acres per mile for 80 miles). The 18,183 acres purchased by the FWS over a 16 year period is only 1.5 percent of the total cropland in the study area and less than one percent of total land area. This highway alone occupies 1/10 of one percent of the total land area.

I. The Issues

Despite the relative insignificance of cropland taken out of production by FWS acquisition, local decision makers believe there are several problems that arise from public ownership of land in their jurisdictions. Problems include economic effects, land management problems (e.g. weed control, wildlife depredation), and threats to the autonomous decision-making authority of local public officials and citizens. DeBates recognizes the importance of satisfying local decision makers. He observes that "County governments in the Prairie Pothole Region are strong, locally-oriented groups. Their support is needed to carry on an effective wetland preservation program." (1967, p. 326) And, he further alludes to the potential impact of state or federal ownership: "In some cases, the federal or state ownership of key wetlands can result in abandonment of the whole proposal (proposed ditch systems)." (p. 327)

Potential economic issues associated with public land ownership (wetlands acquisition) arise from the change in land use from cropland, grassland, or woodland, to wildlife habitat. These include changes in income flows within the local economy, reductions in tax revenue, and loss of employment opportunities. Acquisition by the FWS can result in diminished and redistributed flows of local income, especially where land previously used for crop production is shifted to nonincome producing uses. The purchase of crop production inputs within the region declines, thereby affecting expenditures and incomes in sectors directly and indirectly tied to the crop production activity. The impact is accentuated where irrigated cropland is involved, since costs and returns per acre are generally higher than from dryland.

The Soil Bank Program of the late 1950's and early 1960's took cropland out of production. Taylor (et al., 1961) note that "Probably the most obvious effects are the loss of marketing margins from the decreased use of production inputs and from the reduction in volume of output handled. Other income impacts stem from changes in consumption expenditures by the soil bank farmers." (p. 17) Although the Soil Bank took a high percentage of land out of production (18 percent in the counties studied by Taylor), its impacts can be likened to an extreme of what would happen in the agricultural sector with a similar level of wetland aquisition. There may be offsetting income flows with wetland acquisition, however, as will be discussed later.

Wyckoff (1977) speculates that economies of size may also be important for firms in small, local communities:

> The volume of business generated may be insufficient to approach the firm's lowest cost output. Yet, because the service is demanded, the firm will remain in business as long as it can make an "acceptable" level of income. However, if economic activity in the area declines because of changes in public land use, the businesses may become uneconomic. The resultant impact on quality of life in the community would thus be much greater than anticipated. More information is needed on the effects of alternative public land use allocations on ranches, businesses, households, income level and distribution, employment, the tax base, quantity, quality, and the cost of public services. (p. 16)

Local decision makers share these concerns and should possess such information when faced with decisions regarding land use changes.

Reductions in property tax revenue for local units of government resulting from wetland acquisition impose significant burdens on the fiscal capability of these small taxing units if not adequately compensated for by in lieu payments. Dorf (1979) has shown Minnesota counties in Region 6W generally

do not loose any tax revenue in the aggregate, although some individual counties and smaller taxing districts may loose. Dorf concluded that in lieu payments made to counties did not filter back to the township and other taxing district levels. Townships where acquisition took place may actually lose a substantial amount of their tax revenue. Cohee (1974) found state land ownership in Wisconsin adversely affected local tax collections, which were not completely offset by in lieu payments, but in most cases other local income flows were sufficient to mitigate for tax losses. For the purposes of this paper, it will be assumed that in lieu payments are adequate to cover foregone tax receipts to local taxing entities. If this is not the case, the deficit could be empirically estimated. The problem then becomes one of either pressuring the Congress to increase in lieu payments or encouraging the counties to ensure adequate distribution of in lieu monies to affected taxing jurisdictions.

The onerous economic problem is income foregone due to reduction in agriculturally-related business activity. A shift from cropland to wildlife habitat/wetland may result in fewer employment opportunities in both agricultural and non-agricultural sectors and, in turn, a decline in population, or an increase in unemployment. This is directly related to business income flows and can be assessed after business flows have been estimated. Employment and population issues can be particularly sensitive in rural areas where employment and population have been declining and further out-migration is viewed as detrimental to local economies.

This issue takes on a different set of considerations when viewed from a national perspective. The FWS has been charged with wetlands preservation, regardless of whose taxing jurisdiction or business district the wetlands are located in. From society's viewpoint, wetlands should be preserved as long at their total net social value as wetland is greater than their total net social value as cropland. However, local politicians are quick to point out that it takes real dollars to buy snowplows and build roads, derived measures of society's value of wetlands will not help meet these real fiscal obligations. Local Minnesota businessmen are not concerned about option values held by Sierra Club members in New York City, or increased utility of Mississippi waterfowlers due to hunting Minnesota bred ducks, neither of which adds to local retail sales.

II. Local Dollar Flows

Farm budgets for west central Minnesota in 1978 show that each acre of corn for grain had a gross return of $166.50 (Appendix B). Nearly two-thirds of the return went for purchased inputs, or $110.53, the remainder went to the

farm operator who paid Social Security and income taxes and was left with $42.82 per acre. Corn is used as a proxy for a composite cropland acre in the study area since it is one of the more common crops grown there and has typical income and expenditure patterns for the area.

There is, at present, little substantial information on money flows resulting from wetlands use in their natural state. This is because the uses and values of wetlands, especially prairie potholes, have never been explicitly defined in terms of local economies. An abundance of literature exists on wetland values in subjective terms, but they are usually values to society, and most often are not adequately supported with empirical evidence. The task here is to identify the money flows that directly and indirectly have an impact on the local economy.

By far the largest transaction involving natural wetlands preservation is the purchase payment made by the FWS to the wetland owner. The average amount paid for wetlands purchase in the study area in 1977 was $637 (Leitch and Danielson, 1979, p. 29). This payment, at a minimum, compensates former owners for all foregone expected future income--otherwise they would not have sold--so they are at least as well off after as before the sale.

Recreational activity occurs in the area due to the presence of wetlands. The activity with some estimates of local money spent is waterfowl hunting. Although it has been argued that nonhunters value natural amenities at least as much as hunters, their activities are much harder to quantify in dollar terms (Jaworski and Raphael, 1978). Leitch and Scott (1978b) have estimated that North Dakota wetlands generate approximately $25 of local expenditures by hunters per acre of waterfowl habitat. Estimates of waterfowl hunter expenditures per acre of Michigan coastal wetlands have been made at $31.23 per year (Jaworski and Raphael, 1978). Hunter expenditures can vary considerably depending on wetland characteristics, especially location. The North Dakota estimate will be used herein for three reasons: 1) it is geographically closer to the study area; 2) it is for prairie potholes; and, 3) it is more conservative than the Michigan value. Sorenson (1975) estimated that North Dakota hunters spent 75 percent of their recreation expenditure in the service sector and the remaining 25 percent in the retail trade sector.

Furbearer harvest is an activity that generates local revenue streams as a result of wetlands. Trapping can be either a recreational experience or a serious business. The annual per acre value for muskrats and raccoon harvested in Michigan wetlands was estimated to be $30.44 (Jaworski and Raphael, 1978). Due to the high value of furbearers in recent years and lack of a better estimate, $30 will be used to approximate Minnesota's furbearer sales per acre of

wetland habitat.

The expenditures for operation and maintenance of wetlands areas owned by the FWS can contribute to local business. For example, if considering only Otter Tail County, the operation expenditures of FWS wetland activity would be tremendous since a FWS office is located there. The annual budget of this office, excluding acquisition monies, is approximately $1.2 million (Madsen, 1980). The operation and maintenance activities--such as weed control, sign maintenance, wildlife propagation, and habitat establishment--on an average wetland acre resulted in $22 spent per acre per year.

Other local values espoused in the literature, but basically unquantified, are flood protection, groundwater recharge, and educational and scientific study areas. Estimating values for these functions, much less estimating local money flows, is difficult at best given the present state of the art in wetlands economics.

In summary, the direct money transactions due to natural wetlands acquisition, operation, and maintenance by the FWS, quantifiable at the local level are 1) the purchase outlay, 2) hunter expenditures, 3) FWS operation and maintenance outlays, and 4) furbearer sales. These, at least, are real money flows that can be identified and measured at the local level.

III. Review of Impact Assessment

Regional economics has long been concerned with the economic impact of plant location, large-scale water projects, changes in industry structure, and natural resource development. A variety of techniques have evolved to estimate these impacts on regional economies. Some of the general approaches are input-output, economic base, location quotient, expenditures, shift-and-share, gravity/potential, and most recently, econometric methods (Maki, 1979b; Bendavid, 1974; Isard, 1975; and Emerson and Lamphear, 1975). Many of these have been applied in forecasting change due to relatively important shifts in industry structure, whereas this paper is concerned with small shifts in land-use which in turn affect levels of industry income flows only slightly.

Estimating the expenditures recreationists make locally has been a popular method of assessing the impact of recreation-oriented activity. Most often, however, this has been accomplished for site-specific activity. Money spent by recreationists can affect local economies by contributing to service industries' business, employment, and government revenue (Arthur D. Little, Inc., 1966).

There is an abundance of recreation expenditure studies which estimate the total expenditures made in a local economy. Cohee has estimated the economic impacts of Kentucky State Parks (1976) and state land ownership in Wisconsin (1974). Cohee's study of Wisconsin state land ownership uses a comprehensive balance sheet of induced and foregone dollar flows resulting from a change from private to state ownership. Some of the items he includes are changes in assessed valuations on tax rolls of municipalities and school districts, DNR payments-in-lieu of taxes, loss of private land-use income, added trade and income to local businesses, changes in costs for local government services, employment opportunities lost and gained, and resource conservation of the watershed involved. He cautions the reader that "it is important to recognize that since this report concerns local impacts of state ownership, it does not deal with the broader values of these areas on the entire state." (p. 1) The same caveat is necessary when estimating the local impact of wetlands acquisition. Cohee concludes " . . . if the loss of farm income can be kept low, by minimizing purchase of farm-income-producing tracts, and the state-acquired lands generate sizable amounts of trade and income to local business establishments, there is a real chance for a favorable net balance in the economic impact of DNR ownership." (p. i) Recalling the discussion of the wetlands problem above, one of the primary concerns of local decision makers was taking land out of agricultural production.

The economic impacts and benefits by local county, region, and other parts of Kentucky of state parks is estimated by Cohee (1976). He employs a balance sheet, similar to his Wisconsin study, detailing the economic implications from initial acquisition costs to annual recurring expenditures, taking into account losses due to changes in land use. He does not, in either study, employ multiplier effects of spending in the local economy, but asserts that the overall effects would be to approximately double the income level. Cohee cites Somersan (1976) for developing a general guide of doubling first round expenditures to estimate total local impact.

In response to claims that state land-buying in Wisconsin adversely affected the tax base, Doll (1961) estimated the impacts of a state-owned wildlife area. Although the study addressed taxes, his overall conclusion was supportive of the area's acquisition:

> Compared to this general trend (increasing government services), the small increases brought on in scattered areas by the department's land-buying activities are just that--small increases. When we balance them against the contribution these areas make, both to the

> local economy and the public welfare, there isn't much doubt that public hunting and fishing grounds, state parks and state forests are an asset rather than a liability to any community. (p. 15)

Doll makes the mistake of generalizing the results from a study of Crex Meadows Wildlife Area, where little agricultural production was displaced, to state-owned land in general.

Expenditure studies such as these can provide valuable insights into the money flows that are affected by public land acquisition, but they are less than complete if they do not include indirect effects, especially for foregone business. In addition, comprehensive studies (e.g. Cohee) are best for site-specific cases such as parks, and require an extremely complex and time consuming bookkeeping system. Wetlands acquisition is accomplished in small parcels (averaging 76 acres in the study area), and is more important as a system than as a collection of individual recreation sites. Expenditure and tax information is needed for assessing acquisition impacts, but it cannot alone estimate the interindustry linkages that cause differential impacts from land-use changes.

Input-output analysis is a technique for tabulating and describing the linkages or interdependencies between various industrial groups within an economy.[1] The economy considered may be the national economy or an economy as small as that of a multicounty area. Production by any sector requires the use of inputs, or direct requirements. Some of these will be obtained from outside the region, but many will be produced by and purchased from other sectors in the regional economy. Indirect requirements are a result of additional rounds of input requirements of supporting industry. Total direct and indirect input requirements of each sector are called the input-output interdependence coefficients multiplier.[2] Each coefficient represents the total (direct and indirect) input requirement that must be produced per dollar of output for final demand. Final demand is output by a sector that is sold outside the region. Agricultural crops is one example of this.

---

[1]The input-output model was initially developed and explained by Leontief in 1951. More recent literature on I-O analysis includes Isard (1975), Miernyk (1965), and Maki (1979b) who discusses the literature in detail.

[2]The actual development of input-output interdependence coefficients (multipliers) involves three steps. First, a transactions table is constructed that shows the purchases and sales by each of the sectors to each of the others. This is the most difficult and costly step in I-O analysis and is often done using secondary data. Next, the technical coefficients table is developed from the transactions table, expressed as decimal fractions of column totals. The final step is to subtract the technical coefficients table from an indentity matrix and invert the result. The total of each column of the multiplier matrix shows how much total activity will be generated in the system by one dollar of new income to a sector (sale to final demand), both directly and indirectly.

In addition to the problem of expensive data collection requirements, I-O analysis has other problems. Bendavid (1972) discusses several of the problems with I-O analysis and concedes that despite its shortcomings, there is a trend toward increased use of I-O in regional analysis. Hoppe (1978) suggests that there is the possibility that errors can creep in when interpreting data and fitting them into the model, and it is not often clear how the economic changes should be measured or which multiplier should be applied. Isard (1975) notes the time frame for realization of the full impact of the multiplier is unknown. In addition, the costs of periodically reviewing the tables can be more than the benefits of their use (Gupta, 1973).

Problems aside, I-O is currently the best available research tool for evaluating marginal changes in industry output at the regional level according to Isard:

> With all these serious qualifications to the assumptions we have made, coupled with an inability to take into account numerous social, political, and environmental factors, we may conclude that perhaps it is misleading to use input-output calculations; and, when we are in a critical mood, we may be inclined to discard this technique as a tool of analysis. If we do so, however, we have nothing better to put in its place, and in all probability can only find something that is worse. The literature on national, regional, and urban growth is replete with bold attempts to dig effectively into development phenonema. So far, nothing has emerged that is superior as a tool to the linear systems approach that characterizes input-output, . . . (1975, p. 131)

Maki succinctly agrees "The input-output method is the best known approach in the estimation of regional multipliers." (1979b, p. 13)

The chief advantage of an I-O model is that it allows a determination of the impacts of changes in demand on individual industries as well as the community as a whole. Once constructed, I-O models can be used to estimate impacts from all sorts of industry changes, and very often they are available as spinoffs from other studies. I-O models can be fitted to a region without expensive survey techniques by using location quotients or other methods to fit a national or similar region's model, but this may still not be an easy task. Also, one or two key sectors may be surveyed with only the aggregate technical coefficients for all other industries. Hoppe (1978) used a regional model from Texas to help construct selected sectors in a regional model in Minnesota. He argues (p. 26) ". . . in its place, the small-area input-output

model is valuable. It provides a sector-specific picture of the economy for a particular point in time. It also allows a qualified analyst to quickly perform a detailed analysis of the effects of changes in a local economy."

Another short-cut method of developing input-output coefficients is the tax-survey method as outlined by Henry, et al. (1980). State tax department data, a reliable and available data base, are used to provide sales and expenditure data by type of business. Personal interviews can then dispense with asking for sensitive income data and as such, interviewers will have a much higher level of cooperation from business managers. They found the method to be quite successful in rural North Dakota counties, and added that it is possible to keep coefficients current with very little cost by referring to tax data.

The range of multipliers estimated for industrial sectors in Minnesota is quite large, depending on location and assumptions regarding imports, exports, and what to include in the multiplier. Hughes (1970) estimated the resort sector multiplier (direct plus indirect) to be 2.8 (similar to a Tiebout long-term multiplier) with variations by resort income class in Itasca County. Maki (1980) estimated both demand and supply multipliers for mineral resource development in northeast Minnesota. The long-term demand multiplier he estimated was 3.08, compared to 1.33 for the short-term. Hoppe (1978) estimated the direct, indirect, and induced multipliers, based on secondary data from Minnesota counties, for the agricultural crops sector to be 2.26; a trade multiplier of 2.19; and a other services multiplier of 2.23. Maki, et al. (1978) estimate short run multipliers for west central Minnesota for agricultural crops, retail, and services to be 1.231, 1.294 and 1.161, respectively. Differences in the magnitude of these multipliers are due, in the most part, to the industrial structure of the region, the size of the region, the openness of the region, the time period considered, and differences in the proportions of total outlays for primary inputs and imports within and between industries.

Mapp and Badger (1970) estimated short-run I-O multipliers for recreation in Oklahoma. The output multipliers in their seven county study area were 1.12 for agricultural crops, 1.11 for trade, 1.13 for personal services, and 1.18 for the recreation sector. In comparison to these estimates, Green (1969) estimated the agricultural sector long-term multiplier to be 3.875, and the service sector multiplier, which included recreation, to be 3.627 in a ten county rural area in North Carolina. A tourism multiplier for southwestern Wyoming was estimated to be 2.067 by Kite and Schutz (1967). This is

close to the "doubling" estimate of Arthur D. Little, Inc. (1966). An estimated multiplier for tourism close to these two was a multiplier of 1.8 for tourism in Clinton County, New York (Hiser and Fisher, 1976). Agriculture had the highest multiplier, 3.02 in an I-O study of recreation in Door County Wisconsin (Strang, 1970). Door County's tourism multiplier was 2.17. A tourism multiplier for the Isle of Skye in the Highlands of Scotland was estimated by Brownrigg (1975) to be 1.24, but varied considerably by tourist type from 1.89 to 0.23.

The essence of these last two paragraphs has been to illustrate the variability in I-O multipliers. Unless one has available an I-O model constructed specifically for the region being examined, it is difficult to select the appropriate multipliers.

Income and employment multipliers are oftentimes more important indicators of regional impact than output multipliers. Output multipliers may be high, but if they are for industries with high output/labor ratios, those industries may employ few people.

The input-output model is appropriate to evaluate marginal land-use changes in terms of regional impact only if much internal interdependence exists. Direct, indirect, and induced effects can be estimated. Direct effects are those payments from outside the region to sectors inside the region producing export commodities. Indirect impacts are those that occur within the exporting sector as a result of the sale to outside the region. Induced effects are those that ripple through the sectors that support the exporting sector, the residentiary sectors. In addition to effects on the levels of gross output, employment level effects can also be estimated. The next section illustrates the use of I-O multipliers to assess the impact of land-use changes.

IV. Acquisition Impacts: An Empirical Example

The income and expenditure flows generated by cropland and wetland/wildlife habitat are presented in Table 4. For each acre of cropland taken out of production, there would be $166.50 worth of foregone sales in the agriculture sector. To offset these foregone agriculture sales, $141.50 of income to other local sectors would be generated by the wetland habitat acre.

Two alternative land uses are compared, private ownership of cropland versus public ownership of wetland/wildlife habitat. The shift of a block of land, equal to the average individual purchase by the FWS, from cropland to

TABLE 4. Income and Expenditure Flows Generated by Cropland and Wetland/ Wildlife Habitat, Per Acre, West Central Minnesota

Income or Expenditure	Dollar Amount Per Acre Per Year	Sector Receiving Income
	Cropland	
Crop Gross returns	$166.50	Ag, Crops
	Wetland/Wildlife Habitat	
Acquisition Payment	$ 64.00[a]	Households
Waterfowl Hunter Expenditures	$ 25.00	Services (75%) Retail Trade (25%)
Furbearer Sales	$ 30.00	Households
Operating and Maintenance Espenses	$ 22.00	Households (90%) Trade (5%) Services (5%)

[a]A $637/acre payment annualized at 10% yields $64.00 per year return.

part wetland and part upland habitat requires several qualifying assumptions.

Although the tract purchased by the FWS consisted of an average of 63 percent upland, it is assumed that the 37 percent wetland would have been drained and put into cropland use. The FWS may not be particularly inclined to purchase areas of wetland that were unfeasible to drain. They get the preservation benefits without acquisition. Also assume that the costs of drainage are indirectly related to the propensity of the FWS to purchase the tract. In other words, acquired wetlands would have cost very little to drain, and drainage would have been an economical decision on behalf of the farmer owner. This assumption assures that there are no unduly large injections of expenditures due to drainage activity.

To avoid one politically sensitive issue, assume that in lieu tax payments are at least adequate to compensate for foregone tax payments from the farm operator. Also assume that in lieu payments are equitably distributed so that no taxing jurisdiction gets short-changed, and that these marginal changes in land ownership do not affect state or federal grants-in-aid or revenue sharing payments.

Since the FWS already owns approximately 30 percent of the wetland in the three county area, assume that we are to the point where marginal value equals average value. In other words, the addition of one more wetland tract adds

the same amount to total value of wetlands as did the previous tract addition and as will the subsequent acquisition. This assumption is easily justifiable in the narrow range under consideration.

Further assume that wetland use is directly proportional to the availability of wetlands. This is to say, that the addition of one more wetland area will attract (or retain) users, who, in the absence of the wetland in the study area, would shift their use to other areas out of the study area. For example, waterfowl hunters will be attracted to the newly acquired tract, or to the general vicinity, or they will be attracted to wetlands in other parts of the state or midwest to hunt waterfowl. The same argument holds for the taking of furbearers for sport or commercial trapping.

Operation and maintenance expenditures made by the FWS on acquisition areas would not be made in the study area in the absence of the wetland acquisition program. As such, these O & M expenditures are assumed to be outside injections into the local economy. The entire operating budget of the FWS Wetland Office in Fergus Falls is a tremendous asset to the local business community. It is, in fact, one of the "clean" industries that communities like to attract. Without the program, this office would not be located there, but since it is an area office with administrative and management responsibilities extending over an area larger than the three counties, it will be handled separately.

The most crucial assumption of this analysis is that of the disposition of the money paid to land owners by the FWS for their habitat areas. The assumption, herein, is that the sellers invest the lump sum payment at 10 percent and spend the interest as they would spend profits from cropland. This assumption may be less critical in the short run (three to five years) than in the long run (more than seven years).

Finally, it has to be assumed that there are many other nonmarket individual and social values to both wetlands and croplands that have not been considered in this analysis. Wetlands have been claimed to have values for flood control, waste assimilation, water supply, aesthetics, and scientific and educational purposes. Cropland, as well, may possess some nonmarket/nonmonetary values that are beyond the realm of present day economic measurement. For purposes of this comparison, these nonmarket values are considered either insignificant or not applicable to a regional money flow analysis.

Using multipliers developed for Region 6D (Hoppe, 1978), the income and expenditure flow impacts of land-use conversion from cropland to wetland/wildlife habitat were estimated. Although the multipliers were not developed

explicitly for the study area, they were the best available set which included final demand, income, and employment multipliers. Region 6E is approximately the same physical size as the three county study area, has nearly the same population, has a similar rural/urban mixture, and has a comparable industry structure. It is the relationship between the multipliers, rather than their absolute magnitude, that is important when such comparisons are being made. The assumption implied is that the relative size and relationships of multipliers approximates that in the study area.

To be precise, long-run multipliers should also be estimated. However, since longer runs and larger regions both make multipliers larger, the Region 6E multipliers may approximate long-run multipliers for the study area. Using these as long-term multipliers makes the difference between agriculture, crops and services somewhat conservative, as service multipliers are generally larger in the long-run.

Several of the problems with I-O analysis do not exist in this particular analysis. First, models were available that approximate the structure of the study area, therefore avoiding costly model building. Second, time is not a problem since we are comparing effects among sectors and hypothesizing that the multipliers used would have either the same magnitude or relative magnitudes in any time span. Third, since marginal changes are being examined, the assumption of a linear production function and constant scale economies is valid.

The full employment assumption of I-O analysis can be considered met in the study area. Changing coefficients do not pose a serious concern in either the study area or Region 6E, as the industry structure is fairly stable in both areas. Overall, most of the serious concerns with I-O analysis are not issues in this particular application of the method.

Results

An average-sized parcel (76 acres) was found to generate $12,654 in crop sales annually (Appendix B). Employing Hoppe's multipliers, this annual sale was further estimated to result in $27,459 of regional gross sales, $8,390 in regional personal income to households, and provide employment for 0.87 persons (Table 5). The same parcel in FWS ownership managed for wildlife habitat, especially waterfowl production, generates $20,399 in regional gross sales, $12,642 in regional personal income to households, and provides employment for 0.94 persons.

Looking only at gross sales, one would conclude that cropland was better for the regional economy than FWS land. However, since both personal income and employment are greater for FWS land, that use of land tends to benefit the region

more, given the assumptions of the analysis. FWS lands generate more personal income because much of the dollar flow into the study area goes to households which spend it locally, as compared with purchase of productive inputs for agriculture where leakage exists through input purchases from outside the region (e.g., fuel, machinery, fertilizer).

TABLE 5. Local Economic Impacts of Cropland and FWS Waterfowl Production Area.

Activity Sector	Gross Sales[a]	Personal Income[b]	Employment[c]
	Cropland (76 Acres)		
Ag Crops ($12,654 sales)			
Multiplier	2.17	0.663	(0.0000408)(1.692)
Dollars	$27,459	$ 8,390	0.87
	Wetland Habitat (76 Acres)		
Households ($8,686 sales)			
Multiplier	1.825	1.29	(0.000082)[d]
Dollars	$15,853	$11,206	0.71
Trade ($558 sales)			
Multiplier	2.17	0.74	(0.00008)(1.316)
Dollars	$ 1,212	$ 394	0.06
Services ($1,508 sales)			
Multiplier	2.21	0.69	(0.000081)(1.392)
Dollars	$ 3,334	$ 1,042	0.17
	$20,399	$12,642	0.94

[a]Type II final demand multiplier. SOURCE: Hoppe, 1978, Table 9.

[b]Households row, direct and indirect coefficients matrix. SOURCE: Hoppe, 1978, Table 7.

[c]Ratio of employees/dollar of output multiplied by type II employment multiplier. SOURCE: Hoppe, 1978, Table 9.

[d]Households column, direct coefficients matrix used to weight type II employment multipliers. SOURCE: Hoppe, 1978, Tables 6 and 9.

V. Summary and Conclusions

The economic problems associated with FWS acquisition in three Minnesota counties were shown to be minimal, given the posited conditions. This is due, firstly, to the marginal nature of the change, and secondly, to the FWS land which was found to generate higher household income and greater employment than cropland. Since the two primary export industries are agriculture and tourism, this very small shift of income and expenditures--out of agriculture and into tourism--will not upset the existing industry structure.

Input-output analysis was shown to be an acceptable tool for estimating marginal land-use change effects on a rural economy, provided its cost of implementation was reduced. Optimally, an I-O matrix would be estimated for the study area, but a satisfactory surrogate model was found.

The analysis is sensitive to the income and expenditure flow assumptions, especially on the habitat side, and most importantly, to the assumption of how individuals treat the payment from the FWS for their lands. Significant variables affecting the outcome include the specification of sectors receiving income flows, crop prices, recreation expenditures, land owner equity position, and the very long-run implications.

Another consideration is that the FWS controls drainage on one percent of the land in the study area. It would be overly optimistic on their behalf to expect to acquire an additional one percent (where one percent is roughly one-third of all wetlands). As long as the amount of FWS-owned wetland is so small a part of total land, the assumptions and conclusion of this paper should hold. They certainly may not be valid for FWS ownership of five, ten, or even twenty percent of total land area in this study area. Increases in agricultural productivity can be expected to more than recoup production losses due to FWS acquisition for small purchases. For instance, in the time period 1962-1978 when the FWS purchased 1.5 percent of the upland in the area, yields of corn increased nearly 25 percent, while oats and barley yield increases were approximately 10 percent.

APPENDIX TABLE A1. ESTIMATED AND PROJECTED TOTAL EMPLOYMENT IN SPECIFIED INDUSTRY 1970-2020, REGION 4, MINNESOTA, SOURCE: MAKI, 1979c

INDUSTRY		ESTIMATED		PROJECTED				
NO.	TITLE	1970	1975	1980	1985	1990	2000	2020
1.	AGRICULTURE, FOR., FISH.	17677.	20372.	17682.	15396.	14221.	12809.	9748.
2.	MINING	1092.	1400.	44.	65.	45.	46.	32.
3.	CONSTRUCTION	3834.	4351.	3975.	4254.	4397.	4858.	4921.
4.	FOOD PROD.	1839.	2029.	2023.	2068.	2064.	2088.	1744.
5.	TEXTILE PROD.	20.	55.	11.	12.	10.	11.	10.
6.	APPAREL	210.	239.	271.	310.	323.	350.	333.
7.	LUMBER, FURN.	274.	312.	457.	519.	574.	654.	656.
8.	PAPER PROD.	48.	52.	53.	64.	73.	98.	109.
9.	PRINTING AND PUB.	595.	644.	305.	351.	384.	457.	495.
10.	CHEMICALS	55.	57.	59.	67.	75.	103.	127.
11.	PETROLEUM REFINING	0	0	0	0	0	0	0
12.	PRIMARY METALS	51.	72.	40.	49.	47.	54.	48.
13.	FABRICATED METALS	239.	277.	279.	345.	395.	468.	522.
14.	MACHINERY, EXC. ELEC.	337.	377.	328.	382.	423.	494.	521.
15.	ELECTRICAL MACH.	57.	61.	22.	25.	25.	30.	30.
16.	MOTOR VEHICLES	16.	22.	19.	21.	23.	27.	31.
17.	TRANS., EXC. MOT. VEH.	357.	390.	846.	894.	939.	971.	904.
18.	MISC. MANUFACTURING	794.	806.	788.	910.	1016.	1245.	1339.
19.	TRANS., COMM., UTIL.	3320.	4071.	3985.	4141.	4375.	5010.	5317.
20.	TRADE	12520.	16586.	16053.	16861.	17584.	19402.	18831.
21.	FIN., INS., REAL EST.	1444.	1925.	1986.	2284.	2526.	3100.	3527.
22.	SERVICES	9867.	13407.	12751.	13831.	15113.	17429.	20771.
23.	FEDERAL GOVERNMENT	899.	892.	850.	885.	953.	1012.	1150.
24.	STATE AND LOCAL GOVT.	10953.	12342.	13940.	16285.	17286.	19622.	22417.
25.	MILITARY	27.	17.	18.	19.	19.	20.	20.
26.	TOTAL EMPLOYMENT	66525.	80756.	76783.	80036.	82890.	90360.	93601.
27.	POPULATION	185858.	191736.	195582.	202283.	206819.	212893.	219628.
28.	TOTAL INCOME	458502.	578680.	642204.	767023.	904799.	1269034.	2207621.
29.	TOTAL EARNING	309195.	377054.	425884.	511852.	609403.	871631.	1523708.
30.	TOTAL EMP(BY RESIDENT)	66520.	80629.	78315.	81455.	83955.	90617.	93799.

APPENDIX TABLE A2. ESTIMATED AND PROJECTED TOTAL EARNINGS IN SPECIFIED INDUSTRY 1970-2020, REGION 4, MINNESOTA, SOURCE: MAKI, 1979c

INDUSTRY		ESTIMATED		PROJECTED				
NO.	TITLE	1970	1975	1980	1985	1990	2000	2020
		(VALUE IN THOUSANDS OF 1967 DOLLARS)						
1.	AGRICULTURE, FOR., FISH.	78066.	96905.	60433.	63412.	65279.	72286.	87047.
2.	MINING	4962.	6273.	441.	910.	616.	637.	840.
3.	CONSTRUCTION	23010.	23482.	27046.	32354.	38167.	53131.	87246.
4.	FOOD PROD.	8768.	11448.	15633.	17768.	19986.	25391.	35546.
5.	TEXTILE PROD.	73.	223.	54.	73.	73.	100.	145.
6.	APPAREL	619.	789.	1539.	1862.	2195.	3106.	4983.
7.	LUMBER, FURN.	1070.	1387.	2984.	3865.	4902.	7209.	12668.
8.	PAPER PROD.	287.	372.	685.	734.	965.	1648.	3105.
9.	PRINTING AND PUB.	3154.	3882.	2688.	3362.	4123.	6137.	10851.
10.	CHEMICALS	371.	470.	611.	810.	1049.	1779.	3496.
11.	PETROLEUM REFINING	0	0	0	0	0	0	0
12.	PRIMARY METALS	369.	574.	265.	339.	385.	560.	838.
13.	FABRICATED METALS	1489.	1797.	2193.	2914.	3782.	5639.	10484.
14.	MACHINERY, EXC. ELEC.	1995.	2594.	2724.	3451.	4309.	5299.	10849.
15.	ELECTRICAL MACH.	333.	417.	498.	605.	730.	1073.	1921.
16.	MOTOR VEHICLES	108.	180.	177.	233.	294.	442.	825.
17.	TRANS., EXC. MOT. VEH.	1975.	2895.	7792.	9258.	10944.	14104.	21567.
18.	MISC. MANUFACTURING	3870.	4613.	7543.	9582.	12114.	18739.	34744.
19.	TRANS., COMM., UTIL.	22261.	28481.	33169.	39944.	47573.	68147.	116390.
20.	TRADE	52992.	64995.	74458.	87800.	102524.	143368.	237215.
21.	FIN., INS., REAL EST.	8541.	10391.	13650.	17288.	21670.	33540.	63269.
22.	SERVICES	35667.	44859.	69650.	88773.	112240.	176325.	344869.
23.	FEDERAL GOVERNMENT	7452.	3644.	9958.	11990.	14298.	19839.	34603.
24.	STATE AND LOCAL GOVT.	49917.	59546.	89516.	111950.	138224.	208187.	393571.
25.	MILITARY	1844.	1837.	2176.	2574.	2964.	3946.	6627.
26.	TOTAL EMPLOYMENT	66525.	80756.	76783.	80036.	82890.	90360.	93601.
27.	POPULATION	185858.	191736.	195582.	202283.	206819.	212893.	219628.
28.	TOTAL INCOME	458602.	578580.	642204.	767023.	904799.	1269034.	2207621.
29.	TOTAL EARNING	309193.	377054.	425884.	511852.	609403.	871631.	1523708.
30.	TOTAL EMP(BY RESIDENT)	66520.	80629.	78315.	81453.	83955.	90617.	93799.

Appendix B

Cropland Income Flow Estimation

ASSUME: Corn for grain[a] is proxy for composite cropland acre.

YIELD: 90 bu. ac.

1978 Price: $1.85

Gross return per acre: $166.50

Production Expense	Cost
Seed	$14.62
Fertilizer	30.65
Chemicals	18.00
Machinery[b]	19.85
Land[b]	6.45
Grain drying	12.60
Land taxes	4.20
Crop insurance	4.16
TOTAL	$110.53

Returns Over Expenses	
SS payments	$ 6.00
Federal tax	5.50
State tax	1.65
Return for own labor	7.45
Net profit	35.37
TOTAL	$55.97

---

[a]Primary source of budget information is: Willis E. Anthony et al. 1978. "What should I grow in 1978 in West Central Minnesota." St. Paul: University of Minnesota Agricultural Extension Service, Department of Agricultural and Applied Economics, report FM 418.3 WC.

[b]Since actual cash costs of machinery and land may vary considerably among farmers in different tenure and debt situations certain assumptions were made concerning machinery debt and land equity. Actual cash flow for all farm operators for machine ownership costs were assumed to be 50 percent of the level of new entrant farmers. Cash land costs were assumed to be 25 percent of new entrant costs. These assumptions were made because only actual annual cash flows are of interest here, and also concerning land payments, they may be one of the best investments of the 1970's.

Literature Cited

Anthony, Willis E. et al. 1978. "What should I grow in 1978 in West Central Minnesota?" St. Paul: University of Minnesota Agricultural Extension Service, Department of Agricultural and Applied Economics, Report RM 418.3 WC.

Arthur D. Little, Inc. 1966. Tourism and Recreation. Washington, D.C.: U.S. Department of Commerce, Economic Development Administration.

Bendavid, Avrom. 1972. Regional economic analysis for practioners. New York: praeger.

Brownrigg, Mark and M. A. Greig. 1975. "Differential multipliers for tourism." Scottish Journal of Political Economy. 12(3):261-275.

Cohee, Melville H. 1974. Impact of state land ownership on local economy in Wisconsin. Madison, Wisconsin: Department of Natural Resource, Technical Bulletin Number 80.

_____. 1976. Impacts of Kentucky state parks on local, regional, and state economies. Frankfort, Kentucky: Office of the Secretary Kentucky Development Cabinet.

Crissey, Walter F. 1969. "Prairie potholes from a continental viewpoint." Saskatoon Wetlands Seminar. Ottawa, Ontario: Canadian Wildlife Service Department of Indian Affairs and Northern Development Report Series No. 6, pp. 161-171.

DeBates, Lawrence W. 1967. "The role of small wetland preservation in comprehensive prairie pothole region planning." Thirty-Second North American Wildlife Conference. 1967:325-331.

Doll, Arthur D. 1961. "Effect of wildlife management areas on local economy." Madison: Wisconsin Conservation Department, Crex Meadows Job Completion Report.

Dorf, Ronald J., Thomas P. Jorgens, and Gordon D. Rose. 1979. The fiscal impact of federal and state waterfowl production areas on local units of governments in West Central Minnesota. St. Paul: University of Minnesota Agricultural Extension Service, Special Report 73.

Emerson, M.J. and F.C. Lamphear. 1975. Urban and regional economics: structure and change. Boston: Allyn and Bacon.

Green, H. A. 1969. Evaluating the economic structure of a rural area: demonstration of an input-output analysis. Washington, D.C.: U.S. Department of Agriculture Economic Research Service, ERS-386.

Gupta, Tirath R. 1973. Economic criteria for decisions on preservation and alteration of natural resources with special reference to freshwater wetlands in Massachusetts. Amherst: University of Massachusetts, Ph.D. dissertation.

Hammack, Judd and Gardner Brown. 1974. Waterfowl and wetlands: toward bioeconomic analysis. Baltimore: The Johns Hopkins Press.

Henry, Mark S., Arlen Leholm, Glenn Schaible, and James Haskins. 1980. "A semi-survey approach to building regional input-output models: an application to western North Dakota." North Central Journal of Agricultural Economics. 2(1):17-24.

Hiser, Michel L. and Dennis U. Fisher. 1976. The economic impact of tourism on the Clinton County economy. Ithaca, New York: Cornell University Department of Agricultural Economics, A. E. Ext. 76-19.

Hoppe, Robert. 1978. Building a nonmetropolitan input-output model: Minnesota's Region Six East. St. Paul: University of Minnesota Agricultural Experiment Station Technical Bulletin 313.

Hughes, Jay M. 1970. Forestry in Itasca County's economy: an input-output analysis. St. Paul: University of Minnesota Agricultural Experiment Station Miscellaneous Report 95, Forestry Series 4.

Isard, Walter. 1975. Introduction to regional science. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.

Jaworski, Eugene and C. Nicholas Raphael. 1978. Fish, wildlife, and recreational values of Michigan's coastal wetlands. Wetlands Value Study Phase I. Ypsilanti, Michigan: Eastern Michigan University Department of Geography-Geology.

Kite, Rodney C. and Willard D. Schutz. 1967. Economic impact on southwestern Wyoming of recreationists visiting Flaming Gorge Reservoir. Laramie: University of Wyoming, Agricultural Experimentation Station Journal 11.

Leitch, Jay A. and Leon E. Danielson. 1979. Social, economic, and institutional incentives to drain or preserve prairie wetlands. St. Paul: University of Minnesota Department of Agricultural and Applied Economics Economic Report ER79-6.

Leitch, Jay A. and Donald F. Scott. 1978a. Nonresident hunters in North Dakota: characteristics, expenditures, harvest. Fargo: North Dakota State University Department of Agricultural Economics Report No. 126.

Leitch, Jay A. and Donald F. Scott. 1978b. "Measuring the effects of public land ownership on local economies." Fargo: North Dakota State University, Department of Agricultural Economics Paper AE78001.

Leontief, Wassily W. 1951. The structure of American Economy. New York: Oxford University Press.

Madsen, Carl R. 1980. Personal correspondence, letter dated March 14, 1980. Fergus Falls, Minnesota: U.S. Department of the Interior, Fish and Wildlife Service.

Maki, Wilbur R. 1974. Area financing of water resource development in West Minnesota. St. Paul: University of Minnesota Water Resources Research Center Bulletin 66.

_____. 1979a. "Regional economic forecasts for water and land resources planning. I. forecast system." St. Paul: University of Minnesota Department of Agricultural and Applied Economics Staff Paper Series P79-33.

_____. 1979b. "Alternate forecast methods for water and land resources planning in Minnesota." St. Paul: University of Minnesota, Department of Agricultural and Applied Economics Staff Paper Series P79-29.

_____. 1979c. "Regional economic forecasts for water and land resources planning. II. forecast series: Minnesota." St. Paul: University of Minnesota Department of Agricultural and Applied Economics Staff Paper Series P79-37.

_____. 1980. "Economic effects of mineral resource development in northeast Minnesota." St. Paul: University of Minnesota Department of Agricultural and Applied Economics Staff Paper Series P80-3.

Maki, Wilbur R., Leonard A. Laulainen, Jr. Mason Chen, and Donald R. Newell. 1978. Economic impact of irrigated agriculture in west Minnesota: "Disc" Development of irrigation and specialty crops. St. Paul: University of Minnesota Agricultural Experiment Station Miscellaneous Report 151.

Maki, Wilbur R., Gregory H. Michaels, Leonard A. Laulainen, Jr. and Mason Chen. 1979. Employment trends and projections for Minnesota and its substate development regions. St. Paul: University of Minnesota Department of Agricultural and Applied Economics Staff Paper Series P79-2.

Mann, Grady E. 1979. "Recommendations for Wetland Preservation in Minnesota." Report 4. St. Paul: Minnesota Department of Natural Resources Bureau of Planning and Research.

_____. 1955. Wetlands inventory of Minnesota. Minneapolis, Minnesota: U.S. Department of the Interior, Office of River Basin Studies.

Mapp, Harry P. Jr., and Daniel D. Badger. 1970. "Input-output analysis of the economic impact of outdoor recreation recreation in a low income area." Western Agricultural Economics Association Proceedings pp. 118-121.

Miernyk, William H. 1965. The elements of input-output analysis. New York: Random House.

Nelson, Harvey K. and F. E. Lee. "A New Center for Waterfowl Research." Naturalist 17(1): 29-32.

Rife, John (Chairman). 1972. WesMin project plan. St. Paul, Minnesota: U.S. Department of Agriculture Soil Conservation Service.

SCS. 1971. Minnesota soil and water conservation needs inventory St. Paul, Minnesota: U.S. Department of Agriculture, Soil Conservation Service.

Somerson, Ayse. 1976. "Impacts of recreation in the coastal zone: economic impact and needs of Wisconsin's great lake boaters." Madison: University of Wisconsin, Recreation Resources Center.

Sorenson, Lee A. 1975. Alternative uses of wetlands. Fargo: North Dakota State University, M.S. thesis.

Strang, William A. 1970. Recreation and the local economy, an input-output model of a recreation-oriented economy. Madison: University of Wisconsin Graduate School of Business.

Taylor, Fred R., Laurel D. Loftsgard, and LeRoy W. Schaffner. 1961. Effects of the soil bank program on a North Dakota community. Fargo: North Dakota State University, Department of Agricultural Economics Report 19.

Wyckoff, J. B. 1977. "Allocation problems of public lands in the west." Western Journal of Agricultural Economics. 2:11-20.