

Regional Economic Impacts of Implementation
of the
Conservation Reserve Enhancement Program
in the
Kansas Upper Arkansas River Basin

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April 2006

FINAL INTERIM REPORT

Funding for this project was provided by the Kansas Water Office

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Regional Economic Impacts of Implementation of the Conservation Reserve Enhancement Program in the Kansas Upper Arkansas River Basin

Executive Summary

This study estimated the potential economic impacts associated with implementation of the Conservation Reserve Enhancement Program (CREP) in the Kansas Upper Arkansas River Basin. The analysis assumed approximately 85,000 acres of irrigated land and 15,000 acres of dryland were enrolled. Following 15 years of program participation, the CREP acreage was assumed to return to combined dryland agricultural production/pasture land with irrigation water rights permanently retired.

Acreage enrollment in the CREP was projected based on land productivity and hydrologic characteristics. Associated production values were estimated using an eight-year average value of production by crop type. CRP payment schedules were then used to calculate estimates of new household income associated with CREP payments. Finally, values were calculated to estimate an amount of new recreation spending for lease hunting on fallowed lands.

Under the CREP program, it was estimated that the annual value of agricultural production would decline by about \$15.6 million (2003\$), regional household income would increase by about \$6.5 million each year, and recreation-related businesses would annually capture an additional \$285,000. This makes the total direct impact of the CREP program an annual reduction of about \$8.7 million (2003\$) annually for the 15 years of the program. For perspective, the output reduction represents about 3.0 percent of the total value of all agricultural crops production in the 10-county region.

Following the term of the CREP it was assumed the land would return to a combination of dryland agricultural production and pasture and generate approximately \$2.5 million in productive value to the region. The net annual value of agricultural production, however, was assumed to decline by about \$13.4 million (2003\$). The relatively greater impact post-CREP is due to the loss of the CREP household income payments, and is measured against the irrigated agriculture production values of the 2003 base year. The output reduction represents about 2.6 percent of the total value of all agricultural crops production in the 10-county region.

These direct economic impacts were applied to an economic model of the 10-county regional economy called a Social Accounting Matrix (SAM). The SAM can be used to estimate the indirect economic effects of an event or policy.

Under the scenario of CREP implementation, the combined direct and indirect impact to regional economic output were estimated to be a decline by about \$14.8 million (2003\$) annually. That value of activity is closely tied to about 119 jobs. Using a very broad measure of household income associated with regional productive activity, household economic welfare was projected to decline by about \$7.7 million (2003\$) annually.

Under the post-CREP scenario of the permanent conversion of irrigated cropland to dryland/pasture, regional economic output would decline by about \$17.4 million (2003\$) annually. That value of activity is closely tied to about 165 jobs. Regional household income was projected to decline by about \$9.3 million (2003\$) annually. For perspective, these are in a range of about 0.1 percent to 0.2 percent of total regional activity, depending on the impact indicator considered.

If the changes in regional economic activity into perpetuity are amortized over the 15-year period of the CREP, the overall impact of the program from its inception into perpetuity can be characterized as a single estimate of the change in regional economic output. The annualized reduction in output equals \$24,922,029 (the impact of the CREP plus production reductions into perpetuity) to be paid in 15 annual installments, or a one-time equivalent payment of \$258,682,139 (2003\$).

Applying the assumption that the economy will adjust to changes over time requires a dynamic perspective to overlay the static model output. Absent any directly applicable guidelines to be found in the

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empirical literature, a consensus forecast was generated by the research team. Application of the economic adjustment assumption resulted in a 36 percent overall reduction to \$164,717,276 from \$258,682,139. Also, if the total cost of the program were to be amortized over the 15 years of its existence, the annual cost would be \$24,922,029 with no economic adjustment and only \$15,869,239 if economic adjustments occur like those suggested as plausible.

It should be acknowledged that these long-term impact estimates are associated with a degree of uncertainty. While properly calculated and appropriately reported, there is nonetheless reason to believe that they may overestimate the long-term economic response within the regional economy by some amount. There is anecdotal evidence that the regional economy adjusts in response to CRP enrollment such that the negative impact is lessened by some degree over time. At present, however, no research-based guidelines have been identified that would permit the application of a “decay function” to the impacts. Thus, the estimates of long-term impact reported here should be considered tentative and subject to change should additional information be identified.

Further, it should be acknowledged that these impacts could further be mitigated by the fact that more than 300,000 acres in the 10-county region currently enrolled in the CRP program will be coming out of contract in the next five years. Uncertainty regarding the future of the CRP program and the ultimate disposition of these acres preclude incorporating consideration of them in this analysis. But, any of this acreage returning to agricultural production would represent a positive economic stimulus.

The analysis of changes in county property tax revenue associated with the adjustments to assessed valuation under dryland conditions suggested that total regional county property tax revenue would decline by about \$400,000 (2003\$) in perpetuity. Pawnee County would experience the largest property tax loss. A more general tax impact analysis based on the published data use to construct the regional social accounts estimated that combined federal, state, and local revenue collections would decline by about \$900,000 (2003\$) annually.

A simple sensitivity analysis was incorporated in the research to acknowledge that general trends in irrigated agriculture in Western Kansas are trending lower due to a declining water supply. While a specific estimate of the decline due to diminishing water supplies in the CREP region was beyond the scope of this analysis, it is underway there as it is elsewhere. As such, for each one percent decline in irrigated agriculture, whether due to water availability, energy costs, land retirement, or other reason, regional output declines by about \$2 million and total income declines by about \$1 million. This level of activity is closely linked to about 20 jobs.

Finally, there have been questions about the potential impact of near- and long-term increases in energy prices. For example, K-State economists estimate that in 2004 and 2005, escalating fuel prices have increased costs for irrigated production in western Kansas in excess of \$110 million dollars in all of western Kansas. A review of available research provided general indications of producer responses to energy prices. The review concluded that producers are forced by economic conditions to generally continue with current management schemes and accept lower profits in response to higher energy costs. In general, irrigated acreage, crop choice, and water usage patterns will change for only producers on marginal land or those with credit constraints. In this environment, CREP may represent an expected positive net present value alternative that would enhance participation. In the long-run, if energy costs remain high, producers will make management decisions to lower this cost (e.g., negotiate lower rents, adopt technology and farming systems that reduce fuel usage).

An investigation of the notion of altering the size of the program, e.g. 35 or 50 percent of the presumed total acres enrolled, suggested that the production response curve becomes almost linear after about 35,000 acres. Therefore, the direct economic impacts could be proportioned between 35 and 100 percent. The SAM model used to estimate the indirect economic impacts does incorporate an assumption of linearity. Therefore, it would be appropriate to scale the overall impacts of the CREP program between 35,000 and 100,000 acres. Below 35,000 acres, the impact would be less than the relative percentage change and new direct economic impact estimates would need to be estimated.

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Introduction

The purpose of this study is to report estimated potential regional economic impacts associated with implementation of the Conservation Research Enhancement Program (CREP) in a 10-county region comprising the Kansas Upper Arkansas River Basin. The stated policy objective is to emphasize conservation of the Ogallala Aquifer through the acquisition and retirement of water rights on 85,000 acres of irrigated crop land. The land would be enrolled for 15 years in the CREP program, wherein it would be planted to grass, followed by a return to dryland farming after CREP expiration. It would be expected the CREP annual incentive payments would be sufficient to permanently retire the water rights to the land. An additional 15,000 acres of dry farmland also would be enrolled.

To estimate the economic impacts, the 10-county regional economy is modeled in a detailed accounting system called a Social Accounting Matrix (SAM). The SAM utilized published government economic data to comprehensively account for all financial transactions occurring in the region at a point in time. The accounts show how all industry sectors, households, and other institutions are financially linked one to another. The accounting system provides a rich and detailed description of the economy. Then, through the use of relatively simple matrix algebra, economic changes can be tracked throughout the economy as the impact “ripples” through the various interconnected economic sectors, households, etc. This is more commonly known as the multiplier effect. By estimating the size of the multiplier effect, it then becomes possible to estimate the size and direction of the indirect economic effects that are known to accompany the observable direct economic changes.

The analysis firsts estimates the direct economic impacts based on projected enrollment considering the land productivity and hydrologic characteristics of eligible irrigated acreage. The indirect effects are then estimated arising from the reduction of agricultural production, the infusion of new household income through the CREP payments, and the addition of increased recreation associated with the fallowed lands. A separate analysis estimates the changes to county assessed valuation associated with changing land use. Estimates of the impact of returning to dryland farming following the 15 years of the CREP are then offered. Finally, a review of available literature and relevant economic principles offers insight into potential producer responses to increased energy costs. In addition to the overall 10-county region, a closer look at the impacts accruing to Finney County, the county with the projected highest levels of enrollment, also is provided.

Analysis Method

Social Accounting Matrix (SAM) analysis is a system of accounting for the economic transactions occurring in a national, state or regional economy over a period of one year. A SAM model creates a “computerized spreadsheet,” charting the flow of dollars between local business sectors, households, government, and other non-local consumers of locally-produced goods and services. SAM analysis enables estimates of how spending in one area of the economy “ripples” through the economy to other sectors.

The SAM modeling system used for this analysis is the Micro-IMPLAN (IMPact analysis for PLANing) system developed by the U.S. Forest Service (Minnesota IMPLAN Group, Inc.). The IMPLAN system consists of the software necessary to construct economic accounts, an impact

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analysis routine, and national-, state- and county-level data files containing information related to economic activity.

Direct and Indirect Economic Impacts

Economic impacts arise in several ways. In the case of estimating the economic impacts associated with an industry sector, the direct (immediate) effects are generally the value of the sales, wages, or employment from the sector in the year of the study. In addition to the direct contribution made by the sector, indirect (ripple) effects also arise. There are two ways in which indirect impacts occur.

The first type of indirect impact might be termed an “enterprise effect.” These are the effects associated with an individual facility purchasing goods and services necessary for the facility’s operation from other local businesses. The firms supplying the goods or services to the facility must, in turn, increase their purchase of goods and services in order to meet the facility’s demand. In this way, the effect of demand for one firm’s product spreads to a wide variety of backward-linked businesses.

The second important way indirect impacts arise might be termed the “wage effect.” Employers pay wages to labor who use their income to purchase household goods and services. Similarly, proprietors earn profits which serves as their household income. As workers make these purchases, area trade and service businesses earn the income necessary to pay their workers and generate profits. This creates an additional round of spending. These rounds of spending and re-spending may continue for some time until the purchase of imported goods, paying non-local taxes, and non-local savings eventually cause the impact to “leak” out of the economy.

The time frame in which the indirect effects occur depends on the structure of the economy. In larger places with more goods and service businesses, the economy will capture a greater share of the impact from spending and the total impact may take several years to achieve. In smaller rural economies, the total impact will be much smaller. Of course, the reintroduction of new spending replenishes the process.

In SAM analysis, the entire process is compressed into a one-year time frame. The most recent year for which necessary information is available is 2003. The impact analysis estimates the direct and indirect effects as though the entire process occurred in that year. Each year the spending continues, the direct and indirect effects are replenished.

A more detailed discussion of the analysis techniques employed in this research and the economic phenomena being considered is offered in Appendix 1.

Analysis Assumptions

In general, economic impact analysis also should consider the “opportunity cost” associated with the economic activity. Opportunity costs refer to the alternative use of money or resources if they were not expended or invested in a particular way. For example, instead of investing in a relatively riskier real estate project with a projected return of 10 percent, a person could invest in a somewhat safer bond investment for a projected return of 5 percent. In economic impact analysis, the impact associated with the real estate investment should be reported as 5 percent rather than a 10 percent return. This is because not investing in real estate does not mean the money would have been idle. Rather, there would have been alternative investments available. The value of what was given up should off-set the chosen alternative.

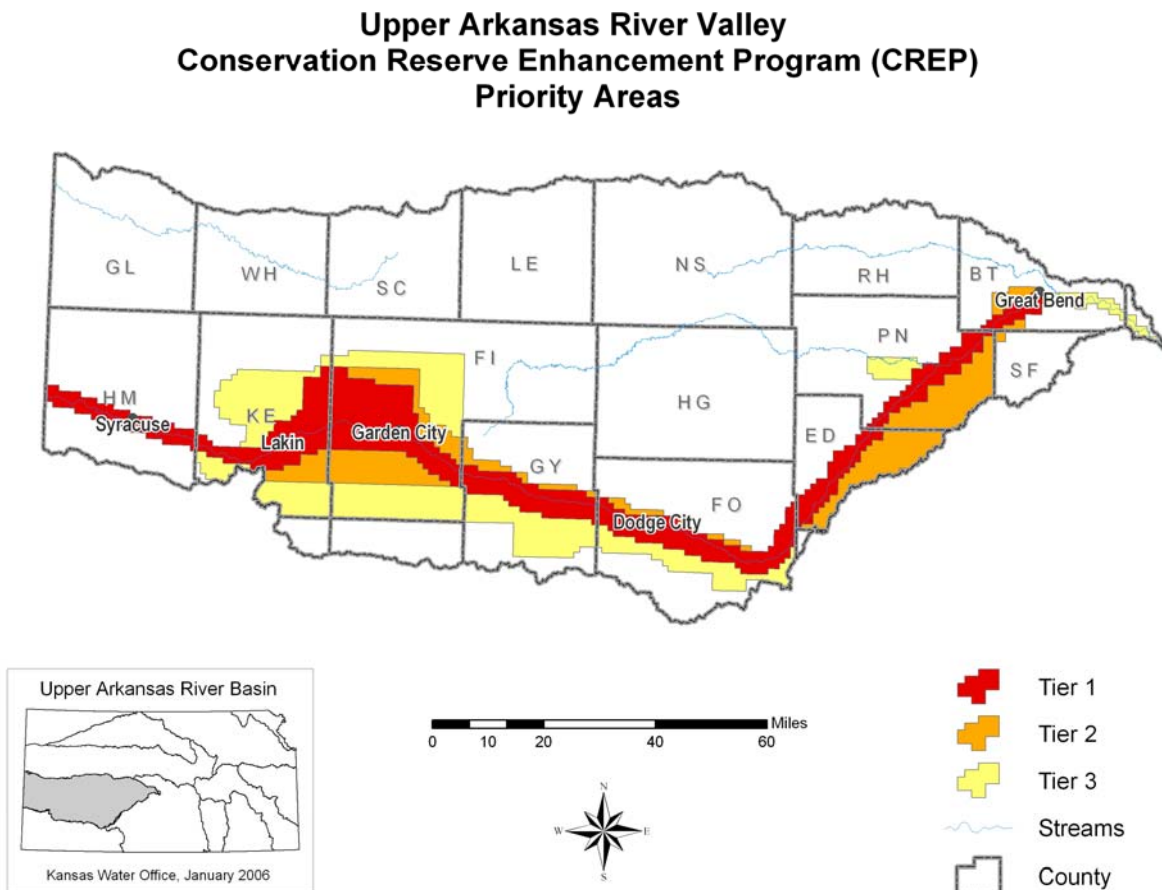
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In this analysis, opportunity costs are considered insofar as changes in production are balanced against an assumed alternative economic reality. The reduction of irrigated agricultural production is offset by the addition of household income (CREP payments) plus a small amount of recreation. In the longer term, irrigated agricultural production is offset by the reintroduction of dryland farming production and the concomitant elimination of the incentive payments.

Finally, all of the impacts estimated in this research are reported in “real” dollars, rather than “nominal” dollars. Whenever financial transactions are being considered over a length of time, it is appropriate to consider the effects of inflation. Inflation tends to reduce the purchasing value of money over time. Any observed trends are thus distorted by this economic phenomenon that is actually independent of the effects of the policy under consideration. To compensate for this effect, all years’ financial values are calibrated to a single year’s value (real dollars), in this case 2003, the year represented in the regional economic model.

The Upper Arkansas River Basin region includes Hamilton, Kearny, Finney, Gray, Edwards, Pawnee, Ford, Stafford, Barton, and Rice counties. A map depicting the river basin and the proposed CREP areas is shown in Figure 1.

Figure 1. Proposed CREP-eligible Areas in the Upper Arkansas River Valley, Kansas



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Regional Economic Overview

A 213 industry-sector model was built for the Upper Arkansas River Basin economy (160 for Finney County¹) and calibrated to 2003, the most recent year the necessary data were available.

The economy can be characterized in several ways. Industry output is the broadest measure of economic activity and refers to the combined revenues of all businesses.² Labor income refers to the value of wages, certain fringe benefits earned by labor, and proprietary income. Value added is a broader measure of the income associated with regional productive activities, and includes employee compensation, proprietary income, corporate income, dividends, interest and rent, and indirect business taxes. Value added is the best indicator of household welfare that a business or industry sector generates. Finally, employment represents estimates of the number of full- and part-time jobs in the region. Among all of the impact measures offered in this analysis, changes to value added probably offers the best view of how implementation of the CREP will affect regional economic welfare.

As shown in Table 1, the total value of regional economic activity was about \$10.3 billion in 2003. Manufacturing, where meat packing and other food processing is represented, is by far the largest economic sector. Regional employment totaled more than 83,000 jobs. Finally, this economic activity generated about \$3.8 billion in value added income, the most important measure of regional household welfare associated with regional economic activity.

¹ The discussion in the body of this report will focus on the overall region. The separate analysis focusing specifically on impacts accruing to Finney County is attached in Appendix 2. While Finney County is not specifically discussed, all of the same assumptions, procedures and discussion dedicated to the regional analysis also are applicable to Finney County.

² More accurately, “output” is the term used to represent the broadest measure of economic activity. It refers to the increment of new value associated with a good or service attributable to the sector present in the region. A loose translation as “sales” is generally more understandable and accurate for most economic sectors. The trade sector is the exception in that the measure shown here only represents the retailer’s margin, or product mark-up. It does not include the cost of goods sold, as most government statistics of retail sales typically show. There also is some double counting of the value of inputs into agricultural production sectors due to certain weaknesses in government accounting. In the agriculture sector, the value added measure is probably closer to the notion of “new value added” due to regional productive activity.

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Table 1. The Upper Arkansas River Basin Regional Economy, 2003\$

Industry	Industry Output*	Employment	Employee Compensation*	Total Value Added*
Ag, Forestry, Fish & Hunting	\$1,673.06	9,695	\$92.86	\$409.14
Mining	\$366.95	1,848	\$43.56	\$188.80
Utilities	\$193.90	477	\$34.75	\$113.03
Construction	\$402.93	4,148	\$102.99	\$165.78
Manufacturing	\$4,258.78	11,512	\$434.16	\$736.13
Wholesale Trade	\$248.16	2,564	\$99.98	\$188.75
Transportation & Warehousing	\$259.84	2,390	\$74.07	\$118.71
Retail trade	\$406.90	9,613	\$154.57	\$308.02
Information	\$122.28	750	\$23.08	\$51.73
Finance & insurance	\$350.03	2,881	\$76.75	\$187.27
Real estate & rental	\$109.11	919	\$10.37	\$74.24
Professional- scientific & tech svcs	\$135.74	1,946	\$43.77	\$73.57
Management of companies	\$22.62	229	\$7.38	\$9.75
Administrative & waste services	\$99.20	1,913	\$26.85	\$43.91
Educational services	\$27.84	620	\$11.62	\$12.45
Health & social services	\$406.53	7,625	\$172.84	\$227.74
Arts- entertainment & recreation	\$22.84	621	\$5.76	\$11.70
Accommodation & food services	\$157.90	4,001	\$45.07	\$70.10
Other services	\$231.48	5,325	\$71.24	\$115.23
Government & non NAICs	\$841.88	14,415	\$439.08	\$712.60
Totals	\$10,337.97	83,491	\$1,970.74	\$3,818.65

*Millions of dollars

Estimates of CREP Acreage and Direct Economic Impacts

Irrigated agriculture in Western Kansas represents a continuum of irrigated practices. Some producers irrigate water intensive crops such as corn and alfalfa, while other producers focus on less water intensive crops such as wheat and grain sorghum. Both full and limited irrigation practices are common. The choice of crop and practice is dependent upon the personal preferences of producers, management schemes, financial goals, and the spatially fixed components of soil type and hydrological characteristics. Previous research suggests that the distributional impacts of the CREP program may not be uniform across acreage and crops. Due to the heterogeneous nature of irrigated producers, the regional economic impacts associated with CREP likely will be dependent on which producers choose to participate in the program.

The purpose of this analysis is to predict which producers have the highest likelihood of participation and estimate the direct economic impacts associated with the loss of farm production in the target area.

Literature

As currently envisioned, the Conservation Reserve Enhancement Program exhibits characteristics of both a land retirement program and a water rights retirement program. As such, literature focusing on both areas will be briefly reviewed.

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The Food Security Act of 1985 authorized the Conservation Reserve Program (CRP). The CRP program is a voluntary cropland retirement program aimed at removing environmentally sensitive lands from production. In this program, the government agrees to rent land (based on a fair market bid process) and the landowner agrees to remove the land from crop production for 10 years and maintain a variety of conservation measures. In studies of the program, the probability of participation increased as land quality decreased, and for absentee landowners. Esseks and Kraft (1988) found that there was a negative relationship between CRP participation and returns to farming. Bechtel and Young (1999) suggested that landowners tended to enroll marginal land as a means of risk reduction.

The most extensive study of CRP enrollment was conducted by the Economic Research Service in 2004. The study found that the majority of farm operator participants could be characterized as either retirement or residential farm operators. Retirement farms were defined as being operated by those who identify themselves as retired, while residential farms were operated by those who identify something other than farming as their principal occupation. These two farm categories also included a majority of CRP acres and received a majority of the payments (ERS, 2004). Hatley et al. (1989) also found that older, part-time farmers made up a sizeable percentage of initial CRP enrollees.

During the 1970s and 1980s a combination of government agricultural policies and high grain prices led to the rapid conversion of pastureland to cropland in the Canadian Prairie Potholes region. This conversion resulted in the destruction of a significant amount of waterfowl habitat. In 1986, a joint US and Canadian effort was implemented with the goal of restoring this habitat. Producers were encouraged through monetary incentives and moral persuasion to restore cropland to dense nesting cover. Kooten and Schmitz (1992) evaluated the program and determined that it failed because the economic incentives offered to the agricultural producers were inadequate. They concluded that moral persuasion could not be used as a replacement for monetary incentives.

In 1990 Congress passed Public Law 101-618, which authorized the purchase of agricultural water rights in the Lahontan Valley of Nevada. Using a discrete choice model, Ise and Sunding (1998) evaluated the characteristics of water right holders that sold their rights to the government in the Lahontan Valley project. The authors found that the probability of selling was statistically increased if the seller had significant off farm income, low annual farm income, a high discount rate, a short planning horizon, or expressed a low consumption value of farming. In a qualitative evaluation, the authors found that those agents who refused to sell were most concerned about the potential for the government to receive a financial windfall by reselling the water rights to municipal and industrial concerns.

The literature relative to voluntary retirement programs is relatively thin. While this policy alternative is new and relatively novel, some insights can be gleaned from the literature. The first, and probably the most important, is that market participants have an expectation of receiving, at a minimum, the fair market value of their asset. While public awareness, environmental concerns, and moral persuasion may be beneficial in motivating the retirement process, the current water right holders will require fair compensation for their assets. Additionally, the literature suggests that participation could be improved by demographic targeting.

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Data

Water Information Management and Analysis System Data

In 1991, the U.S. Geological Survey, in cooperation with the Kansas Division of Water Resources, developed a Geographic Information Systems (GIS) application known as the Water Information Management and Analysis System (WIMAS). This application is used to assist in the analysis and management of the State's water resources. The WIMAS generated dataset provides time series data on each point of diversion (PDIV), typically a single water well, in the target area. For each PDIV the dataset includes spatial location, well capacity, average annual acre-foot water usage, authorized water usage, seniority level, the technology used to irrigate the associated parcel, cropping practice, as well as other well-specific information.

Public Land Survey System

The Public Land Survey System (PLSS) is a rectangular survey system, in which land is divided into townships and then subdivided into sections. The use of the PLSS system to spatially link data from a variety of sources is becoming common practice. The PLSS system will be used to spatially link other datasets to the WIMAS dataset.

Kansas Geological Survey Data

The Kansas Geological Survey High Plains Aquifer Section-Level Database (KGS dataset) consolidates information formerly maintained by several local, state, and federal agencies. The section-level data can be accessed through the WIZARD system maintained by the Kansas Geological Survey. The KGS dataset contains the necessary information on depth to water, saturated thickness, annual aquifer decline, sustainable yield, and other hydrological parameters. These data were merged with the WIMAS data based on PLSS section aggregation.

Kansas Agricultural Statistics Service Data

The Kansas Agricultural Statistics Service (KASS) provides yearly aggregate estimates of crop prices and crop yields, by county, for irrigated and dryland cropland. These data were obtained for the most recent eight years and averaged to obtain per acre estimates of average revenue on an individual crop basis. These data were merged with the WIMAS data based on county level aggregation.

Soil Productivity Index

The Property Valuation Division (PVD) of the Kansas Department of Revenue (KDR) uses soil productivity indices to value individual parcels of land for agricultural property tax purposes. The Kansas Soil Rating for Plant Growth (SRPG) is used in the valuation of dryland cropland while the Kansas Irrigated Productivity Index (KIPI) is used in the valuation of irrigated cropland. Both indices rank each soil mapping unit (soil type) based on its productive value. Each index is normalized so that the average soil, on a county basis, has an index value of one. Golden, Tsoodle, and Kastens (2006) and Tsoodle, Golden, and Featherstone (2006) have also applied these indices in valuation studies. These data were merged with the WIMAS data based on PLSS section aggregation.

Methods

Data were obtained from the Kansas Water Office which provided all possible points of diversion (PDIV) in the CREP target area. In order to be eligible for CREP participation, a PDIV must have been used for at least three out of five years (1999-2003) and used an average of at

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least 50% of its authorized quantity for those three years. Table 2 provides mean statistics on the eligible PDIVs.

Table 2. Mean Values by County for Points of Diversion in the CREP Target Area

Variable	County									
	Barton	Edwards	Finney	Ford	Gray	Hamilton	Kearny	Pawnee	Rice	Stafford
Number of PDIV	129	284	963	258	453	64	449	367	3	5
Years Irrigated	4.891	4.873	4.892	4.872	4.872	4.797	4.884	4.896	4.667	5
Acre Trend	0.1%	0.0%	0.3%	0.3%	-0.3%	1.3%	0.2%	0.0%	0.0%	-0.1%
Water Use	0.824	0.918	0.792	0.839	0.791	0.866	0.863	0.817	0.881	0.842
Irrigated Acres per PDIV	115.884	131.761	173.259	136.214	144.448	234.844	196.74	129.542	173.667	126
KIPI Index	1.011	0.997	0.95	0.989	0.975	0.915	0.96	0.955	0.983	1.019
SRPG Index	0.874	0.788	0.671	0.87	0.656	0.64	0.592	0.812	0.604	1.121
Depth to Water	14.217	30.487	132.237	77.289	98.775	172.631	139.314	29.546	0	19.6
Saturated Thickness	89.242	84.512	251.81	94.178	130.944	74.624	231.88	82.435	42.123	137.582
Water Use Density	222.063	240.262	553.468	272.755	482.641	267.521	583.16	201.229	55.747	191.46
Well Change	0.538	-0.847	-11.118	-1.186	-11.692	-15.061	-12.864	0.008	-0.123	0.418

Acre Trend is the average percent change in irrigated acreage per PDIV. Water Use is the average ratio of annual water-used to annual water authorized. Depth to Water is the 2001 depth to the static water level, measured in feet. Saturated Thickness is the saturated thickness of the remaining aquifer in 2002, measured in feet. Water Use Density is the average acre-foot water usage in a two square mile area. Well Change is the change in static water level between 1996 and 2002, measured in feet.

The WIMAS data provide information on the type of crop grown and the technology used. Any PDIV associated with perennial crops, nurseries, or orchards were removed from the data. Conversations with irrigated producers in western Kansas and other KSU extension professionals suggested that producers of irrigated alfalfa likely will not participate in the program and these PDIVs were removed from the data. Subsurface drip irrigation technology is relatively new and expensive to install. It was assumed that any PDIV with this technology would not be enrolled in the CREP program and were removed from the data.

The literature review revealed that the most likely landowners to participate in the CREP program are those that are older, and/or those that are preparing for retirement. Unfortunately, no data are available to link these characteristics to individual PDIVs. The second group that is likely to participate are landowners that place a low value on current or expected future water use. While no direct data exist to provide this information, valuations can be inferred based on historical WIMAS data.

For the purpose of this analysis it is assumed that low valuation is inferred by:

- 1) Intermittent use of the water right as reflected by water use in only three out of the past five years.
- 2) Intermittent use of the water right as reflected by water use in only four out of the past five years.
- 3) A relatively low ratio of annual acre foot usage to the annual authorized acre foot usage.
- 4) Low cropland productivity as measured by the KIPI and/or SRPG index.

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- 5) The inability to produce high-value crops and/or sustain full irrigation during the season as measured by available saturated thickness of the aquifer.
- 6) Excessively high marginal costs of water as measured by the depth to the static water level.
- 7) Low saturated thickness and/or rapid decline rate of aquifer.

A computer algorithm was developed using SAS Interactive Matrix Language (IML). SAS-IML is a dynamic, interactive environment that allowed the selection of PDIVs, based on sequential and pre-selected constraints, within a sampling-without-replacement framework. PDIVs were ranked and selected, by constraint, within a county until the maximum allowable county-acreage or maximum allowable program-acreage was achieved. Maximum allowable acreages are reported in Table 3 (listed as Method 1). Method 1 assumes there are no acreage restrictions on a per county basis, other than a PDIV has to meet the CREP eligibility requirement. Method 2 assumes that each county will enroll only their pro-rata share of the potential 85,000 CREP acres. Both methods maintain the 85,000 acre limit for CREP enrollment.

Table 3. Maximum Eligible Enrollment of Irrigated Acres by County

County	Method 1 Acres	Method 2 Acres
Barton	19,227	2,367
Edwards	62,284	5,677
Finney	276,369	32,216
Ford	60,530	7,015
Gray	113,019	13,388
Hamilton	16,674	1,941
Kearny	125,440	14,664
Pawnee	64,471	7,468
Rice	1,539	179
Stafford	737	86
Program Limit	85,000	85,000

An example of the reasons for selection, the ordering of selection, and applicable constraint values are listed in Table 4.

Table 4. CREP Acreage Enrollment by Order and Criteria

Order of Selection	Reason	Constraint
1	Infrequent water use	Years Used < 4
2	Infrequent water use	Years Used < 5
3	Low water use	Percent of authorized quantity < 50%
4	Poor land quality	KIPI index < 0.75
5	Limited saturated thickness	Saturated Thickness < 35'
6	Excessive depth to water	Depth to water > 285'
7	Poor land quality	SRPG index < 0.5

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The WIMAS data provides information on the crop grown for each PDIV during the study period. Based on KASS data, as reported in Table 5, yearly irrigated crop revenues (*ICR*) were assigned to the PDIV. Average yearly irrigated revenue (*IAR*) is defined as:

$$IAR_i = KIPi_i * \frac{\sum_{t=1}^5 ICR_{ijk}}{5} * ACRE_i$$

where *i* indexes the PDIV, *t* indexes time, *j* indexes the crop, *k* indexes the county, *KIPi* is the normalized soil productivity index for irrigated cropland, and *ACRE* is the average irrigated acreage associated with the PDIV.

The CREP program also allows the enrollment of dryland cropland (15,000 acres). It is assumed that this is to account for the dryland acreage typically associated with the corners of a center pivot irrigated parcel. The WIMAS data do not reflect the cropping practices of these dryland acres. For the purpose of this analysis the dryland acres are assumed to be 17.65% of the selected irrigated acreage on a PDIV. Extension professionals suggest that the typical crop rotation on these dryland acres would likely be a wheat-sorghum-fallow rotation. Based on these factors average yearly dryland revenue (*NAR*) is defined as:

$$NAR_i = SRPG_i * \frac{\sum_{t=1}^3 NCR_{ijk}}{3} * ACRE_i * 0.1765$$

where *i* indexes the PDIV, *t* indexes time, *j* indexes the crop, *k* indexes the county, *SRPG* is the normalized soil productivity index for dryland cropland, and *ACRE* is the average irrigated acreage associated with the PDIV.

When the CREP program terminates, the enrolled cropland will be eligible to return to dryland production. Based on the literature review, it is anticipated that only 50% of the enrolled land will return to crop production (ERS 2004). Based on current trends in cultural practices, Extension professionals suggest that future cultural practices will allow a more intensive cropping pattern. The expected future revenue is based on a sorghum-soybean-wheat-fallow rotation. Based on current trends we might also expect yields for these crops to improve overtime. For the purpose of this analysis no trend increase is included. Based on these factors, future average yearly dryland revenue (*FAR*) is defined as:

$$FAR_i = SRPG_i * \frac{\sum_{t=1}^4 FCR_{ijk}}{4} * ACRE_i * 1.1765 * 0.5$$

where *i* indexes the PDIV, *t* indexes time, *j* indexes the crop, *k* indexes the county, *SRPG* is the normalized soil productivity index for dryland cropland, and *ACRE* is the average irrigated acreage associated with the PDIV.

The direct economic impacts associated with the retirement of 85,000 irrigated acres and 15,000 dryland acres is reported in Table 6. The Total Revenue column reports the estimated total decline in irrigated production revenue associated with the elimination of irrigation during the term of the CREP. The total was approximately a \$15.9 million reduction.

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The Future Revenue column shows the estimated revenue associated with dryland production following the term of the CREP. While the future revenue totals some \$2 million, this only partially offsets the original decline, resulting in a net regional economic reduction of \$13.8 million.

However, it is recognized that some of the idled land enrolled in the CREP would be eligible to be used for grazing. Up to one-third of the acreage could be used for managed haying and grazing on a rotational basis each year. Thus, a value for grazing was credited to the total revenues shown. Using estimates by Dhuyvetter and Kastens (2005), the cash rent per acre for pasture land in the Southwest Kansas was \$8.70 for 2003-05. The annual total value for CREP-enrolled acres is estimated to be \$290,328 for the region (\$76,538 in Finney County). These values are deducted from the estimated decrease in agricultural production for the region, making the annual net impact to the region a reduction of \$15,613,839. This value was utilized to estimate the indirect economic impacts during the term of the CREP.

Similarly, since it was assumed that some of the poorest land would be most likely enrolled in the CREP, only 50 percent was assumed to return to dryland farming following program expiration. The remaining 50 percent of the acreage was assumed to be used for pasture. This value, \$435,535 for the region and \$114,818 for Finney County, also were deducted from the net dryland reductions. Thus, the values used to estimate the indirect impacts totaled reductions of \$13,119,340 for the region and \$4,584,875 in Finney County.

Table 5. Average Irrigated and Dryland Revenue per Acre by Crop and County, 1998-2005 (2003\$)

County	Irrigated Revenue				Dryland Revenue			
	Wheat	Sorghum	Corn	Beans	Wheat	Sorghum	Corn	Beans
Barton	\$137	\$206	\$355	\$263	\$118	\$126	\$177	\$106
Edwards	\$153	\$176	\$400	\$300	\$99	\$93	\$179	\$69
Finney	\$137	\$200	\$415	\$271	\$80	\$89	\$656	\$60
Ford	\$120	\$198	\$396	\$256	\$84	\$88	\$659	\$64
Gray	\$137	\$190	\$442	\$290	\$84	\$86	\$660	\$68
Hamilton	\$117	\$151	\$344	\$202	\$62	\$97	\$325	\$85
Kearny	\$139	\$177	\$412	\$219	\$83	\$90	\$347	\$55
Pawnee	\$136	\$199	\$353	\$257	\$108	\$93	\$292	\$110
Rice	\$137	\$186	\$367	\$269	\$139	\$112	\$165	\$112
Stafford	\$155	\$184	\$376	\$295	\$122	\$106	\$95	\$124

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Table 6. Direct Annual Economic Impact Associated with CREP and Return to Dryland Farming, 2003\$

County	Number of PDIV	Total Revenue	Irrigated Revenue	Dryland Revenue	Pasture Revenue	Irrigated Acres*	Dryland Acres*	Future Revenue
Barton	13	-\$328,594	-\$321,329	-\$14,177	\$6,912	1,351	238	\$57,729
Edwards	49	-\$1,384,708	-\$1,368,619	-\$50,015	\$33,926	6,629	1,170	\$212,086
Finney	147	-\$5,006,429	-\$5,002,825	-\$118,422	\$114,818	22,435	3,960	\$536,372
Ford	49	-\$1,461,201	-\$1,448,390	-\$49,508	\$36,697	7,170	1,266	\$223,205
Gray	26	-\$854,644	-\$849,552	-\$24,841	\$19,749	3,859	681	\$112,010
Hamilton	54	-\$1,947,044	-\$1,942,787	-\$70,320	\$66,063	12,909	2,278	\$369,856
Kearny	38	-\$1,807,243	-\$1,820,010	-\$69,056	\$81,824	15,988	2,822	\$414,851
Pawnee	117	-\$2,639,789	-\$2,597,175	-\$117,312	\$74,698	14,596	2,576	\$564,664
Rice	1	-\$38,982	-\$38,111	-\$1,719	\$848	166	29	\$7,054
Stafford	0	\$0	\$0	\$0	\$0	0	0	\$0
Total	494	-\$15,468,632	-\$15,388,797	-\$515,370	\$435,535	85,103	15,020	\$2,497,826

* Following the logic of the algorithm used in the selection process, the acreages shown are the total coming closest to the policy acreage goal.

Sensitivity Analysis

There is a continuum of alternative specifications for selecting likely parcels that would enroll in the CREP. As such, it is relevant to investigate how sensitive the direct economic impacts (estimated reductions in agricultural production value) are to the selection of constraints and/or methods. In general, sensitivity analysis is conducted by varying the independent variable (constraints), holding all else constant, and observing the impact on the dependent variable (direct economic impact). Within the framework described, the impact of all other constraints cannot be held constant. As an example, raising the threshold for the KIPI index will reduce the number of PDIVs selected for this reason but increase the number of PDIVs selected for other reasons.

In the proceeding analysis, the per-county acre constraint was based on Table 3, Method 1, which assumes that the PDIVs can be selected from any county up to the irrigated acreage within the target portion of that county. An alternative constraint specification would be that the per-county limit on acreage is based on a proportionate distribution across counties, which is reported as Method 2 in Table 3. Based on this specification direct economic impacts would increase by approximately 10%.

An alternative modeling method would be to apply the KASS revenue data to the WIMAS cropping data, calculate an average annual expected revenue and pick PDIVs solely on the assumption that those with the lowest expected revenue would enroll first. Based on this specification direct economic impacts would decrease by approximately 20%.

The direct economic impacts were relatively unaffected by reasonable constraint alterations and/or the ordering of selection, with the exception of the choice based on depth to water. Lowering this constraint and/or moving this constraint up in the order of selection increased the direct economic impact considerably. The model is severely sensitive to this constraint. This is due to the high correlation between increasing depth to water and the cropping pattern of 'continuous corn' which has the highest per acre revenue.

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We would expect that, for a given crop, as annual acre-foot usage declines, the crop yields would decline, which would result in a lower per acre expected revenue. PVD uses such de-rating factors to reduce yield and thus reduce expected landlord net income and property tax calculations on parcels with limited capacity wells. This procedure was tested within the framework of the above specified model. Incorporating these de-rating factors reduced the direct economic impact considerably. The model is severely sensitive to assumption regarding the impact of well capacity on crop yield.

There were several PDIVs selected because the WIMAS data reflected that, while they met the minimum requirement for enrollment, there was water use in only three or four years of the five-year period. Extension economists suggest that this observation is due to fallowing the land and/or the incorporation of dryland wheat into the rotation. Table 6 assumes the land was fallowed and therefore the expected revenue for that year was set to zero. If the property was assumed to be in a dryland wheat rotation, direct economic impacts would increase by approximately 2.5%.

Implicit to the selection criteria is the assumption that lower average annual water usage increases the probability of CREP participation. The PDIVs within the target area, which met the minimum use criteria, had an average annual water usage of 1.38 acre-feet. The average annual water usage of the selected PDIVs varied with selection criteria. On average, selected PDIVs had an average annual water usage of 1.17 acre-feet.³

As currently envisioned, the CREP program will allow the enrollment of 100,000 acres of cropland. Acreage will be allowed to enroll over a 5 year continuous sign up period. The direct economic impacts assume that the entire 100,000 acres are enrolled in the first year.⁴ The timing of enrollment and the number of acres enrolled may impact the severity of the direct economic impacts. Since ERS (2004) suggests that the negative economic impacts may be short lived, the timing of enrollment may be an important determinant of economic impacts. Additional research is needed to estimate the direct economic impacts associated with phasing in the anticipated CREP acreage.

Limited simulation/sensitivity analysis has been conducted based on the overall acreage constraints. The results suggest that for enrolled acreage between 35,000 and 100,000 acres, the direct economic impacts vary linearly with enrolled acres. As an example, if 35,000 acres are enrolled in the first year, then the direct economic impact will be approximately 35% of the numbers previously discussed. For enrolled acreage between zero and 35,000 acres, the direct economic impacts vary non-linearly with enrolled acres. As an example, if 10,000 acres are enrolled in the first year, then the direct economic impact will be less than 10% of the numbers previously discussed.

Participation levels will undoubtedly be impacted by the CREP rental rates as determined by FSA. Golden (2005) suggests that the value of water rights, and by extension the fair rental value, will vary by county and past water use history. Recent CREP focus groups in western Kansas also suggest that expectations of fair rental values vary among market participants. Sensitivity analysis to rental rates has not been performed. Additional research is needed to estimate how the monetary level of rental rates may impact specific acreage selection and the variability of direct economic impacts.

³ All averages were based on the sum of the observed water use during the 5 year period, divided by 5.

⁴ Nebraska has a similar enrollment goal but has enrolled less than 35,000 acres.

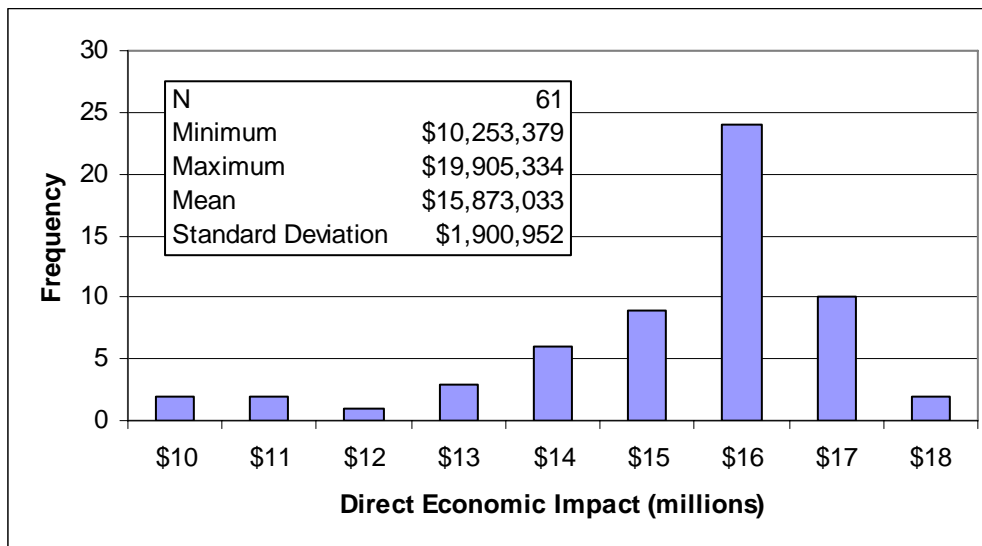
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Dhuyvetter et al. (2005) estimated that, due to an energy price increase relative to 2004 prices, the production cost per irrigated acre increased \$34.15 in 2005 and is expected to increase another \$12.97 in 2006, for an annual average increase of \$23.56 per acre. The production cost per dryland acre increased \$6.33 in 2005 and is expected to increase another \$5.58 in 2006, for an average increase of \$5.95 per acre. If these averages represent a long-term annual increase in production costs, then the combined impact on the 85,000 acres of irrigated land and 15,000 acres of dryland enrolled in CREP would be slightly over \$2 million per year. In so far as the acreage enrollment in CREP would not incur these future expenses, and give that CREP rental payments are expected to be based on past measures of profitability, the \$2 million per year could be viewed as a positive direct economic impact. Due to the uncertainty associated with future trends in energy prices, sensitivity analysis to potential impacts of energy prices have not been preformed. Additional research is needed to estimate how expectations of future energy prices may impact specific acreage selection and the variability of direct economic impacts.

Conclusion

The near-term negative direct economic impact of a \$15,613,839 reduction in agricultural production represents an estimation based on one likely scenario. In order to develop a confidence interval surrounding this estimation the model was repetitively used, under a variety of constraints, to generate a distribution of possible outcomes. This distribution is illustrated in Figure 2. Based on this simulation, and assuming a normal distribution, the 90% confidence interval is \$13,439,813 to \$18,306,251.

Figure 2. Possible Distribution of Immediate Direct Economic Impacts



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CREP Payments

The analysis assumed full program implementation with slightly more than 100,000 acres enrolled in the CREP. Of the total, approximately 85,000 acres were assumed irrigated and about 15,000 acres were dryland. Irrigated acreage was further subdivided into dryland-irrigated and wetland irrigated. While no data were available to verify the distribution of irrigated acres between dryland- and wetland-irrigated, it was assumed approximately 5,000 of the total irrigated acres were wetland-irrigated as shown in Table 7.

A question for many is whether all of the CREP payments will, in fact, stay in the region or will much of the income actually be sent to non-local landowners. While a detailed analysis of CRP enrollment by land-owner mailing address location was beyond the scope of this research and the information was not otherwise available to the authors, the ERS national study may shed light on this question. In the national study of CRP impact, they estimated a leakage of about 10 percent of CRP program payments from the "Prairie Gateway Region," which included Kansas, to landowners living outside of the region. They went on to point out that this percentage was not statistically different from a corresponding pattern for all agriculture support payments. That is, whether the land remained actively farmed or retired for some period made no difference in whether agriculture support payments actually benefit the region in which the farmland is located. Assuming the 10 percent leakage is applicable in the case of the CREP, the regional household income impact associated with the new CREP payments was reduced by this amount.

CRP payment schedules for each of the three acreage classes were then used to calculate estimated annual CREP payments by county. Including the full 100,000 acres resulted in total annual payments of about \$6.5 million, and total program payments of about \$97.5 million. These were the amounts of new household income that were used in the impact analysis.

CREP Recreation Benefits

It's known that the conversion of agricultural production land to grassland benefits wildlife. The presence of wildlife and access to the land thus creates new recreation benefits. The benefits accrue principally from hunting and wildlife watching on the CRP lands.

To estimate some amount of recreation benefits assumed to emanate from the new CREP acreage, information from the ERS' national study of the CRP program was used. As part of that study, the ERS estimated the national value of recreation benefits associated with CRP. They first indicated that on average, each acre of CRP land annually generates \$1.20 of access lease income for the landowner. They go on to discuss the method whereby they estimated total recreation value, indicating that it employed the formula: $\text{CRP acres} \times \text{landowner lease income factor} \times \text{recreation factor} = \text{total value of recreation benefit}$. While never specifying what the recreation factor used was, the authors did identify total CRP acres, the landowner factor and the total estimated benefit. Solving for the unknown recreation factor, it was determined to be 3.38. As shown in Table 8, these values together with the estimated CREP acreages were used to estimate an annual and total recreation benefit by county.

In addition to the new landowner household income from land leasing, regional retail and service businesses would be assumed to benefit from new visitors to the area. Deducting the landowner income benefit from the total recreation benefit in each county produced a total value

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in each county to be allocated among regional retail and service businesses. To create a specific budget, information from a recent U.S. Department of Interior, et al. (2003) survey was used. The survey report estimated total spending by U.S. residents on hunting and fishing in Kansas. That budget is shown as the hunting expenditure profile in Table 9. The expenditure categories used in the survey did not match the economic sectors in the regional accounting system used for this research, and were reallocated by the author as shown in Table 9. Finally, the annual and total new recreation spending by trade sector and county were calculated as shown in Table 10. These values, together with the new landowner household income, were used in the regional model to estimate the value of the new recreation benefit.

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Table 7. Estimates of CREP Acreage by Type and Annual Payments by County, 2003\$

County	Share of CREP Acres	Share of Regular Irr Acres	Share of Wetland Irr Acres	Share of CREP Dry Acres	Dryland Payment	Regular Irrigated Payment	Wetland Irrigated Payment	Annual Payment	Assumed Regional Leakage	Net Regional Payments	Eligible Years	Total Regional Payments
Hamilton	12,909	12,150	759	2,278	\$32.13	\$78.00	\$92.60	\$1,091,181	10.0%	\$982,063	15	\$14,730,939
Kearny	15,988	15,048	940	2,822	\$33.13	\$78.00	\$92.60	\$1,354,288	10.0%	\$1,218,859	15	\$18,282,884
Finney	22,435	21,115	1,320	3,960	\$34.33	\$78.00	\$92.60	\$1,905,145	10.0%	\$1,714,630	15	\$25,719,451
Gray	3,859	3,632	227	681	\$36.00	\$78.00	\$92.60	\$328,832	10.0%	\$295,949	15	\$4,439,235
Edwards	6,629	6,239	390	1,170	\$35.00	\$78.00	\$92.60	\$563,705	10.0%	\$507,335	15	\$7,610,019
Pawnee	14,596	13,737	859	2,576	\$36.00	\$78.00	\$92.60	\$1,243,759	10.0%	\$1,119,383	15	\$16,790,752
Ford	7,170	6,748	422	1,266	\$35.00	\$78.00	\$92.60	\$609,728	10.0%	\$548,755	15	\$8,231,325
Stafford	0	0	0	0	\$40.00	\$78.00	\$92.60	\$0	10.0%	\$0	15	\$0
Barton	1,351	1,272	79	238	\$38.44	\$78.00	\$92.60	\$115,687	10.0%	\$104,118	15	\$1,561,774
Rice	166	156	10	29	\$38.29	\$78.00	\$92.60	\$14,201	10.0%	\$12,781	15	\$191,713
Total	85,103	80,097	5,006	15,020				\$7,226,525		\$6,503,873		\$97,558,093

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Table 8. Estimates of Annual Recreation Revenue Generated from CREP Acreage, 2003\$

County	Total CREP Acres	Recreation Lease Value per Acre	Annual		Annual Recreation Benefit	Annual Recreation Minus Landowner Income		CREP Years	Total	
			Landowner Recreation Income	Recreation Factor		Landowner Income	Recreation Income		Recreation Benefit	
Hamilton	15,187	\$1.20	\$18,224	3.38	\$61,598	\$43,374	15	\$273,366	\$923,977	
Kearny	18,810	\$1.20	\$22,572	3.38	\$76,293	\$53,721	15	\$338,580	\$1,144,400	
Finney	26,395	\$1.20	\$31,674	3.38	\$107,058	\$75,384	15	\$475,110	\$1,605,872	
Gray	4,540	\$1.20	\$5,448	3.38	\$18,414	\$12,966	15	\$81,720	\$276,214	
Edwards	7,799	\$1.20	\$9,359	3.38	\$31,633	\$22,274	15	\$140,382	\$474,491	
Pawnee	17,172	\$1.20	\$20,606	3.38	\$69,650	\$49,043	15	\$309,096	\$1,044,744	
Ford	8,436	\$1.20	\$10,123	3.38	\$34,216	\$24,093	15	\$151,848	\$513,246	
Stafford	0	\$1.20	\$0	3.38	\$0	\$0	15	\$0	\$0	
Barton	1,589	\$1.20	\$1,907	3.38	\$6,445	\$4,538	15	\$28,602	\$96,675	
Rice	195	\$1.20	\$234	3.38	\$791	\$557	15	\$3,510	\$11,864	
Region	100,123		\$119,914		\$405,308	\$285,951		\$1,798,704	\$6,079,620	

Source: Based on USDA, 2004.

Table 9. CREP Recreation Expenditure Profiles Based on Kansas Hunter Survey Information and Translated into Trade Sectors Used in this Research

Hunting Expenditure Profile			Redistributed Annual Expenditure Profile, 2003\$		
Trade Sector	2001 Total (thousands)	Share of Total	Trade Sector	Expenditures	Share of Total
Food and lodging	\$47,461	21.6%	Food and beverage stores	\$23,377	9.6%
Transportation	\$36,296	16.5%	Gasoline stations	\$30,467	10.7%
Other trip costs	\$12,607	5.7%	Sporting goods stores	\$128,875	45.1%
Hunting equipment	\$84,582	38.5%	General merchandise stores	\$6,534	2.3%
Auxiliary equipment	\$13,143	6.0%	Miscellaneous retail stores	\$7,479	2.6%
Magazines and books	\$717	0.3%	Automotive rental and leasing	\$30,466	10.7%
Membership dues	\$3,036	1.4%	Hotels and motels	\$27,376	9.6%
Other	\$22,073	10.0%	Food services and drinking places	\$27,377	9.6%
Total	\$219,915	100.0%	Total	\$285,951	100.0%

Source: U.S. Department of the Interior, et al., 2003.

Based on the authors' calculation.

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Table 10. Estimates of Annual and Total Recreation Expenditures by County, 2003\$

Annual											
Trade Sector	Hamilton	Kearny	Finney	Gray	Edwards	Pawnee	Ford	Stafford	Barton	Rice	Sum
Food and beverage stores	\$4,153	\$5,143	\$7,217	\$1,241	\$2,132	\$4,695	\$2,307	\$0	\$434	\$53	\$27,376
Gasoline stations	\$4,621	\$5,724	\$8,032	\$1,381	\$2,373	\$5,225	\$2,567	\$0	\$484	\$59	\$30,467
Sporting goods stores	\$19,548	\$24,212	\$33,975	\$5,844	\$10,039	\$22,103	\$10,859	\$0	\$2,045	\$251	\$128,876
General merchandise stores	\$991	\$1,228	\$1,723	\$296	\$509	\$1,121	\$551	\$0	\$104	\$13	\$6,534
Miscellaneous retail stores	\$1,135	\$1,405	\$1,972	\$339	\$583	\$1,283	\$630	\$0	\$119	\$15	\$7,480
Automotive rental and leasing	\$4,621	\$5,724	\$8,032	\$1,381	\$2,373	\$5,225	\$2,567	\$0	\$484	\$59	\$30,467
Hotels and motels	\$4,153	\$5,143	\$7,217	\$1,241	\$2,132	\$4,695	\$2,307	\$0	\$434	\$53	\$27,376
Food services & drinking places	\$4,153	\$5,143	\$7,217	\$1,241	\$2,132	\$4,695	\$2,307	\$0	\$434	\$53	\$27,376
Total	\$43,374	\$53,721	\$75,384	\$12,966	\$22,274	\$49,043	\$24,093	\$0	\$4,538	\$557	\$285,951

Total											
Trade Sector	Hamilton	Kearny	Finney	Gray	Edwards	Pawnee	Ford	Stafford	Barton	Rice	Sum
Food and beverage stores	\$62,288	\$77,147	\$108,256	\$18,620	\$31,987	\$70,429	\$34,599	\$0	\$6,517	\$800	\$410,644
Gasoline stations	\$69,320	\$85,856	\$120,477	\$20,722	\$35,598	\$78,380	\$38,505	\$0	\$7,253	\$890	\$457,001
Sporting goods stores	\$293,224	\$363,176	\$509,624	\$87,656	\$150,580	\$331,550	\$162,879	\$0	\$30,680	\$3,765	\$1,933,133
General merchandise stores	\$14,866	\$18,413	\$25,838	\$4,444	\$7,634	\$16,809	\$8,258	\$0	\$1,555	\$191	\$98,009
Miscellaneous retail stores	\$17,018	\$21,077	\$29,577	\$5,087	\$8,739	\$19,242	\$9,453	\$0	\$1,781	\$219	\$112,193
Automotive rental and leasing	\$69,320	\$85,856	\$120,477	\$20,722	\$35,598	\$78,380	\$38,505	\$0	\$7,253	\$890	\$457,001
Hotels and motels	\$62,288	\$77,147	\$108,256	\$18,620	\$31,987	\$70,429	\$34,599	\$0	\$6,517	\$800	\$410,644
Food services & drinking places	\$62,288	\$77,147	\$108,256	\$18,620	\$31,987	\$70,429	\$34,599	\$0	\$6,517	\$800	\$410,644
Total	\$650,611	\$805,820	\$1,130,762	\$194,494	\$334,109	\$735,648	\$361,398	\$0	\$68,073	\$8,354	\$4,289,269

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Overall Economic Impact of the Implementation of the CREP

During the term of the CREP, the combined impacts in the reduction in agricultural production value associated with the elimination of irrigation, the increase in pasture land production values, the increase in recreational activity, and the new household income payments from the CREP are considered. Following expiration of CREP, it is assumed the household payments stop, the recreation value is eliminated, dryland production increases, pasture land production values increase, and irrigation values are permanently gone. The values associated with these two scenarios are summarized in Table 11.

The first impact scenario modeled the combined effects of a \$15.9 million annual reduction in agricultural output to grain farm and oil seed production sectors represented in the model, the increase of \$290,000 in pasture land production, the infusion of \$6.6 million in new annual household income in the \$50,000-\$75,000 household income category⁵ (CREP payments and landowner lease income), plus the addition of about \$285,000 in new annual recreation spending. The inputs were applied to the fully-disaggregated 213-sector model. Tables 12 and 13 report the results annually and in total. The results are aggregated using a standard 2-digit North American Industry Classification System (NAICS) scheme.

When both the negative shock of the production reduction and the positive shock of the infusion of new household income are fully realized, it was estimated that overall productive activity in the region would decline by about \$14.8 million annually (2003\$). This amount of productive activity is closely tied to about 119 jobs.⁶ Regional value added, the broadest measure of household income and the best measure of changes to regional household welfare, was estimated to decline by about \$7.7 million (2003\$).

The combined effects over the life of the program are shown in Table 13. The impact to jobs is assumed to remain constant, i.e. the jobs are not lost over and over again. Again, focusing on value added, regional economic welfare (income) was estimated to decline by about \$115 million (2003\$) over the 15-year life of the program.⁷

⁵ The ERS analysis of the CRP indicated that program participants had typical annual household incomes in the \$60,000-\$64,000 range. This included off-farm earnings.

⁶ It would not be appropriate, however, to assume 119 jobs would actually be lost. The reduction in overall demand in any given sector may represent only a fraction of the demand met by many of these jobs. In many cases, there would be a slackening of the work required for these positions without the presumed layoff. Certainly, we would assume the actual loss of jobs would be most directly experienced in agricultural production and closely allied industries. Further, many of the people affected likely would transition into some other productive activity, making the overall "net" loss something less. Many economists believe input-output analysis over-estimates job impacts.

Conversely, nothing is really known about the current nature of the jobs affected. In some cases, they may already be experiencing slack demand and even a relatively small reduction could become the tipping point where the job would be lost. Thus, the 119 job loss estimate also may be reasonably accurate.

⁷ It might be expected that the overall impact would be mitigated somewhat over time as business and labor adjusted and found new productive pursuits. Still, there is no relevant available evidence that would allow any conclusions regarding adjustments to such a dislocation. While it might be reasonable to assume such adjustments might occur, it is equally reasonable to assume the full scope of the estimated impacts play out as the analysis suggests.

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**Table 11. Summary of Annual Direct Economic Inputs for Upper Arkansas Region
CREP and Post-CREP Impacts versus Current Irrigated Usage (2003\$)**

Impact Model Sectors	Term of CREP	Post-CREP Dryland Farming	Difference CREP to Post-CREP
Oilseed farms	-\$2,258,392	-\$1,965,546	\$292,846
Grain farms	-\$13,645,780	-\$11,876,330	\$1,769,450
Pasture and grazing	\$290,328	\$435,535	\$145,207
Gross landowner lease income	\$119,914		
Regional leakage (10%)	-\$11,991		
Net regional landowner lease income	\$107,923		-\$107,923
Food and beverage stores	\$27,376		-\$27,376
Gasoline stations	\$30,467		-\$30,467
Sporting goods stores	\$128,876		-\$128,876
General merchandise stores	\$6,534		-\$6,534
Miscellaneous retail stores	\$7,480		-\$7,480
Automotive equipment rental and leasing	\$30,467		-\$30,467
Hotels and motels	\$27,376		-\$27,376
Food services and drinking places	\$27,376		-\$27,376
Gross CREP household income	\$7,226,525		
Regional leakage (10%)	-\$722,653		
Net regional CREP household income	\$6,503,873		-\$6,503,873
Total Direct Economic Impacts	-\$8,716,096	-\$13,406,341	-\$4,690,245

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Table 12. Estimated Annual CREP Direct and Total Economic Impacts to Regional Production, Jobs and Income (2003\$)

Industry	Direct Impact	Total Output	Total Employment	Labor Income	Value Added
Ag, Forestry, Fish & Hunting	-\$15,613,844	-\$16,285,015	-150.7	-\$2,800,276	-\$8,573,211
Mining		-\$104,890	-0.4	-\$16,943	-\$48,514
Utilities		\$2,641	0.0	-\$708	-\$3,359
Construction		-\$27,323	-0.4	-\$12,193	-\$12,983
Manufacturing		-\$453,653	-0.2	-\$147,219	-\$249,011
Wholesale Trade		-\$116,354	-1.2	-\$49,577	-\$88,498
Transportation & Warehousing		-\$75,074	-0.6	-\$22,877	-\$35,422
Retail Trade	\$200,733	\$554,650	14.9	\$264,795	\$421,752
Information		\$56,010	0.3	\$12,668	\$25,886
Finance & Insurance		\$90,320	0.8	\$22,188	\$36,032
Real Estate & Rental		-\$172,612	-1.6	-\$23,289	-\$122,097
Professional-Scientific & Technical Services		\$24,998	0.4	\$12,159	\$16,237
Management of Companies		\$3,939	0.0	\$1,305	\$1,698
Administrative & Waste Services		\$14,252	0.4	\$6,232	\$7,449
Educational Services		\$33,900	0.7	\$14,612	\$15,271
Health & Social Services		\$483,211	8.1	\$244,684	\$279,545
Arts- Entertainment & Recreation		\$25,754	0.7	\$8,390	\$13,677
Accommodation & Food Services	\$85,219	\$271,282	6.9	\$82,718	\$122,030
Other Services		\$98,754	3.7	\$54,017	\$64,041
Government & non-NAICs		\$482,600	-0.3	-\$11,083	\$418,790
Institutions		\$285,317	0.0	\$0	\$0
Regional Household Income	\$6,611,796				
Total	-\$8,716,096	-\$14,807,296	-119	-\$2,360,398	-\$7,710,687

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Table 13. Estimated 15-Year Total CREP Direct and Total Economic Impacts to Regional Production, Jobs and Income (2003\$)

Industry	Direct Impact*	Total Output*	Total Employment	Labor Income*	Value Added*
Ag, Forestry, Fish & Hunting	-\$234,207.7	-\$244,275.2	-150.7	-\$42,004.1	-\$128,598.2
Mining		-\$1,573.4	-0.4	-\$254.1	-\$727.7
Utilities		\$39.6	0.0	-\$10.6	-\$50.4
Construction		-\$409.8	-0.4	-\$182.9	-\$194.7
Manufacturing		-\$6,804.8	-0.2	-\$2,208.3	-\$3,735.2
Wholesale Trade		-\$1,745.3	-1.2	-\$743.7	-\$1,327.5
Transportation & Warehousing		-\$1,126.1	-0.6	-\$343.2	-\$531.3
Retail Trade	\$3,011.0	\$8,319.8	14.9	\$3,971.9	\$6,326.3
Information		\$840.2	0.3	\$190.0	\$388.3
Finance & Insurance		\$1,354.8	0.8	\$332.8	\$540.5
Real Estate & Rental		-\$2,589.2	-1.6	-\$349.3	-\$1,831.5
Professional-Scientific & Technical Services		\$375.0	0.4	\$182.4	\$243.6
Management of Companies		\$59.1	0.0	\$19.6	\$25.5
Administrative & Waste Services		\$213.8	0.4	\$93.5	\$111.7
Educational Services		\$508.5	0.7	\$219.2	\$229.1
Health & Social Services		\$7,248.2	8.1	\$3,670.3	\$4,193.2
Arts- Entertainment & Recreation		\$386.3	0.7	\$125.9	\$205.2
Accommodation & Food Services	\$1,278.3	\$4,069.2	6.9	\$1,240.8	\$1,830.5
Other Services		\$1,481.3	3.7	\$810.3	\$960.6
Government & non-NAICs		\$7,239.0	-0.3	-\$166.2	\$6,281.9
Institutions		\$4,279.8	0.0	\$0.0	\$0.0
Regional Household Income	\$99,176.9				
Total	-\$130,741.4	-\$222,109.4	-119	-\$35,406.0	-\$115,660.3

*Thousands of dollars

Property Tax Effects by Switching CREP and All Irrigated Acres to Dryland Acres

The property tax effects of switching irrigated acres in the CREP region to dryland acres were examined on a parcel basis. A parcel of land has its own legal description and is taxed as a unit. The legal descriptions of each of the CREP-eligible parcels were obtained from the Kansas Water Office for each of the counties. These legal descriptions were matched with the Property Valuation Division all agricultural parcel database at the Department of Agricultural Economics at Kansas State University. The Property Valuation Data were from 2003 and contained all agricultural parcels in the counties with CREP-eligible parcels. The 2003 actual valuation used for the irrigated acres was obtained on a parcel basis from this data set. Next, an estimate of the 2003 dryland value was calculated for each of the irrigated parcels, using the agricultural parcel by soil type data from the Property Valuation Division. Using the Landlord Net Income calculated by the Department of Agricultural Economics Department on a contract basis for the Property Valuation Division, an estimate of the dryland value for each soil type for each agricultural parcel was determined. The capitalization rate used was the county capitalization rate for 2003 obtained from the Property Valuation Division Website (<http://www.ksrevenue.org/pdf/03CapRate.pdf>). The

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assessed value for parcels was determined assuming CREP-eligible acreage was dryland, the change in the tax base due to changing the use category from irrigated to dryland land was determined using the county average rural mill rate (<http://www.ksrevenue.org/pdf/02-04TableVavglevies.pdf>). This was compared to the actual county property tax revenue that occurred in 2003 from agricultural use value. It should be noted that because we are using county averages instead of the assessment rate at the actual taxing district our results could introduce a small error if the CREP acreage assessment rate is significantly different from the county rate.

The results from the analysis are found in Table 14 and Table 15. Table 14 provides information on the total CREP-eligible acres, the total CREP-eligible irrigated acres, the aggregate irrigated assessed valuation, the estimated dryland assessed valuation, the difference with conversion, the difference on a per acre basis, and a percentage change in valuation by county and the entire CREP region. The average reduction in assessment is \$108.84 per acre, which is a 59.6% reduction in the appraisal value for the 544,997 irrigated acres in the CREP region. The total reduction in assessed valuation is \$59,314,912. Edwards and Ford counties had the largest difference per acre and Rice and Kearny the smallest difference per acre. It should be noted that those soils which are predominantly sand based have the largest difference because the alternative use under non-irrigation is limited. Thus, the economic impact will be larger for those farmers than for those that have soils that have better productivity under dryland production methods.

Table 15 provides information on the effect on county property tax collections using 2003 as the basis. Table 15 contains the number of CREP-eligible parcels and the difference in CREP assessed value determined by multiplying the difference from Table 14 by the 30% assessment rate. Table 15 also contains the property tax difference, the difference in the property tax per acre, the total county agricultural land property tax collections, and the percentage reduction in the property tax collections from the conversion of CREP-eligible irrigated acreage to dryland acreage. The total reduction in property tax collections for the CREP-eligible parcels is \$2,090,482. The largest impact is in Finney County with a reduction of \$579,364. The average reduction in property tax per acre for the region is \$3.84 per acre. The total agricultural land property taxes collected for the CREP counties is \$21,058,484. The reduction in property taxes collected averaged 9.93% with a high of 22.34% in Finney County. Again, this is assuming that 100% of the CREP land is converted from irrigated to dryland. If a smaller number of acres were originally dryland rather than irrigated, the lost tax effect on the counties would be less.

Table 16 presents the results of an assumed actual conversion of 85,103 acres of irrigated land. The distribution of the acres, the effect on property tax collections, and a measure of the percentage reduction in agricultural land use collections by county are presented. Assuming that an average quality acre is removed, the total effect is a reduction of \$400,005 collected. The largest reduction in property tax collections occur in Pawnee County (\$105,237). The largest average percentage reduction in agricultural use collections in any county occurs in Hamilton County with a reduction of 5.47%. The average across the CREP area is 1.90%. This analysis assumes that the distribution of acres converted is as listed in Table 16, an average quality acre is removed, and that a total of 85,103 acres of irrigated land are converted. The effect on the county budget could also be affected depending on which acres were converted. As stated above, conversion of soils with a higher sand content will have a larger effect on property tax collections than will conversion of other soils due to the lack of alternative uses for those types of soils.

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Following termination of the CREP after 15 years, the tax impact would remain unchanged if grasslands returned to dryland farming. The tax impact could be greater if the land were converted to a lower-value use, e.g. pasture or waste. For the tax analysis, no assumptions were made regarding such land conversion.

Table 14. Agricultural Use Valuation Changes for CREP Irrigated Acres, 2003

County	Total CREP-Eligible Acres	Total CREP-Eligible Irrigated Acres	Irrigated Assessed Valuation	Non-Irrigated Assessed Valuation	Difference in Valuation	Difference in Valuation per Irrigated Acre	Percentage Difference in Valuation
Hamilton	22,951	11,507	\$2,867,180	\$875,649	\$1,991,531	\$173.07	69.46%
Kearny	122,361	92,590	\$11,687,020	\$5,255,964	\$6,431,056	\$69.46	55.03%
Finney	284,642	211,190	\$32,308,070	\$14,550,288	\$17,757,782	\$84.08	54.96%
Gray	117,515	88,833	\$13,734,790	\$5,626,292	\$8,108,498	\$91.28	59.04%
Edwards	48,707	35,060	\$9,273,460	\$2,605,068	\$6,668,392	\$190.20	71.91%
Pawnee	60,005	44,059	\$12,831,150	\$5,031,888	\$7,799,262	\$177.02	60.78%
Ford	71,127	44,907	\$12,094,700	\$3,659,826	\$8,434,874	\$187.83	69.74%
Stafford	753	625	\$213,150	\$103,398	\$109,752	\$175.68	51.49%
Barton	21,585	15,644	\$4,406,480	\$2,434,735	\$1,971,745	\$126.04	44.75%
Rice	1,042	584	\$100,620	\$58,600	\$42,020	\$72.00	41.76%
Region	750,687	544,997	\$99,516,620	\$40,201,708	\$59,314,912	\$108.84	59.60%

Table 15. County Property Tax Effects for CREP Irrigated Acres, 2003

County	Parcels	Total CREP-Eligible Acres Assessed Value Difference	Total CREP-Eligible Acres Property Tax Difference	Property Property Tax Difference per CREP Acre	Total County Agricultural Land Property Taxes	Percentage Reduction in Property Taxes from CREP Conversion
Hamilton	110	-\$597,459	-\$75,029	-\$6.52	\$1,538,384	-4.88%
Kearny	495	-\$1,929,317	-\$158,723	-\$1.71	\$1,093,510	-14.51%
Finney	1,130	-\$5,327,335	-\$579,364	-\$2.74	\$2,593,795	-22.34%
Gray	769	-\$2,432,549	-\$276,007	-\$3.11	\$2,105,611	-13.11%
Edwards	241	-\$2,000,518	-\$247,204	-\$7.05	\$1,693,930	-14.59%
Pawnee	350	-\$2,339,779	-\$317,620	-\$7.21	\$2,150,768	-14.77%
Ford	361	-\$2,530,462	-\$347,190	-\$7.73	\$2,637,334	-13.16%
Stafford	4	-\$32,926	-\$4,956	-\$7.93	\$2,664,126	-0.19%
Barton	133	-\$591,524	-\$82,693	-\$5.29	\$2,427,230	-3.41%
Rice	5	-\$12,606	-\$1,697	-\$2.91	\$2,153,797	-0.08%
Region	3,598	-\$17,794,474	-\$2,090,482	-\$3.84	\$21,058,485	-9.93%

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Table 16. Annual County Property Tax Effects for the Removal of CREP Irrigated Acres, 2003, 2003\$

County	Irrigated Acres Enrolled	Loss in Property Tax Revenue	Percentage Reduction in Ag. Property Taxes from CREP Implementation
Hamilton	12,909	-\$84,167	-5.47%
Kearny	15,988	-\$27,339	-2.50%
Finney	22,435	-\$61,472	-2.37%
Gray	3,859	-\$12,001	-0.57%
Edwards	6,629	-\$46,734	-2.76%
Pawnee	14,596	-\$105,237	-4.89%
Ford	7,170	-\$55,424	-2.10%
Stafford	0	\$0	0.00%
Barton	1,351	-\$7,147	-0.29%
Rice	166	-\$483	-0.02%
Region	85,103	-\$400,005	-1.90%

Tax Analysis Based on the Regional SAM

The Social Accounts of a region track the monetary flows between industries and institutions. The inter-industry transactions represent the market exchanges between the producers of goods and services and their customers, whether they are other industry sectors or private consumers. These are used to estimate the market (private sector) impacts of changing production patterns.

The financial flows between institutions (households, government, investment and trade) also are tracked in the SAM. We can take advantage of the tremendous amount of information in the social accounts to generate estimates of the changes in revenues flowing to the government. Following the accounting conventions of the sources against which the tax data are benchmarked, changes in federal non-defense revenue and combined state/local government non-education revenue can be tracked in some detail.

Estimating the tax impacts assumes, first, that any change in activity exactly mirrors the patterns that exist in the base year of the social accounts. This is the same assumption inherent in estimating the private sector impacts. The second assumption is that the indirect tax impacts utilize the average distribution of all industries no matter which is actually directly affected. This second assumption is most problematic, but it nonetheless permits the generation of approximate overall impacts to public finance, including those occurring indirectly.

Table 17 shows the changes in federal and state/local government receipts associated with various income sources. With full implementation of the CREP, the estimated annual impact to the federal government is a reduction of about \$500,000, and the impact to combined state and local revenues is a reduction of about \$400,000.

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Table 17. Estimated Annual Tax Impacts Associated with Full Implementation of CREP in the Upper Arkansas River Basin, 2003 (2003\$)

		Employee Compensation	Proprietary Income	Household Expenditures	Enterprises (Corporations)	Indirect Business Taxes	Total
Federal Government NonDefense	Corporate Profits Tax				-\$291,588		-\$291,588
	Indirect Bus Tax: Custom Duty					-\$7,185	-\$7,185
	Indirect Bus Tax: Excise Taxes					-\$22,933	-\$22,933
	Indirect Bus Tax: Fed NonTaxes					-\$7,790	-\$7,790
	Personal Tax: Estate and Gift Tax						\$0
	Personal Tax: Income Tax			-\$73,061			-\$73,061
	Personal Tax: NonTaxes (Fines- Fees)						\$0
	Social Ins Tax- Employee Contribution	-\$3,271	-\$105,559				-\$108,830
	Social Ins Tax- Employer Contribution	-\$3,382					-\$3,382
Total		-\$6,653	-\$105,559	-\$73,061	-\$291,588	-\$37,908	-\$514,768
State/Local Government NonEducation	Corporate Profits Tax				-\$24,236		-\$24,236
	Dividends				-\$71,278		-\$71,278
	Indirect Bus Tax: Motor Vehicle License					-\$2,260	-\$2,260
	Indirect Bus Tax: Other Taxes					-\$5,604	-\$5,604
	Indirect Bus Tax: Property Tax					-\$92,571	-\$92,571
	Indirect Bus Tax: S/L NonTaxes					-\$14,679	-\$14,679
	Indirect Bus Tax: Sales Tax					-\$125,366	-\$125,366
	Indirect Bus Tax: Severance Tax					-\$3,267	-\$3,267
	Personal Tax: Estate and Gift Tax						\$0
	Personal Tax: Income Tax			-\$48,500			-\$48,500
	Personal Tax: Motor Vehicle License			-\$3,172			-\$3,172
	Personal Tax: NonTaxes (Fines- Fees)			-\$21,578			-\$21,578
	Personal Tax: Other Tax (Fish/Hunt)			-\$1,297			-\$1,297
	Personal Tax: Property Taxes			-\$1,515			-\$1,515
	Social Ins Tax- Employee Contribution	-\$33					-\$33
Social Ins Tax- Employer Contribution	-\$108					-\$108	
Total		-\$141	\$0	-\$76,062	-\$95,514	-\$243,747	-\$415,464
Total		-\$6,794	-\$105,559	-\$149,123	-\$387,102	-\$281,655	-\$930,232

Source: Minnesota IMPLAN Group, Inc., 2006

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Reintroduction of Dryland Agriculture

Following conclusion of the CREP, it was assumed that most land would return to dryland agricultural production. This scenario assumed the continued reduction in irrigated agricultural production, the ending of CREP payments, the associated elimination of new recreation spending and landowner lease payments, and the expansion of dryland farming and pasture land.

Table 18 shows the analysis results. Trading dryland agricultural production for irrigated production results in a direct loss of about \$13.4 million (2003\$) in productive activity. When all of the direct and indirect effects are tallied, regional production is reduced by about \$17.5 million (2003\$) annually into perpetuity. This is closely tied to about 165 jobs. And, regional value added declines by about \$9.3 million annually (2003\$).

Table 18. Economic Impact of Conversion of Irrigated Acreage to Dryland Farming Acreage following Dismissal of Water Rights in the Upper Arkansas River Basin, 2003\$

Industry	Direct Impact	Total Output	Total Employment	Labor Income	Value Added
Ag, Forestry, Fish & Hunting	-\$13,406,341	-\$14,029,215	-130.8	-\$2,405,479	-\$7,350,942
Mining		-\$139,248	-0.6	-\$22,494	-\$64,409
Utilities		-\$147,975	-0.4	-\$28,861	-\$92,114
Construction		-\$56,719	-0.7	-\$23,144	-\$26,418
Manufacturing		-\$604,840	-0.6	-\$176,267	-\$291,704
Wholesale Trade		-\$274,273	-2.8	-\$116,865	-\$208,609
Transportation & Warehousing		-\$160,257	-1.4	-\$56,360	-\$76,246
Retail Trade		-\$282,166	-6.9	-\$132,089	-\$211,528
Information		-\$74,032	-0.4	-\$17,475	-\$33,064
Finance & Insurance		-\$242,261	-1.8	-\$62,552	-\$138,428
Real Estate & Rental		-\$255,115	-2.2	-\$43,521	-\$174,342
Professional-Scientific & Technical Services		-\$72,309	-1.0	-\$34,099	-\$40,506
Management of Companies		-\$7,182	-0.1	-\$2,379	-\$3,096
Administrative & Waste Services		-\$40,069	-0.8	-\$13,731	-\$17,853
Educational Services		-\$19,153	-0.4	-\$8,268	-\$8,611
Health & Social Services		-\$309,162	-5.4	-\$154,925	-\$176,527
Arts- Entertainment & Recreation		-\$18,052	-0.5	-\$5,852	-\$9,479
Accommodation & Food Services		-\$128,428	-3.3	-\$38,595	-\$56,371
Other Services		-\$180,840	-3.8	-\$68,635	-\$87,933
Government & non-NAICs		-\$419,616	-0.9	-\$29,474	-\$251,565
Total	-\$13,406,341	-\$17,460,912	-165	-\$3,441,063	-\$9,319,741

Upon completion of the 15-year CREP, the impact to federal and state/local revenues is very similar to impact during the term of the program, as shown in Table 19.

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Table 19. Estimated Annual Tax Impacts Associated with Dryland Conversion following CREP in the Upper Arkansas River Basin, 2003 (2003\$)

		Employee Compensation	Proprietary Income	Household Expenditures	Enterprises (Corporations)	Indirect Business Taxes	Total
Federal	Corporate Profits Tax				-\$305,796		-\$305,796
Government	Indirect Bus Tax: Custom Duty					-\$14,364	-\$14,364
NonDefense	Indirect Bus Tax: Excise Taxes					-\$45,845	-\$45,845
	Indirect Bus Tax: Fed NonTaxes					-\$15,572	-\$15,572
	Personal Tax: Estate and Gift Tax						\$0
	Personal Tax: Income Tax			-\$103,977			-\$103,977
	Personal Tax: NonTaxes (Fines- Fees)						\$0
	Social Ins Tax- Employee Contribution	-\$68,914	-\$103,344				-\$172,258
	Social Ins Tax- Employer Contribution	-\$71,246					-\$71,246
	Total	-\$140,160	-\$103,344	-\$103,977	-\$305,796	-\$75,782	-\$729,060
State/Local	Corporate Profits Tax				-\$25,417		-\$25,417
Government	Dividends				-\$74,751		-\$74,751
NonEducation	Indirect Bus Tax: Motor Vehicle License					-\$4,518	-\$4,518
	Indirect Bus Tax: Other Taxes					-\$11,203	-\$11,203
	Indirect Bus Tax: Property Tax					-\$185,059	-\$185,059
	Indirect Bus Tax: S/L NonTaxes					-\$29,346	-\$29,346
	Indirect Bus Tax: Sales Tax					-\$250,619	-\$250,619
	Indirect Bus Tax: Severance Tax					-\$6,531	-\$6,531
	Personal Tax: Estate and Gift Tax						\$0
	Personal Tax: Income Tax			-\$69,000			-\$69,000
	Personal Tax: Motor Vehicle License			-\$4,514			-\$4,514
	Personal Tax: NonTaxes (Fines- Fees)			-\$30,698			-\$30,698
	Personal Tax: Other Tax (Fish/Hunt)			-\$1,845			-\$1,845
	Personal Tax: Property Taxes			-\$2,154			-\$2,154
	Social Ins Tax- Employee Contribution	-\$700					-\$700
	Social Ins Tax- Employer Contribution	-\$2,271					-\$2,271
	Total	-\$2,971	\$0	-\$108,212	-\$100,168	-\$487,276	-\$698,627
	Total	-\$143,131	-\$103,344	-\$212,189	-\$405,964	-\$563,058	-\$1,427,686

Source: Minnesota IMPLAN Group, Inc., 2006

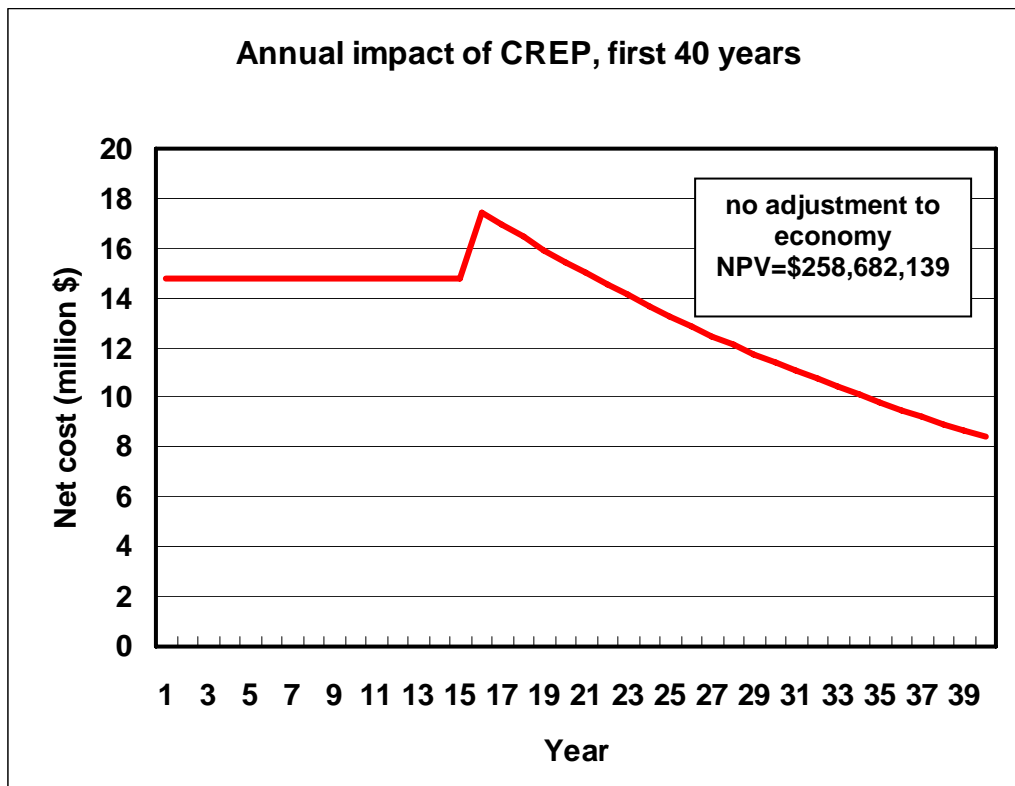
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Present Value of the Total Program Impacts

The amount in Table 18 is the effect of the reintroduction of dryland agriculture into perpetuity where the \$17.5 million is the first-year payment of an infinite stream of payments. However, because of a declining water table, it is likely that some of that land would be converted to dryland over time. Assuming an average 3% loss of irrigated acreage beginning in year 16 and into perpetuity (perhaps 90 percent of the total is paid in 30 years) and a 5% real interest rate (the time value of money), the value of the \$17.5 million into perpetuity is equivalent to another one time \$104,987,465 (2003\$) reduction in economic activity. This amount can be amortized over the fifteen years resulting in an annual reduction of \$10,114,733 (2003\$). This value represents the combined long-term impacts stated in 2003\$ assuming 15 annual installments. This number can be compared with the amount in Table 12 to get the relative effect during the 15 year CREP payment period compared to the effect after the 15 year CREP payment.

If the changes in regional economic activity into perpetuity are amortized over the 15-year period of the CREP and added to the CREP impact, the overall impact of the program from its inception into perpetuity can be characterized as a single estimate of the change in regional economic output. The annualized reduction in output equals \$24,922,029 (2003\$) to be paid in 15 annual installments, or a one-time equivalent payment of \$258,682,139 (2003\$). How the impacts of the net present value analysis play out over time is illustrated in Figure 3.

Figure 3. Net Present Value of the Stream of Regional Economic Costs Associated with Implementation of CREP and Post-CREP Dryland Farming/Pasture Land Use



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It should be acknowledged that these long-term impact estimates are associated with a degree of uncertainty. While properly calculated and appropriately reported, there is nonetheless reason to believe that they may overestimate the long-term economic response within the regional economy by some amount. There is anecdotal evidence that the regional economy adjusts in response to CRP enrollment such that the negative impact is lessened by some degree over time. At present, however, no research-based guidelines have been identified that would permit the application of a “decay function” to the impacts. Thus, the estimates of long-term impact reported here should be considered tentative and subject to change should additional information be identified.

Further, it should be acknowledged that these impacts could further be mitigated by the fact that more than 300,000 acres in the 10-county region currently enrolled in the CRP program will be coming out of contract in the next five years. Uncertainty regarding the future of the CRP program and the ultimate disposition of these acres preclude incorporating consideration of them in this analysis. But, any of this acreage returning to agricultural production would represent a positive economic stimulus.

Finally, it needs to be recognized that the entire analysis to this point has assumed a static regional economy in which no adjustment occurs other than those introduced by the analysts alternative production scenario (CREP household payments, recreation, and grazing followed by a return to dryland farming and pasture). This remain a principle limitation of the analysis to this point insofar as it is known that people and the overall economy are more likely fill any economic void with alternative activities unknown in the present. Thus, the present value analysis would overstate the impacts expected to occur.

A Dynamic Reinterpretation of CREP and Post-CREP Impacts

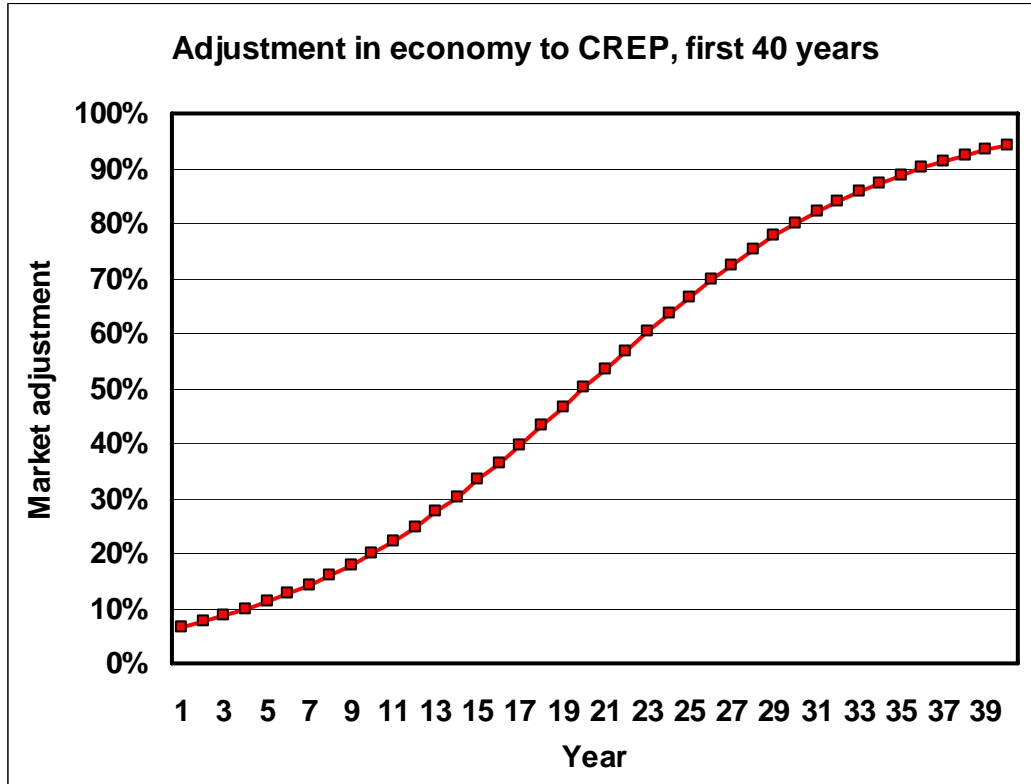
The \$258,682,139 one-time net cost of the CREP program equivalently can be represented as an annual cost of \$14,807,296 that occurs for the first 15 years of time, followed by a \$17,460,912 in year 16, diminishing to 97% of that number in year 17 (i.e., \$16,937,085), and so on into infinity. But, people generally are innovative in their response to economic change, always creating and destroying businesses to accommodate such change. So, given that an economy is never static in the way it responds to change, it is likely that these calculated annual net costs associated with the program would in fact diminish over time during the first 15 years, and would diminish at a rate beyond the 3% thereafter that was implied by our framework and which was assumed to be due to diminishing water tables. Likely, this stream of costs would follow a path often followed by new technologies, where the rate of decline would be slow at first since it takes awhile for entrepreneurs to devise successful business reactions to the change. Then, as a few successes are observed, suddenly there is a mini explosion in new activities to exploit the change that took place. Finally, the rate of decline again slows over time. This is the usual S-curve of technology adoption, as illustrated in Figure 4.

Typically, an S-curve is created by considering the portion of an impact remaining at particular points in time in an infinite time series. In this case, based on a consensus forecast of the research group, one reasonable infinite-time-horizon path of adjustment is one that retains 80 percent of the impact at 10 years but only 20 percent at 30 years. In this setting, only 1.5 percent of the impact remains after 50 years. This array of percentage adjustments was next applied directly to the annual series of net costs to the program discussed above. That is, the S-curve shown in Figure 4 was applied to the net present

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values in Figure 3 to generate the lower stream of impacts shown in Figure 5.

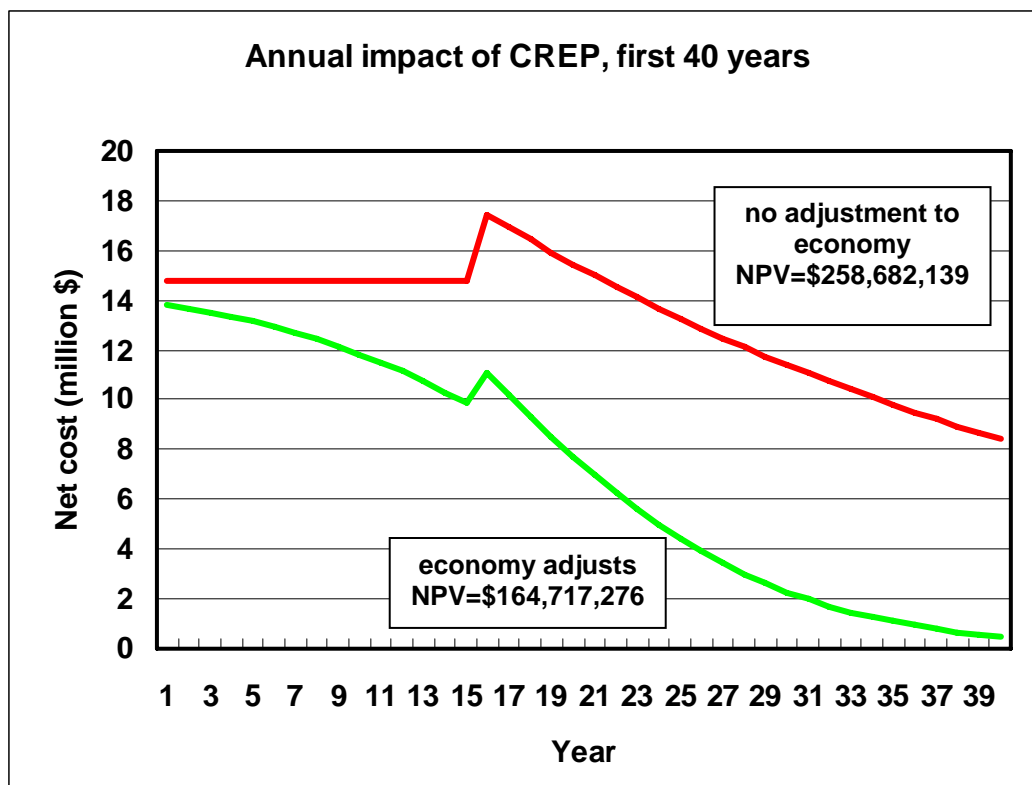
Figure 4. Consensus Forecast of Regional Economic Adjustments Associated with CREP



The net present value of this infinite series of costs is \$164,717,276, which can be compared directly to the one time cost listed above of \$258,682,139. So, the assumption that the economy will adjust to change over time results in an expected reduction in total cost of 36 percent. Also, if the total cost of the program were to be amortized over the 15 years of its existence, the annual cost would be \$24,922,029 with no economic adjustment and only \$15,869,239 if economic adjustments occur like those suggested as plausible.

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Figure 5. Net Present Value of the Stream of Regional Economic Costs Associated with Implementation of CREP and Post-CREP Dryland Farming/Pasture Land Use Assuming a Dynamic Economic Response



Likely Impacts of Rising Energy Prices on Irrigated Agriculture in Western Kansas

Introduction

Cost of production has increased for all agricultural producers. Due to higher energy use, irrigated producers in western Kansas have been more severely impacted. Dhuyvetter et al. (2005) estimated that, due to energy price increase and relative to 2004, the cost per irrigated acre increased \$34.15 in 2005 and is expected to increase another \$12.97 in 2006.⁸

With a rise in energy prices, the cost of crop production may increase for several reasons. First, as we have seen, there will be a direct increase in the price of fuel and of fertilizers and pesticides that are manufactured from fossil fuels. Seed costs might also increase due to the increased cost of producing and transporting seed. The cost of other production inputs requiring transportation likely will also increase. A long-run cost increases would be expected due to an increase in the cost of manufacturing, capital, and replacement items. Unfortunately, producers have limited ability, in the short-run, to pass these costs associated with higher fuel prices on to consumers.

⁸ Includes irrigation pumping costs, fuel and oil, and fertilizer.

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Escalating fuel price and the associated negative impact on production agriculture have caused a great deal of concern among producers, policy makers, and other stake holders. Among the questions raised in the context of this research is the extent to which rising energy prices might otherwise affect agricultural production in the region without regard to the CREP. A rigorous quantitative analysis of this question was beyond the scope of this research. However, a review of previous research and relevant economic principles provides some insight into potential producer responses to the high cost of energy. The purpose of this research is to provide a normative economic analysis and qualitative discussion of the likely responses by irrigated producers in western Kansas to the increasing energy costs. Additionally, the impact of rising energy prices and producer responses to the Conservation Reserve Enhancement Program will be discussed.

Producers engaged in the production of irrigated crops face a variety of management decisions. These decisions include whether to irrigate or stop irrigating, which irrigation technology to adopt, which crop to produce, and how much water to use in the production process. These questions generally are thought to be approached and solved within a profit maximization framework. That is, a producer will make the choice that maximizes expected profit. Normally, these decisions are simultaneously determined, whereby all combinations and their respective profits are compared and a single production plan chosen. An analysis and discussion based on simultaneously determined solutions can be very complex and often times confusing. As such, this review will focus on the likely impacts that escalating energy costs will have on each decision individually, assuming all other factors are held constant.

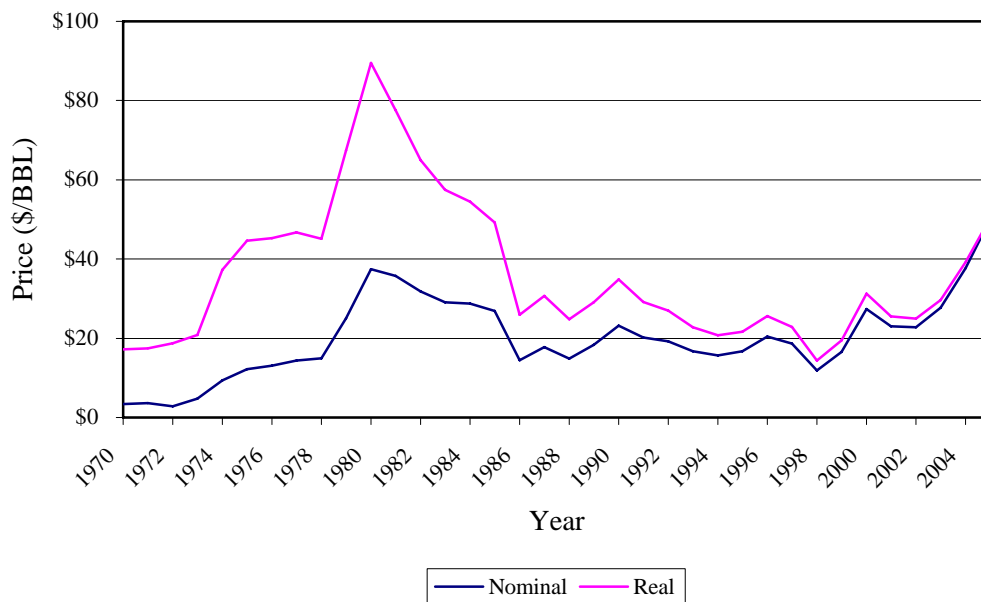
Fuel Prices in Perspective

Agricultural producers currently are facing some of the highest nominal prices they have ever seen. However, we need to recognize that even though fuel prices were over 40% higher in 2005 as compared to 2004, the proportional increase in the cost of machinery operations will be considerably less because fuel only makes up a small percent of total machinery costs (Dhuyvetter and Kastens, 2005). Additionally, while nominal fuel prices are at record levels, in real (adjusted for inflation) terms, today's fuel price is far lower than that seen in the late 1970s and early 1980s as illustrated in Figure 6 and adjusted to 2004 dollars.

In the face of the 1999 – 2000 increase in fuel price, the United States Department of Agriculture Economic Research Service (USDA-ERS) suggested that producers of energy-intensive crops such as corn would see substantial increases in production costs as output prices remain relatively unchanged. Since producers cannot pass these costs on to consumers they are forced to absorb these increases, at least in the short run. That is, even with reduced profits agricultural output was not expected to decline in the short-run (ERS, 2000).

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Figure 6. Average Annual Crude Oil Price



Source: United States Department of Energy at www.economicmagic.com

More recently, the USDA forecasted net farm income to be relatively stable from 2006 to 2015, after declining from historically high levels in 2004 and 2005 (these historic highs occurred even with higher than normal fuel prices). Overall, farm cash receipts increase through the projections due to growing domestic use and export demand as well as increases in agricultural commodity prices. Rising production expenses and lower government payments, however, offset gains in cash receipts and other sources of farm income. Stable net farm income assists in asset accumulation and debt management. The debt-to-asset ratio falls moderately in the projections, continuing a generally declining trend since the mid-1980s (USDA, 2006).

The USDA further suggests that the increases in oil prices from late 2002 through 2005 resulted from strong crude oil demand and largely reflect world economic recovery and rapid manufacturing growth in China and India. Oil prices, in real terms, are projected to fall, between 2007 to 2010 as new crude supplies help offset the rise in demand from Asia. In subsequent years, crude oil prices are projected to rise, but only slightly faster than the general inflation rate. Factors expected to constrain long run oil price increases include new oil discoveries; new technologies for finding, extracting, and refining oil; the ability to switch to non-petroleum fuels; and the ability to increase energy efficiency by substituting non-energy inputs for energy (USDA, 2006).

Fuel Prices and the Decision to Irrigate

In 1982, the High Plains Study Council released the *Summary of Results of the Ogallala Aquifer Regional Study, with Recommendations to the Secretary of Commerce and Congress*. The results of the High Plains Study projected substantial reductions in water use in the state of Kansas (Kansas Water Office, 1982) due to higher energy prices and reduced

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water availability. As illustrated in Figure 3, this period represented a time of exceptionally high fuel prices. The late 1970s and early 1980s also represented a period of rapid conversion from dryland production to irrigated production. In all likelihood this conversion was due to the relatively high profitability of irrigated production relative to dryland production.

Chanyalew, Featherstone, and Buller (1989) suggested that, as pumping costs increase, either from increased fuel price or increased pumping lift, the number of irrigated acres would decline. Buller and Williams (1990) suggested that if natural gas prices continued to rise relative to commodity prices at the time, irrigated agriculture would become less important in western Kansas. This combination would first generate a shift away from corn to crops that require less water, and eventually a shift away from irrigated agriculture.

Peterson and Bernardo (2003) provided a concise evaluation of water-related literature generated over the previous 20 years. Referencing the 1982 High Plains study, the authors found that the projections from the High Plains Study model grossly overestimated the conversion of irrigated land to dryland production. Much of the discrepancy could be attributed to assumptions built into the model concerning yields, prices, and technology. One of the most critical of these were the over-estimation of energy prices and their impact on profitability.

From an economic perspective, energy prices may become so high that producers are forced to curtail farming operations or shift to dryland production. Figure 7 illustrates the relationship between marginal cost (MC), marginal revenue (MR), average total costs (ATC), average variable costs (AVC), and the point at which production may cease. So long as a producer operates where marginal cost equals marginal revenue (MR1), and both are above average total costs (ATC), then the producer will generate positive net incomes.⁹ If costs are such that the producer operates where marginal cost, average total cost (ATC), and marginal revenues (MR2) are equal, then the producer will generate zero net income, but have sufficient revenues to cover all costs. If a producer cannot break even his next best alternative is to minimize losses. In the event that energy prices escalate to the point where marginal cost, marginal revenue (MR3), and average variable costs (AVC) are equal, then the producer will generate negative net income, but will cover average variable costs. In the short run, production will continue as long as the revenues generated from production contribute to the payment of fixed overhead (at or above MR3). In the long run, when all costs are considered variable, production must occur where net income is positive (at or above MR2). Therefore, the current relationship between marginal revenue, marginal cost, and average total cost for irrigated producers in western Kansas must be determined. Figure 8 illustrates the relationship between net farm income and fuel prices for the Kansas agricultural sector. Albright (2002) suggests that irrigated producers in western Kansas typically have higher net farm income than comparable dryland producers. Dhuyvetter et al. (2005) suggest that, while the rise in energy prices has reduced profits, those profits are still positive. The most recent calculations from the Property Valuation Division of the Kansas

⁹ Marginal revenue (MR) is the revenue generated from the last unit of output. For example, the marginal revenue for a bushel of corn would be the market price of a bushel of corn. Marginal cost (MC) is the cost incurred from producing the last unit of output. Average total costs (ATC) is the average cost per unit of output including fixed (equipment, buildings, etc.), and variable costs (fertilizer, seed, water, etc.). Average variable cost (AVC) is the average cost per unit of output including only variable costs.

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Department of Revenue indicate that, while the eight-year average landlord net income (LNI) for irrigated producers in western Kansas is declining, it remains at a profitable level. Taken together, the preceding information suggests that the marginal revenue from irrigated production currently is greater than the average total cost of that production. This would indicate that average revenue from irrigated production, even with higher energy costs, is above both the point of zero net income as well as the shutdown point illustrated in Figure 7.

Figure 7. Relationship Between Marginal Cost (MC) and Marginal Revenue (MR)

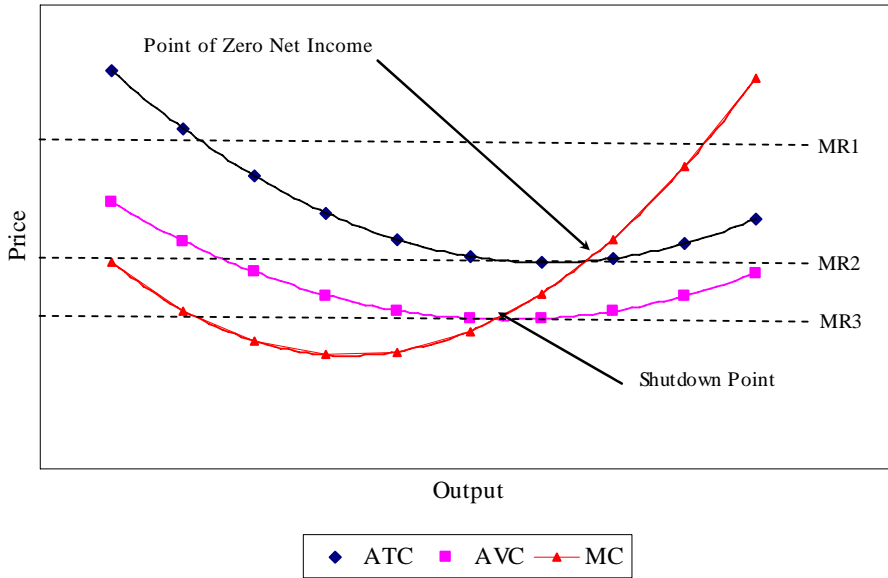
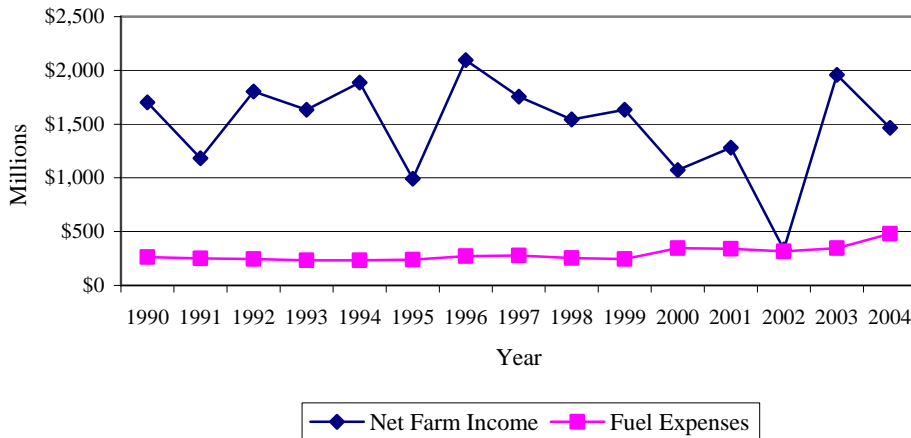


Figure 8. Kansas Agricultural Sector Net Farm Income and Fuel Expense

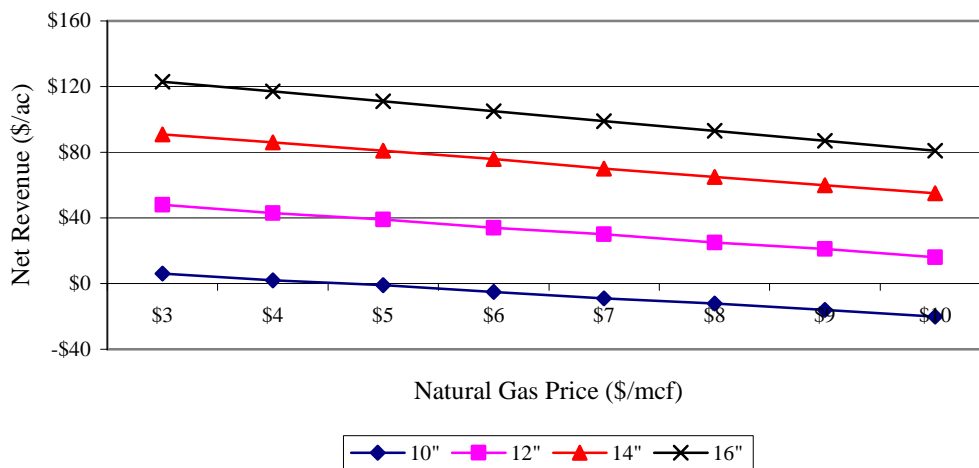


Source: USDA-ERS at <http://www.ers.usda.gov/Data/FarmIncome/Finfidmu.htm>.

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The Crop Water Allocator (CWA) is a computer program designed to aid irrigated producers in their management decisions.¹⁰ CWA uses relationships between crop yields, rainfall, water application, crop prices, and production expenses to generate measures of net returns to management, land, and irrigation equipment. This computer-aid was designed specifically for western Kansas. Figure 9 illustrates the impact that increasing fuel price has on profitability. On average, each dollar increase in the price of natural gas decreases net returns by approximately five dollars per acre. The levels of profit generated by CWA further suggests that current levels of profitability are above the shutdown level depicted in Figure 7.

Figure 9. Impacts of Energy Prices on Net Returns to Management, Land and Irrigation Equipment for Corn Production; Calculated at Various Water Application Amounts



Based on CWA output at 11" of rainfall and a corn price of \$2.56 per bushel. All other variables were set to default values.

The evidence suggests that, in the short-run, the current level of fuel prices will not significantly reduce the numbers of irrigated acres in western Kansas. On average, producer profitability appears to be above the shutdown level. This should not be construed as indicating all producers will continue to irrigate. Albright (2002) provided data to suggest that there is significant variation (approximately \$130 per acre) in the profitability of irrigated producers using the same technology. Irrigated producers that have historically low profitability may face banker- or self-imposed credit constraints that limit their ability to produce irrigated crops in the immediate future. Higher energy costs also could result in marginally profitable land being taken out of farming.

In the long-run, current average profits combined with a projected slowing of fuel price increases would suggest that profitability will stay above the shutdown level. Some reduction in irrigated acreage may occur as the low profit producers face difficulty in replacing irrigation equipment as it wears out. However, it should be pointed out that past forecasts of reductions in total irrigated acreage resulting from the inability of irrigators to replace worn-out systems did not occur as projected by some economists (Peterson and Bernardo, 2003).

¹⁰ Available at www.oznet.ksu.edu/mil.

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Fuel Prices and the Crop Choice Decision

The High Plains Study Council (1982), Buller (1988), Chanyalew, Featherstone, and Buller (1989), and Buller and Williams (1990) suggested that as the marginal cost of water increases producers will respond by shifting to crops with lower water requirements. Wu, Bernardo, and Mapp (1996) developed an econometric model to explain crop mix variation. Acreage elasticities suggested that crop mix response to crop price was inelastic; that is, crop mix is relatively unresponsive to crop price. Additionally, saturated thickness had little impact on crop choice within a localized area. Across counties it was observed that areas with larger saturated thickness tended to allocate more acreage to corn. These long run elasticities suggest that producers react less to these variables than might be indicated by a linear programming model based on the assumption of short-term profit maximization. Peterson and Bernardo (2003) suggested that during the past two decades, most economic models did not predict the increase in acres of high water use crops.

From an economic perspective, a producer will allocate water to its most profitable use. In essence, a producer will choose the crop that generates the most revenue less costs, given his farm's water availability. This would suggest a crop selection that has the largest value marginal product of water, assuming water availability sufficient to meet the crop's requirements.¹¹ Table 20 provides information on the yield response to water, the value marginal product of water, and the marginal cost of water for a typical producer in western Kansas. Table 20 suggests that the first inch of water applied to an acre of corn results in an increased yield of 13.3 bushels which generates \$33.28 in revenue. On the other hand, if the same inch of water was applied to an acre of grain sorghum it would increase yield by 9.4 bushels which would generate \$20.59 in revenue per acre. Regardless of the crop selection, the marginal cost of water stays constant and is approximately \$4.28 per acre-inch. The implication of these data is that corn production, even at today's high fuel price, generates the most income for an acre-inch of water applied. While not reported in this research, Kansas State University crop budgets also suggest that irrigated corn is more profitable than other crops.¹² Additionally, simulation modeling with CWA, as reported in Figure 10, supports these finding.

¹¹ The value marginal product of water is the revenue generated from the application of an inch of water. The marginal cost of water is the cost associated with the application of an inch of water.

¹² Alfalfa has not been included in this discussion do to the lack of crop response data.

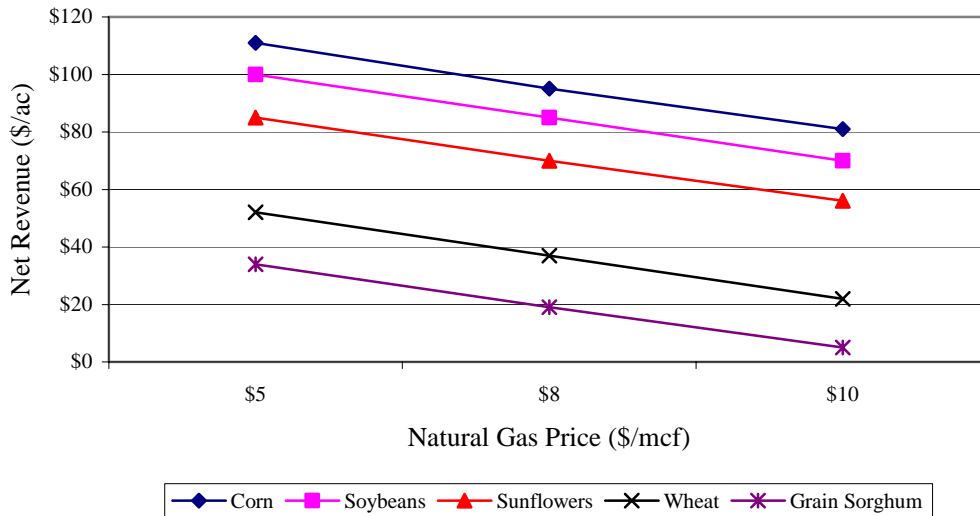
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Table 20. Yield Response to Water, Marginal Value, and Marginal Cost in Western Kansas

Crop	Yield Increase per Inch of Water	Crop Price	Value of the Marginal Product	Marginal Cost of Water
Corn	13.3	\$2.51	\$33.38	\$4.28
Soybeans	4.5	\$6.10	\$27.45	\$4.28
Sorghum	9.4	\$2.19	\$20.59	\$4.28
Sunflowers	6.0	\$2.92	\$17.52	\$4.28
Wheat	4.6	\$3.37	\$15.50	\$4.28

Yield increase is based on a discussion with Loyd Stone and is measured in bushel per inch of net irrigation water. Crop prices are in dollars per bushel and were obtained from KSU extension at <http://www.oznet.ksu.edu/library/agec2/mf1013.pdf>. The marginal cost is in dollars per inch of net irrigation water and obtained from the Crop Water Calculator based on a natural gas price of \$8.10 per million cubic feet, a static water level of 120 feet, and a pivot pressure requirement of 35 psi.

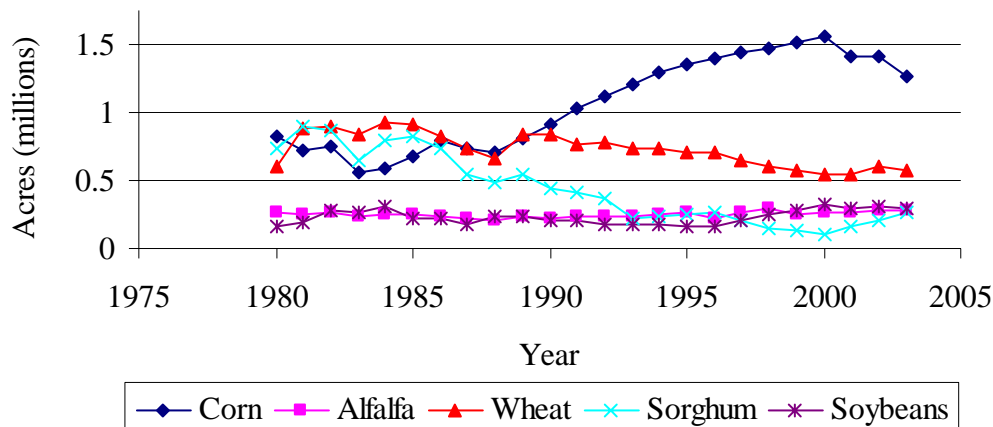
Figure 10. The Impact of Fuel Price on Crop Net Revenue



Based on CWA output at 11" of rainfall and a corn price of \$2.51 per bushel. All other variables were set to default values.

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Figure 11. Trends in the Irrigated Crop Mix in Western Kansas



Source: Kansas Agricultural Statistic Service. Includes Crop Reporting Districts NW10, WC20, SW30, C50, and WC60.

Crop acreage trends illustrated in Figure 11 further suggest that corn is the crop of choice in western Kansas. However, when comparing Figure 6 and Figure 11, it is apparent that the increase in fuel prices starting in 2000 may have been accompanied by a shift in irrigated acres from corn to grain sorghum. Additional research is required to determine if this was a localized response or distributed uniformly across western Kansas, the result of a relative output price difference between corn and grain sorghum, or the result of declining water well capacity. However, if producers in the 10 county CREP target area shift from corn to grain sorghum; assuming a uniform distribution across the target area and applying KASS acreage and revenue data; a 1% reduction in corn acres would reduce corn acres by approximately 3,800 acres per year and reduce gross revenue in the target area by approximately \$820,000 per year.

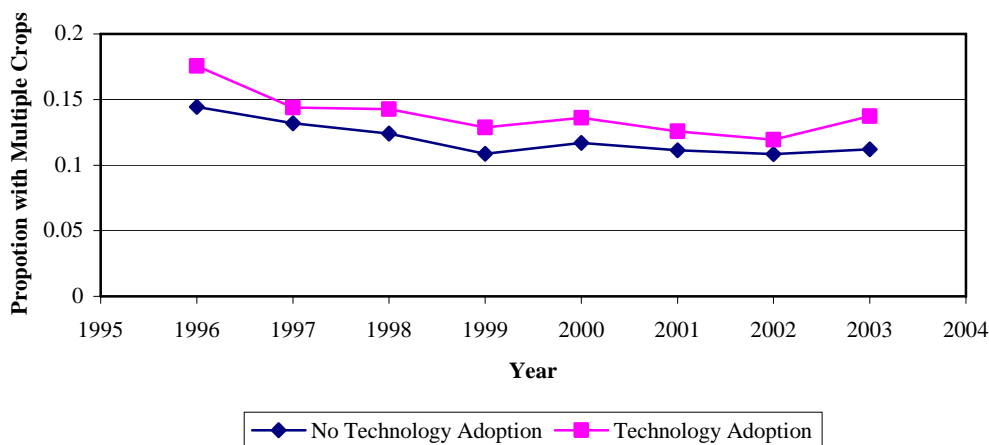
The crop response data reported in Table 20 represent the crop yield increase resulting from the first inch of irrigation water applied. Economists, engineers, and producers are aware that the yield response to irrigation water is curvilinear and diminishes as additional water is applied. This implies that the last portion of water applied to corn might yield greater profits if it were allocated to another crop. With this in mind, a purely profit maximizing producer might allocate acreage under an irrigation system to multiple crops.¹³ Simulation modeling with CWA suggests that, as pumping capacities are limited or as the price of fuel increases, profits will be enhanced by growing multiple crops under a single irrigation system.

Golden (2005) suggested that asset specificity, producer crop preferences, landlord preferences, agronomic factors, crop rotational considerations, government programs, risk preferences, planning horizons, and management time are implicit constraints that may limit a producer's ability to operate as a profit maximizer in the short run and grow multiple crops under a single irrigation system. As reported by Golden and Peterson (2006) and depicted in Figure 12, multi-crop management schemes are limited in acceptance and do not appear to be impacted by energy prices.

¹³ A producer might also do this to spread the timing of water use across the irrigation season.

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Figure 12. Proportion of Producers Growing Multiple Crops on a Single PDIV



Technology Adoption refers to producers who adopted a more efficient irrigation technology during the time period.

The evidence suggests that, in the short-run, the current level of fuel prices will not significantly affect crop choice. Dhuyvetter et al. (2005) suggested that these price trends do not appear sufficient to alter a producer's acreage decision independent of other factors. This should not be construed as indicating all producers will maintain their current cropping schemes. Planting decisions ultimately will depend on relative price expectations, risk preferences, input availability, and costs at planting time. Also, as previously discussed, there is significant variation in the profitability of any irrigated crop between producers using the same technology. Irrigated producers who have historically have low profitability may face banker- or self-imposed credit constraints that require they produce a crop with a lower cost structure. Additionally, we should be aware that some benefits to growing crops may not be fully reflected in a single year's net returns, such as agronomic benefits of crop rotations. Many factors influence a farmer's decision of what to plant from year to year. Short-term profit maximization is seldom the only criterion considered.

In the long-run, crop choice will be a function of the relative profitability among crops, which will depend on the available water, relative yield response to water, marginal values, and marginal costs. It should be pointed out that past forecasts of long-run crop mix change due to declining water availability and rising fuel costs did not occur as projected by some economists (Peterson and Bernardo, 2003). While, in the short-run, producers may not exhibit purely profit maximizing behavior, they certainly are long-run profit maximizers.

Fuel Prices and the Water Allocation Decision

Once the producer has made the choice of what crop to produce, he is faced with the choice of how much irrigation water to use in the production process. Production theory implies that a profit maximizing producer will use water to the point where the value marginal product of water, which is the additional revenue generated by the use of one more unit of water, is equal to the marginal cost of the additional unit of water. As a result, the demand curve for irrigation water is downward sloping, indicating that, as the price of water (which is positively

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correlated with fuel price) increases, the amount of irrigation water used in crop production decreases.

Extensive economic research has focused on the demand for irrigation water. Allen and Gisser (1984); Nieswiadomy (1985); Kim, Hanchar, and Moore (1987); Ogg and Gollehon (1989); Moore and Negri (1992); Moore, Gollehon, and Carey (1994); Schaible (1997); Peterson and Ding (2005); and Golden (2005) have all estimated the demand for irrigation water. The research consensus is that the price elasticity of demand is highly elastic, that is, the quantity demanded is relatively unresponsive to price. The implication is that, once the crop choice is made, producers apply water based on a fixed land:water ratio. It should be pointed out that the fuel price variability observed in several of these studies was less than the current variability.

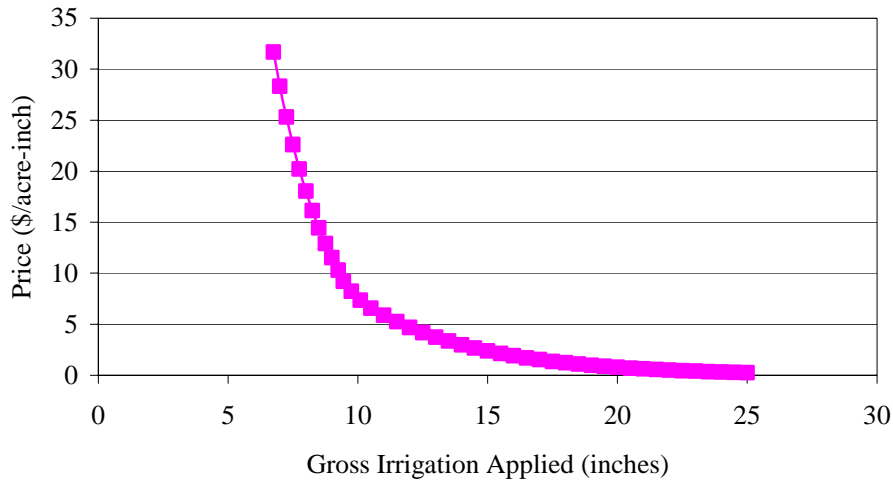
For illustrative purposes, the demand curve for irrigation water in corn production for western Kansas, as calculated by Golden (2005), is reported in Figure 13. This demand curve suggests that, in the current fuel price range, demand is very inelastic and unresponsive to price change. However, in the current range of fuel prices, irrigated producers would maximize profits by reducing water use. Past research suggests they will not reduce water use. Several researchers have indicated that fixed well water yields and the large fixed investment in irrigation equipment contribute to water consumption being especially unresponsive to price signals. Golden (2005) suggested that it is simply a response to risk aversion. Table 20 suggests that the cost of pumping an additional inch of water is approximately \$4.28 while Kansas State University crop budgets suggest the annual cost of an irrigated acre of corn in Southwest Kansas to be in excess of \$700.¹⁴ These figures suggest that the downside risk of diminishing crop yield due to inadequate irrigation may be substantially higher than the cost associated with pumping an additional inch of water.

The evidence suggests that, in the short-run and given an existing technology and crop choice, the current level of fuel prices probably will not significantly impact the quantity of water consumed. Golden and Peterson (2006) reported that, for all crops and technological combinations, rain-adjusted water use per acre in western Kansas had a downward trend and was thus declining over time. These trends may be the result of producers 'learning by doing' and the recent trends in fuel price. In the long-run, escalating fuel prices will in all likelihood increase the downward slope of these trends.

¹⁴ Available at <http://www.oznet.ksu.edu/library/agec2/mf585.pdf>.

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Figure 13. The Demand for Water for Center Pivot Irrigated Corn in GMD #3



Assumes the price of corn is \$2.50 per bushel.

Fuel Prices and Technology Adoption

There is significant research focusing on irrigation technology adoption. Ellis, Lacewell, and Reneau (1985); Earls and Bernardo (1992); Dhuyvetter, Lamm, and Rogers (1994); Wu, Mapp, and Bernardo (1994); Williams et al. (1996); Delano and Williams (1997); DeLano, Williams, and O'Brien (1997); O'Brien et al. (1998); Green and Sunding (1997); Lamm and Trooien (2000); O'Brien et al. (2000); Peterson and Ding (2005); Golden (2005); and Golden and Peterson (2006) each have analyzed technology adoption from various perspectives. Research suggests that irrigation technology is adopted as a result of an immediate crisis that threatens survival, the opportunity for better production, and the opportunity to reduce risks. Adoption rates are a function of producer age, education, management capacity, farm size and land quality, availability of financing and financial condition, cost of the technology, accessibility of information, water source and availability, relative crop prices, availability of irrigation inputs, government programs, environmental regulation, farming tradition, and risk preferences.

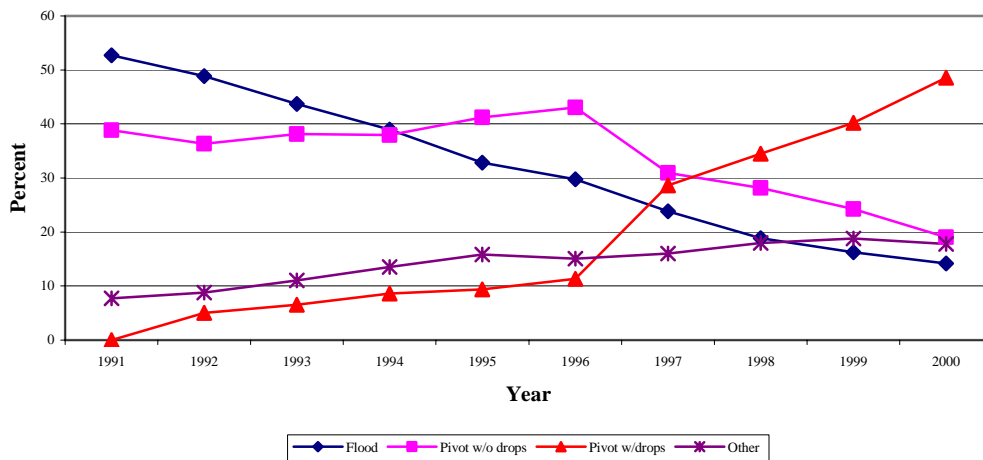
Adopting more efficient irrigation technologies and farming practices will be a likely response to the increasing price of fuel and marginal cost of water. Conversion to more efficient irrigation technology is a common response from Kansas irrigated producers as illustrated in Figure 14. The adoption of irrigation technology has increased water use efficiency, reduced the cost of production and enhanced producer profitability. However, it may also have contributed to producers shifting to water intensive crops such as corn, expanding acreage, and may not have reduced water consumption in the aggregate (Golden and Peterson, 2006).

In all likelihood the current trends of converting from flood irrigation technology to center pivot technology and/or adding low-pressure drop technology to existing center pivots will continue. Lamm and Trooien (2000) suggested that there will be significant fuel and water savings realized by converting to subsurface drip irrigation technology. Schlegel, Stone, and

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Dumler (2005) reported significant water savings and, by inference, fuel savings, with the adoption of limited irrigation technology. Harman et al. (1985) indicated that returns to land, management, and risk are substantially higher using no-till technology. Kastens and Dhuyvetter (2006) suggested that precision technologies have the potential of reducing both fuel and fertilizer cost in irrigated production.¹⁵ Klocke (2004) suggested that computer-aid technologies such as the CWA and the Kansas Water Budget Model have the ability to reduce water consumption and enhance producer profitability. Producers might also adopt more energy efficient pumping units. CWA suggests that conversion from natural gas to electricity can reduce pumping costs. The Associated Press reports that many western Kansas farmers who can switch from natural gas to electricity to power irrigation pumps are doing so.¹⁶

Figure 14. Irrigation Technology Adoption in Western Kansas



Fuel Price and Land Rent

Several economic theories have been used to explain the monetary level of land rent. The 'contribution-based equitable rent' concept suggests that, in the long-run, landowners and tenants should acquire approximately the same rate of return on their investment (Dhuyvetter and Kastens, 2001). Based on this principle, as input prices increase, the tenant's rate of return decreases. In order to maintain equitable contributions the land rent would need to decline. The theory that land rent represents the 'residual return to land', suggests that land rent represents the net profits generated from a farming operation after all variable and fixed expenses have been paid and the renter has received a fair wage Johnson et al. (2000). Applying this theory also suggests that, as input prices increase, the landowner should expect a reduced residual return and thus a lower cash rent.

A likely impact of escalating fuel prices is a reduction in the land rent of irrigated cropland in western Kansas. Dhuyvetter et al. (2005) suggested that, assuming producers do not make major production changes, land rents would need to decrease by \$47.13 for irrigated acres from 2004 to 2006 in order to fully offset the impact of higher energy costs alone. In the

¹⁵ Available at [http://www.agmanager.info/dhuyvetter/presentations/KSUPACConf\(Jan2006\).pdf](http://www.agmanager.info/dhuyvetter/presentations/KSUPACConf(Jan2006).pdf).

¹⁶ Available at <http://www.kansas.com/mld/kansas/news/state/13257576.htm>.

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short-run, a producer's ability to renegotiate rental rates is limited and as a result near-term profits will suffer¹⁷. Dhuyvetter and Kastens (2005) suggested that in the long run, higher production costs will lead to either higher prices for commodities or a lowering of land costs.

Fuel Price and Property Tax Valuation

In 1985, the State of Kansas adopted use-value appraisal for agricultural land. Use-value appraisal is based on the concept of income-capitalization. For each land-use type (irrigated cropland, dryland cropland, and pastureland) measures of income potential are generated. For an individual parcel of land a portion of this income is allocated as landlord net income (LNI). The LNI is then divided by a capitalization rate which yields the appraised value. As a result of this method, as rising energy prices increase production expenses (fuel, fertilizer, etc.), LNI would be expected to decline which would result in reduced appraised values. In the long-run landowners will realize a reduced tax burden while local governments will realize reduced tax revenues. In so far as high taxes reduce land prices, land values would be expected to rise.

The relevant production costs per acre are obtained from the Kansas State University Farm Management Guides, the Kansas Irrigation Water Use (published by the Kansas Division of Water Resources) and producer surveys. The type of irrigation (flood or sprinkler) and typical fuel type are taken into consideration when calculating the fixed and variable expenses associated with irrigation. Due to the timing of data availability, these data are incorporated into LNI calculations two years after they are observed in the market. K.S.A. 79-1476 requires that an eight-year average of landlord net returns (LNI) be used by the Property Valuation Division of the Kansas Department of Revenue in determining the agricultural land use-values. The averaging process is used to stabilize tax values. As a result of delays in data availability and the use of an eight year average the impact of current rising energy prices will have a limited short-run impact on landowner's tax burden, local government's tax revenues, or land prices.

The Impact of Fuel Price on CREP

The CREP is a voluntary and incentive based program that allows irrigated landowners in western Kansas to retire their irrigated acreage and receive irrigated rental payments. Current provision suggests that the Farm Service Agency (FSA) will set rental payments based on historic land rent values for irrigated cropland in the target area. Golden (2005) reviewed past voluntary land retirement schemes and suggests that market participants have an expectation of receiving, at a minimum, the fair market value of their asset and that older and/or retired landowners will be the most likely to participate.

A landowner will choose to participate in the CREP, all other factors held constant, if the net present value of the expected future income stream derived from the CREP program is greater than the expected net present value of the future income stream derived from crop production or land rent. Given that 1) irrigated cropland rent may decrease as previously discussed, 2) the most likely participants will be concerned with rental income as opposed to production income, 3) FSA sets rental rates on historic values, then the CREP expected payments may be greater than expected land rent and we would expect the demand for CREP contracts to increase.

¹⁷ Where possible, tenants will renegotiate land rent to reflect current fuel prices in the short-run.

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It should be pointed out that 1) in so far as higher energy costs may result in marginally profitable land being taken out of production anyway and assuming that the land is eligible for CREP, the program may be redundant to current market conditions, and 2) since FSA sets rental rates on historic values and participants may have a lower expectation for future rents, the CREP may retire water rights by paying much less than previously thought.

Conclusion

Since 2004, escalating fuel prices have increased costs for irrigated production in western Kansas in excess of \$110 million dollars.¹⁸ While a portion of this impact has been mitigated by higher crop prices and yields, it has most certainly decreased profits and has had a negative economic impact on irrigated producers and rural communities. Producers are unable to pass these costs on to consumers, and are economically constrained from changing irrigated acreage, crop choice, or water usage patterns in the short-run. As a result, producers are economically forced to continue with current management schemes and accept lower profits. In general, irrigated acreage, crop choice, and water usage patterns will probably change for only producers on marginal land or those with credit constraints. In this environment, CREP may represent an expected positive net present value alternative that would enhance participation.

In the long-run, if energy costs remain high, producers will make management decisions to lower this cost (e.g., negotiate lower rents, adopt technology and farming systems that reduce fuel consumption). Irrigated acreage trends, crop choice trends, and water use trends will remain in place unless market forces act in such a manner to alter the current relationships between marginal revenues, marginal costs, and average total costs.

A Sensitivity Analysis of the Decline of Agriculture

A final analysis estimates the impact of a gradual decline in the value of agricultural production. While the impact of future energy costs, water supplies or other factors is somewhat speculative, there is a relative certainty that the value of agricultural crops production in the region will decline, assuming relatively constant technology. To get a sense of what this may mean for the region, a sensitivity analysis was performed modeling the conversion of 1, 2, 5, and 10 percent of irrigated agricultural acreage to dryland acreage. The results are shown in Table 21.

For each one percent decline in irrigated agriculture, whether due to water availability, energy costs, land retirement, or other reason, regional output declines by about \$2 million and total income declines by about \$1 million. This level of activity is closely linked to about 20 jobs.

¹⁸ Costs based on Dhuyvetter and Kastens (2005) and irrigated acreage in Crop Reporting Districts 10, 20 and 30 and are cumulative for the 2004 and 2005 crop years.

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Table 21. A Sensitivity Analysis of the Reduction of Irrigated Agriculture in the Upper Arkansas River Basis, (2003\$)

	Irrigated Acres	Dryland Acres	Net Difference
Regional Value of Production*	\$227,266,171	\$294,355,021	
Total Acres	708,592	3,026,503	
Value Per Acre	\$320.73	\$97.26	
1% Total Irrigated Acres	7,086		
2% Total Irrigated Acres	14,172		
5% Total Irrigated Acres	35,430		
10% Total Irrigated Acres	70,859		
1% Value Reduction/Increase	-\$2,272,662	\$689,170.10	-\$1,583,492
2% Value Reduction/Increase	-\$4,545,323	\$1,378,340.20	-\$3,166,983
5% Value Reduction/Increase	-\$11,363,309	\$3,445,850.51	-\$7,917,458
10% Value Reduction/Increase	-\$22,726,617	\$6,891,701.01	-\$15,834,916

	Total Output	Total Employment	Labor Income	Value Added
Grain Farm Production				
1% Net Value Change	-\$2,059,277	-20	-\$402,726	-\$1,096,299
2% Net Value Change	-\$4,118,554	-40	-\$805,452	-\$2,192,598
5% Net Value Change	-\$10,296,385	-101	-\$2,013,630	-\$5,481,495
10% Net Value Change	-\$20,592,770	-202	-\$4,027,260	-\$10,962,990

* The estimated regional value of production is based on total production in the 10 CREP counties.

Perspective on the Net Impacts of CREP

Table 22 is offered to provide perspective on the scale of the impact associated with the CREP program. When compared to the overall level of regional economic activity in 2003, the annual impacts of the CREP represent about 0.14 percent of regional production, 0.14 percent of employment, and 0.20 percent of value added. From a regional perspective, these impacts are neither calamitous nor trivial.

Table 22. Overall Regional Economic Impact and Share of Total Activity Associated with Implementation of CREP and Conversion of Irrigated Acreage to Dryland Farming following Dismissal of Water Rights in the Upper Arkansas River Basin, \$2003

Industry	Industry Output	Employment	Employee Compensation	Total Value Added
Total Regional Activity	\$10,337,974,000	83,491	\$1,970,735,000	\$3,818,645,000
Full CREP Implementation	-\$14,807,296	-119	-\$2,360,398	-\$7,710,687
Share of Regional Activity	-0.14%	-0.14%	-0.12%	-0.20%
Dryland Conversion	-\$17,460,912	-165	-\$3,441,063	-\$9,319,741
Share of Regional Activity	-0.17%	-0.20%	-0.17%	-0.24%

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Summary

This study estimated the potential economic impacts associated with implementation of the Conservation Reserve Enhancement Program (CREP) in the Kansas Upper Arkansas River Basin. The analysis assumed approximately 85,000 acres of irrigated land and 15,000 acres of dryland were enrolled. Following 15 years of program participation, the CREP acreage was assumed to return to combined dryland agricultural production/pasture land with irrigation water rights permanently retired.

Acreage enrollment in the CREP was projected based on land productivity and hydrologic characteristics. Associated production values were estimated using an eight-year average value of production by crop type. CRP payment schedules were then used to calculate estimates of new household income associated with CREP payments. Finally, values were calculated to estimate an amount of new recreation spending for lease hunting on fallowed lands.

Under the CREP program, it was estimated that the annual value of agricultural production would decline by about \$15.6 million (2003\$), regional household income would increase by about \$6.5 million each year, and recreation-related businesses would annually capture an additional \$285,000. This makes the total direct impact of the CREP program an annual reduction of about \$8.7 million (2003\$) for each of the 15 years of the program. For perspective, the output reduction represents about 3.0 percent of the total value of all agricultural crops production in the 10-county region.

Following the term of the CREP it was assumed the land would return to a combination of dryland agricultural production and pasture and generate approximately \$2.5 million in productive value to the region. The net annual value of agricultural production, however, was assumed to decline by about \$13.4 million (2003\$). The relatively greater impact post-CREP is due to the loss of the CREP household income payments, and is measured against the irrigated agriculture production values of the 2003 base year. The output reduction represents about 2.6 percent of the total value of all agricultural crops production in the 10-county region.

These direct economic impacts were applied to an economic model of the 10-county regional economy called a Social Accounting Matrix (SAM). The SAM can be used to estimate the indirect economic effects of an event or policy.

Under the scenario of CREP implementation, the combined direct and indirect impact to regional economic output were estimated to be a decline by about \$14.8 million (2003\$) annually. That value of activity is closely tied to about 119 jobs. Using a very broad measure of household income associated with regional productive activity, household economic welfare was projected to decline by about \$7.7 million (2003\$) annually.

Under the post-CREP scenario of the permanent conversion of irrigated cropland to dryland/pasture, regional economic output would decline by about \$17.4 million (2003\$) annually. That value of activity is closely tied to about 165 jobs. Regional household income was projected to decline by about \$9.3 million (2003\$) annually. For perspective, these are in a range of about 0.1 percent to 0.2 percent of total regional activity, depending on the impact indicator considered.

If the changes in regional economic activity into perpetuity are amortized over the 15-year period of the CREP, the overall impact of the program from its inception into perpetuity can be characterized as a single estimate of the change in regional economic output. The annualized reduction in output equals \$24,922,029 (the impact of the CREP plus production

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reductions into perpetuity) to be paid in 15 annual installments, or a one-time equivalent payment of \$258,682,139 (2003\$).

Applying the assumption that the economy will adjust to changes over time requires a dynamic perspective to overlay the static model output. Absent any directly applicable guidelines to be found in the empirical literature, a consensus forecast was generated by the research team. Application of the economic adjustment assumption resulted in a 36 percent overall reduction to \$164,717,276 from \$258,682,139. Also, if the total cost of the program were to be amortized over the 15 years of its existence, the annual cost would be \$24,922,029 with no economic adjustment and only \$15,869,239 if economic adjustments occur like those suggested as plausible.

It should be acknowledged that these long-term impact estimates are associated with a degree of uncertainty. While properly calculated and appropriately reported, there is nonetheless reason to believe that they may overestimate the long-term economic response within the regional economy by some amount. There is anecdotal evidence that the regional economy adjusts in response to CRP enrollment such that the negative impact is lessened by some degree over time. At present, however, no research-based guidelines have been identified that would permit the application of a “decay function” to the impacts. Thus, the estimates of long-term impact reported here should be considered tentative and subject to change should additional information be identified.

Further, it should be acknowledged that these impacts could further be mitigated by the fact that more than 300,000 acres in the 10-county region currently enrolled in the CRP program will be coming out of contract in the next five years. Uncertainty regarding the future of the CRP program and the ultimate disposition of these acres preclude incorporating consideration of them in this analysis. But, any of this acreage returning to agricultural production would represent a positive economic stimulus.

The analysis of changes in county property tax revenue associated with the adjustments to assessed valuation under dryland conditions suggested that total regional county property tax revenue would decline by about \$400,000 (2003\$) in perpetuity. Pawnee County would experience the largest property tax loss. A more general tax impact analysis based on the published data use to construct the regional social accounts estimated that combined federal, state, and local revenue collections would decline by about \$900,000 (2003\$) annually.

A simple sensitivity analysis was incorporated in the research to acknowledge that general trends in irrigated agriculture in Western Kansas are trending lower due to a declining water supply. While a specific estimate of the decline due to diminishing water supplies in the CREP region was beyond the scope of this analysis, it is underway there as it is elsewhere. As such, for each one percent decline in irrigated agriculture, whether due to water availability, energy costs, land retirement, or other reason, regional output declines by about \$2 million and total income declines by about \$1 million. This level of activity is closely linked to about 20 jobs.

Finally, there have been questions about the potential impact of near- and long-term increases in energy prices. For example, K-State economists estimate that in 2004 and 2005, escalating fuel prices have increased costs for irrigated production in western Kansas in excess of \$110 million dollars in all of western Kansas. A review of available research provided general indications of producer responses to energy prices. The review concluded that producers are forced by economic conditions to generally continue with current management schemes and

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accept lower profits in response to higher energy costs. In general, irrigated acreage, crop choice, and water usage patterns will change for only producers on marginal land or those with credit constraints. In this environment, CREP may represent an expected positive net present value alternative that would enhance participation. In the long-run, if energy costs remain high, producers will make management decisions to lower this cost (e.g., negotiate lower rents, adopt technology and farming systems that reduce fuel usage).

A final note is offered on the nature of the impact analysis results offered in this report. An investigation of the notion of altering the size of the program, e.g. 35 or 50 percent of the presumed total acres enrolled, suggested that the production response curve becomes almost linear after about 35,000 acres. Therefore, the direct economic impacts could be proportioned between 35 and 100 percent. The SAM model used to estimate the indirect economic impacts does incorporate an assumption of linearity. Therefore, it would be appropriate to scale the overall impacts of the CREP program between 35,000 and 100,000 acres. Below 35,000 acres, the impact would be less than the relative percentage change and new direct economic impact estimates would need to be estimated.

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Appendix 1

An Introduction to Input-Output Analysis

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Basics of Input-Output Modeling

Steven C. Deller¹⁹

A simple non-technical discussion of the formulation of input-output (IO) modeling is presented in this section. Similar descriptive treatments are readily available, including Shaffer, Deller and Marcouiller (2004), while more advanced discussions of input-output include Miernyk (1965), and Miller and Blair (1985). As a descriptive tool, IO analysis represents a method for expressing the economy as a series of accounting transactions within and between the producing and consuming sectors. As an analytical tool, IO analysis expresses the economy as an interaction between the supply and demand for commodities. Given these interpretations, the IO model may be used to assess the impacts of alternative scenarios on the region's economy.

Transactions Table

A central concept of IO modeling is the interrelationship between the producing sectors of the region (e.g., manufacturing firms), the consuming sectors (e.g., households) and the rest of the world (i.e., regional imports and exports).²⁰ The simplest way to express this interaction is a regional transactions table (Table A1). The transactions table shows the flows of all goods and services produced (or purchased) by sectors in the region. The key to understanding this table is realizing that one firm's purchases are another firm's sales and that producing more of one output requires the production or purchase of more of the inputs needed to produce that product.

The transactions table may be read from two perspectives. Reading down a column gives the purchases by the sector named at the top of the column from each of the sectors named at the left. Reading across a row gives the sales of the sector named at the left of the row to those named at the top. In the illustrative transaction table for a fictitious regional economy (Table A1), reading down the first column shows that the agricultural firms buy \$10 worth of their inputs from other agricultural firms. The sector also buys \$4 worth of inputs from manufacturing firms and \$6 worth from the service industry. Note that agricultural firms also made purchases from non-processing sectors of the economy, such as the household sector (\$16) and imports from other regions (\$14).²¹ Purchases from the household sector represent value added, or income to people in the form of wages and investment returns. In this example, agricultural firms purchased a total of \$50 worth of inputs.

Reading across the first row shows that agriculture sold \$10 worth of its output to agriculture, \$6 worth to manufacturing, \$2 worth to the service sector. The remaining \$32

¹⁹ This section is reprinted with minor modification and some addition by permission of the author, Steven Deller, 2004. Department of Applied and Agricultural Economics, University of Wisconsin-Madison.

²⁰ A "region" is defined here as a functioning economic area. This could be as large as multiple states such as the Great Plains states or as small as a specific county. For this study we are interested in the region defined as Upper Arkansas River Basin.

²¹ Note that government has not been entered into the table. If government were to be introduced, payments would be in the form of taxes.

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worth of agricultural output was sold to households or exported out of the region. In this case \$20 worth of agricultural output was sold to households within the region and the remaining \$12 was sold to firms or households outside the region. In the terminology of IO modeling, \$18 = (\$10+\$6+\$2) worth of agricultural output was sold for intermediate consumption, and the remaining \$32 = (\$20+\$12) worth was sold to final demand. Note that the transactions table is balanced: total agricultural output (the sum of the row) is exactly equal to agricultural purchases (the sum of the column). In an economic sense, total outlays (column sum, \$50) equal total income (row sum, \$50), or demand exactly equals supply. This is true for each sector.

Table A1.

Table 1. Illustrative Transactions Table						
Processing Sectors (Sellers)	Purchasing Sectors (Demand)			Final Demand		Output
	Agr	Mfg	Serv	HH	Exports	
Agr	10	6	2	20	12	50
Mfg	4	4	3	24	14	49
Serv	6	2	1	34	10	53
HH	16	25	38	1	52	132
Imports	14	12	9	53	0	88
Inputs	50	49	53	132	88	372

The transactions table is important because it provides a comprehensive picture of the region's economy. Not only does it show the total output of each sector, but it also shows the interdependencies between sectors. It also indicates the sectors from which the region's residents earn income as well as the degree of openness of the region through imports and exports. In this example households' total income, or value added for the region is \$132 (note total household income equals total household expenditure), and total regional imports is \$88 (note regional imports equals regional exports). More open economies will have a larger percentage of total expenditures devoted to imports. As discussed below, the "openness" of the economy has a direct and important impact on the size of economic multipliers. Specifically, more open economies have a greater share of purchases, both intermediate and final consumption purchases, taking the form of imports. As new dollars are introduced (injected from exports) into the economy they leave the economy more rapidly through leakages (imports).

Direct Requirements Table

Important production relationships in the regional economy can be further examined if the patterns of expenditures made by a sector are stated in terms of proportions. Specifically, the proportions of all inputs needed to produce one dollar of output in a given sector can be used to identify linear production relationships. This is accomplished by dividing the dollar value of inputs purchased from each sector by total expenditures. Or, each transaction in a column is divided by the column sum. The resulting table is called the direct requirements table (Table A2).

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The direct requirements table, as opposed to the transactions table, can only be read down each column. Each cell represents the dollar amount of inputs required from the industry named at the left to produce one dollar's worth of output from the sector named at the top. Each column essentially represents a 'production recipe' for a dollar's worth of output. Given this latter interpretation, the upper part of the table (above households) is often referred to as the matrix of technical coefficients. In this example, for every dollar of sales by the agricultural sector, 20 cents worth of additional output from itself, 8 cents of output from manufacturing, 12 cents of output from services, and 32 cents from households will be required.

Table A2.

Table 2. Illustrative Direct Requirements Table			
Processing Sectors (Sellers)	Purchasing Sectors (Demand)		
	Agr	Mfg	Serv
Agr	0.20	0.12	0.04
Mfg	0.08	0.08	0.06
Serv	0.12	0.04	0.02
HH	0.32	0.51	0.72
Imports	0.28	0.24	0.17
Inputs	1.00	1.00	1.00

In the example region, an additional dollar of output by the agricultural sector requires firms in agriculture to purchase a total of 40 cents from other firms located in the region. If a product or service required in the production process is not available from within the region, the product must be imported. In the agricultural sector, 28 cents worth of inputs are imported for each dollar of output. It is important to note that in IO analysis, this production formula, or technology (the column of direct requirement coefficients), is assumed to be constant and the same for all establishments within a sector regardless of input prices or production levels.

Assuming the direct requirements table also represents spending patterns necessary for additional production, the effects of a change in final demand of the output on the other of sectors can be predicted. For example, assume that export demand for the region's agricultural products increases by \$100,000. From Table A2, it can be seen that any new final demand for agriculture will require purchases from the other sectors in the economy. The amounts shown in the first column are multiplied by the change in final demand to give the following figures: \$20,000 from agriculture, \$8,000 from manufacturing, and \$12,000 from services. These are called the direct effects and, in this example, they amount to a total impact on the economy of \$40,000 (the initial change [\$100,000] plus the total direct effects [\$40,000]). For many studies of economic impact the direct and initial effects are treated as the same although there are subtle differences.

The strength of input-output modeling is that it does not stop at this point, but also measures the indirect effects of an increase in agricultural exports. In this example, the agricultural sector increased purchases of manufactured goods by \$8,000. To supply agriculture's new need for manufacturing products, the manufacturing sector must increase production. To

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accomplish this, manufacturing firms must purchase additional inputs from the other regional sectors.

Continuing our \$100,000 increase in export demand for a region's agricultural products, for every dollar increase in output, manufacturing must purchase an additional 12 cents of agricultural goods ($\$8,000 \times .12 = \960), 8 cents from itself ($\$8,000 \times .08 = \640), and 4 cents from the service sector ($\$8,000 \times .04 = \320). Thus, the impact on the economy from an increase in agricultural exports will be more than the \$140,000 identified previously. The total impact will be \$140,000 plus the indirect effect on manufacturing totaling \$1,920 ($\$960 + \$640 + \320), or \$141,920. A similar process examining the service sector increases the total impact yet again by \$1,440 ($[\$12,000 \times .04] + [\$12,000 \times .06] + [\$12,000 \times .02] = \$1,440$).

The cycle does not stop, however, after only two rounds of impacts. To supply the manufacturing sectors with the newly required inputs, agriculture must increase output again, leading to an increase in manufacturing and service sector outputs. This process continues until the additional increases drop to an insignificant amount. The total impact on the regional economy, then, is the sum of a series of direct and indirect impacts. Fortunately, the sum of these direct and indirect effects can be more efficiently calculated by mathematical methods. The methodology was developed by the Noble winning economist Wassily Leontief and is easily accomplished in computerized models.

Total Requirements Table

Typically, the result of the direct and indirect effects is presented as a total requirements table, or the Leontief inverse table (Table A3). Each cell in Table A3 indicates the dollar value of output from the sector named at the left that will be required in total (i.e., direct plus indirect) for a one dollar increase in final demand for the output from the sector named at the top of the column. For example, the element in the first row of the first column indicates the total dollar increase in output of agricultural production that results from a \$1 increase in final demand for agricultural products is \$1.28. Here the agricultural multiplier is 1.28: for every dollar of direct agricultural sales there will be an additional 28 cents of economic activity as measured by industry sales.

An additional, useful interpretation of the transactions table, as well as the direct requirements and total requirements tables, is the measure of economic linkages within the economy. For example, the element in the second row of the first column indicates the total increase in manufacturing output due to a dollar increase in the demand for agricultural products is 12 cents. This allows the analyst to not only estimate the total economic impact but also provide insights into which sectors will be impacted and to what level.

Highly linked regional economies tend to be more self-sufficient in production and rely less on outside sources for inputs. More open economies, however, are often faced with the requirement of importing production inputs into the region. The degree of openness can be obtained from the direct requirements table (Table A2) by reading across the imports row.²² The higher these proportions are the more open the economy. By definition, as imports increase the values of the direct requirement coefficients will decline. It follows then that the

²² As described above, the openness of the economy can also be discussed in terms of leakages; greater leakages translate into a more open economy.

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values making up the total requirements table, or the multipliers, will be smaller. In other words, more open economies have smaller multipliers due to larger imports. The degree of linkage can be obtained by analyzing the values of the off-diagonal elements (those elements in the table with a value of less than one) in the total requirements table. Generally, larger values indicate a tightly linked economy, whereas smaller values indicate a looser or more open economy.

Table A3.

Table 3. Illustrative Total Requirements Table			
Processing Sectors (Sellers)	Purchasing Sectors (Demand)		
	Agr	Mfg	Serv
Agr	1.28	0.17	0.06
Mfg	0.12	1.11	0.07
Serv	0.16	0.07	1.03
Total	1.56	1.35	1.16

Input-Output Multipliers

Through the discussion of the total requirements table, the notion of external changes in final demand rippling throughout the economy was introduced.²³ The total requirements table can be used to compute the total impact a change in final demand for one sector will have on the entire economy. Specifically, the sum of each column shows the total increase in regional output resulting from a \$1 increase in final demand for the column heading sector. Retaining the agricultural example, an increase of \$1 in the demand for agricultural output will yield a total increase in regional output equal to \$1.56 (Table A3). This figure represents the initial dollar increase plus 56 cents in direct and indirect effects. The column totals are often referred to as output multipliers.

The use of these multipliers for policy analysis can prove insightful. These multipliers can be used in preliminary policy analysis to estimate the economic impact of alternative policies or changes in the local economy. In addition, the multipliers can be used to identify the degree of structural interdependence between each sector and the rest of the economy. For example, in the illustrative region, a change in the agriculture sector would influence the local economy to the greatest extent, while changes in the service sector would produce the smallest change.

The output multiplier described here is perhaps the simplest input-output multiplier available. The construction of the transactions table and its associated direct and total requirements tables creates a set of multipliers ranging from output to employment multipliers.

²³ Economic impact analysis is an attempt to model the impacts that an economic change has on regions. Input-output analysis specifies this economic change, most commonly, as a change in final demand for some product. Economists sometimes might refer to this as the "exogenous shock" applied to the system. Simply stated, this is the manner in which we attempt to introduce an economic change.

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The complete set includes:

<u>Type</u>	<u>Definition</u>
1. Output Multiplier.	The output multiplier for industry i measures the sum of direct and indirect requirements from all sectors needed to deliver one additional dollar unit of output of i to final demand.
2. Income Multiplier.	The income multiplier measures the total change in income throughout the economy from a dollar unit change in final demand for any given sector.
3. Employment Multiplier.	The employment multiplier measures the total change in employment due to a one unit change in the employed labor force of a particular sector.

The income multiplier represents a change in total income (employee compensation plus proprietary income plus other property income plus indirect business taxes) for every dollar change in income for any given sector. The employment multiplier represents the total change in employment resulting from the change in employment in any given sector. Thus, we have three ways that we can describe the change in final demand.

Consider for example a cattle feeder operation that has \$1 million in sales (industry output), pays labor \$100,000 inclusive of wages, salaries and retained profits, and employs three workers including the farm proprietor. Suppose that demand for cattle produced at this operation increased 10 percent, or \$100,000 dollars. We could use the traditional output multiplier to determine what the total impact on output would be. Alternatively, to produce this additional output the farmer may find that they need to hire a part-time worker. We could use the employment multiplier to examine the impact of this new hire on total employment in the economy. In addition, the income paid to labor will increase by some amount and we can use the income multiplier to see what the total impact of this additional income will have on the larger economy.

But how are these income and employment multipliers derived if the IO model only looks at the flow of industry expenditures (output)? In the strictest sense, the IO does not understand changes in employment or income, only changes in final demand (sales or output). To do this we use the fact that the IO model is a “fixed proportion” representation of the underlying production technologies. This is perhaps most clear by reexamining the direct requirements table (Table A2). For every dollar of output (sales) inputs are purchased in a fixed proportion according to the production technology described by the direct requirements table. For every dollar of output there is a fixed proportion of employment required as well as income paid. In our simple cattle feeder example, for every dollar of output there are $.000003 = (3 \div 1,000,000)$ jobs and $$.10 = (1,000,000 \div 100,000)$ in income. We can use these fixed proportions to convert changes in output (sales) into changes in employment and income.

Graphically, we can illustrate the round-by-round relationships modeled using input-output analysis. This is found in Figure A1. The direct effect of change is shown in the far left-hand side of the figure (the first bar (a)). For simplification, the direct effect of a \$1.00 change in the level of exports, the indirect effects will spillover into other sectors and create an

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additional 66 cents of activity. In this example, the simple output multiplier is 1.66. A variety of multipliers can be calculated using input-output analysis.

While multipliers may be used to assess the impact of changes on the economy, it is important to note that such a practice leads to limited impact information. A more complete analysis is not based on a single multiplier, but rather, on the complete total requirements table.

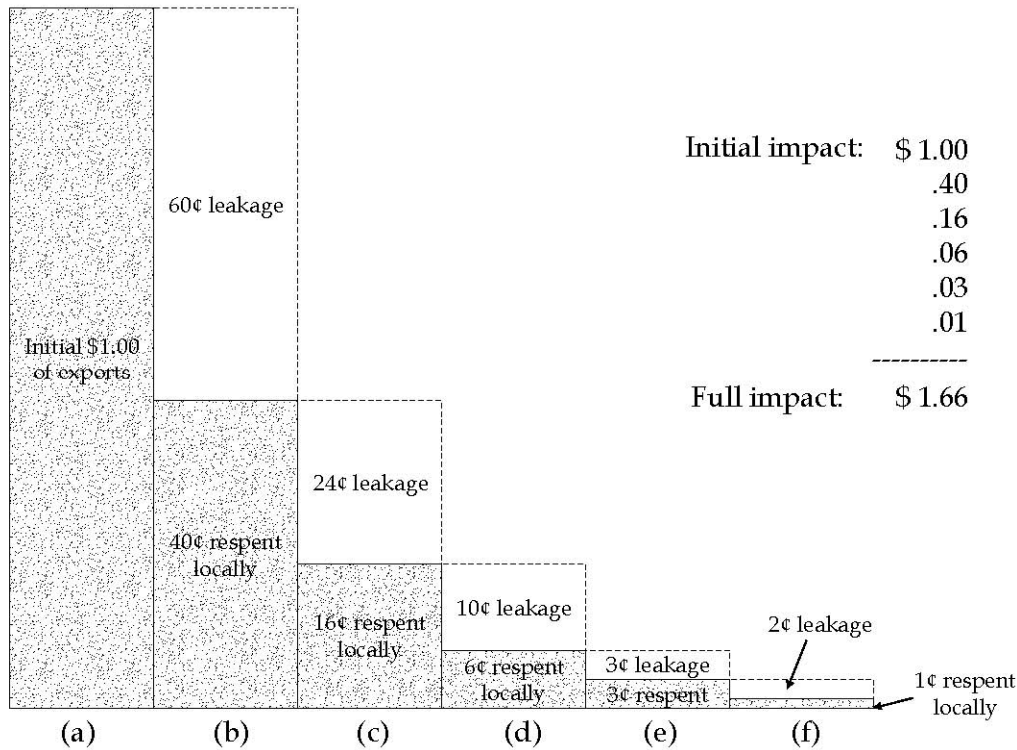


Figure A1. Multipliers and the round-by-round impacts estimated using input-output analysis Initial, Indirect and Induced Effects

The input-output model and resulting multipliers described up to this point presents only part of the story. In this construction of the total requirements table (Table A3) and resulting multipliers the production technology does not include labor. In the terminology of IO modeling, this is an “open” model. In this case, the multiplier captures only the initial effect (initial change in final demand or the initial shock) and the impact of industry to industry sales. This latter effect is called the indirect effect and results in a Type I multiplier. A more complete picture would include labor in the total requirements table. In the terminology of IO modeling, the model should be “closed” with respect to labor. If this is done, we have a different type of multiplier, specifically a Type II multiplier, which is composed of the initial and indirect effects and also what is called the induced effects.

The Type II multiplier is a more comprehensive measure of economic impact because it captures industry to industry transactions (indirect) and also the impact of labor spending

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income in the economy (induced effect). In the terminology of IO analysis an “open” model where the induced effect is not captured, any labor or proprietor income that may be gained (positive shock) or lost (negative shock) is assumed to be lost to the economy. In our simple cattle feeder example, any additional income (wages, salaries and profits) derived from the change in output (sales) is pocketed by labor and is not re-spent in the economy. This clearly is not the case: any additional income resulting from more labor being hired (or fired) will be spent in the economy generating an additional round of impacts. This second round is referred to as the induced impact.

Insights can be gained by comparing and contrasting the indirect and induced effects. For example, industries that are more labor intensive will tend to have larger induced impacts relative to indirect. In addition, industries that tend to pay higher wages and salaries will also tend to have larger induced effects. By decomposing the Type II multiplier into its induced and indirect effects one can gain a better understanding of the industry under examination and its relationship to the larger economy.

Extensions to Social Accounting Matrix Analysis

While IO analysis focuses exclusively on the producing sectors of the economy, social accounting matrix (SAM) analysis tracks all monetary flows in the region. Thus, a SAM represents a much more comprehensive accounting system than IO. In capturing non-market financial flows (government transfers, pension, saving, etc.) as well as the market transaction, the SAM provides a more complete indication of the changes associated with an economic event or policy. The SAM retains the essential structure and assumptions of the IO system, but expands the accounting to comprehensively track all financial transactions in the region.

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Appendix 2

Economic Impacts of the Conservation Reserve Enhancement Program to Finney County, Kansas

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Table B1. The Finney County, KS Economy, 2003\$

Industry	Industry Output*	Employment	Employee Compensation*	Total Value Added*
Ag, Forestry, Fish & Hunting	\$358.035	1,434	21.822	76.005
Mining	\$88.713	347	14.276	46.021
Utilities	\$96.321	232	17.019	53.675
Construction	\$169.352	1,763	40.172	68.772
Manufacturing	\$1,615.131	3,705	138.771	355.994
Wholesale Trade	\$60.784	610	24.191	46.232
Transportation & Warehousing	\$83.909	833	20.453	36.449
Retail Trade	\$160.608	3,850	56.806	122.092
Information	\$31.874	244	6.286	10.200
Finance & Insurance	\$68.349	563	18.377	46.931
Real Estate & Rental	\$40.573	362	5.088	27.674
Professional-Scientific & Technical Services	\$42.081	646	11.720	22.334
Management of Companies	\$11.615	116	3.841	5.070
Administrative & Waste Services	\$27.868	586	8.563	13.136
Educational Services	\$2.394	41	0.998	1.128
Health & Social Services	\$130.569	2,757	54.927	75.016
Arts- Entertainment & Recreation	\$7.066	200	1.537	3.790
Accommodations & Food Services	\$52.605	1,270	16.531	25.492
Other Services	\$74.004	1,485	27.352	40.521
Government & non-NAICs	\$206.891	3,294	109.491	178.433
Totals	\$3,328.742	24,338	598.222	1,254.964

*Millions of dollars

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Table B2. Summary of Annual Direct Economic Inputs for Finney County CREP and Post-CREP Impacts versus Current Irrigated Usage (2003\$)

Impact Model Sectors	Term of CREP	Post-CREP Dryland Farming	Difference CREP to Post-CREP
Oilseed farms	-\$727,217	-\$667,356	\$59,861
Grain farms	-\$4,394,030	-\$4,032,337	\$361,693
Pasture and grazing	\$76,538	\$114,818	\$38,280
Gross landowner lease income	\$31,674		
Regional leakage (10%)	-\$3,167		
Net regional landowner lease income	\$28,507		-\$28,507
Food and beverage stores	\$7,217		-\$7,217
Gasoline stations	\$8,032		-\$8,032
Sporting goods stores	\$33,975		-\$33,975
General merchandise stores	\$1,723		-\$1,723
Miscellaneous retail stores	\$1,972		-\$1,972
Automotive equipment rental and leasing	\$8,032		-\$8,032
Hotels and motels	\$7,217		-\$7,217
Food services and drinking places	\$7,217		-\$7,217
Gross CREP household income	\$1,905,145		
Regional leakage (10%)	-\$190,515		
Net regional CREP household income	\$1,714,631		-\$1,714,631
Total Direct Economic Impacts	-\$3,226,187	-\$4,584,875	-\$1,358,688

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Table B3. Estimated Annual CREP Direct and Total Economic Impacts to Finney County Production, Jobs and Income (2003\$)

Industry	Initial Impact	Total Output	Total Employment	Labor Income	Value Added
Ag, Forestry, Fish & Hunting	-\$5,044,709	-\$5,209,379	-34.1	-\$881,893	-\$2,732,988
Mining		-\$26,449	-0.1	-\$4,518	-\$12,987
Utilities		-\$8,171	0.0	-\$2,038	-\$6,732
Construction		-\$12,666	-0.2	-\$5,302	-\$5,778
Manufacturing		-\$136,341	0.0	-\$45,469	-\$76,104
Wholesale Trade		-\$40,789	-0.4	-\$17,374	-\$31,024
Transportation & Warehousing		-\$24,604	-0.2	-\$7,570	-\$10,691
Retail Trade	\$52,919	\$149,989	4.2	\$70,945	\$113,557
Information		\$9,643	0.1	\$1,907	\$3,755
Finance & Insurance		-\$339	0.0	\$1,029	\$1,134
Real Estate & Rental		-\$97,842	-0.9	-\$14,972	-\$68,071
Professional-Scientific & Technical Services		\$5,119	0.1	\$2,557	\$3,573
Management of Companies		\$1,673	0.0	\$561	\$730
Administrative & Waste Services		\$2,748	0.1	\$963	\$1,220
Educational Services		\$4,045	0.1	\$1,719	\$1,906
Health & Social Services		\$132,444	2.3	\$70,104	\$80,475
Arts- Entertainment & Recreation		\$6,670	0.2	\$2,162	\$3,659
Accommodation & Food Services	\$22,466	\$74,396	1.8	\$23,527	\$34,487
Other Services		\$21,749	0.8	\$12,760	\$15,330
Government & non-NAICs Institutions		\$117,232	-0.1	-\$4,103	\$103,437
Household Income	\$2,189,740				
Total	-\$2,779,584	-\$4,955,703	-26	-\$795,004	-\$2,581,112

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Table B4. Estimated 15-Year Total CREP Direct and Total Economic Impacts to Finney County Production, Jobs and Income (2003\$)

Industry	Initial Impact	Total Output	Total Employment	Labor Income	Value Added
Ag, Forestry, Fish & Hunting	-\$75,670,635	-\$78,140,685	-34.1	-\$13,228,395	-\$40,994,820
Mining	\$0	-\$396,735	-0.1	-\$67,770	-\$194,805
Utilities	\$0	-\$122,565	0	-\$30,570	-\$100,980
Construction	\$0	-\$189,990	-0.2	-\$79,530	-\$86,670
Manufacturing	\$0	-\$2,045,115	0	-\$682,035	-\$1,141,560
Wholesale Trade	\$0	-\$611,835	-0.4	-\$260,610	-\$465,360
Transportation & Warehousing	\$0	-\$369,060	-0.2	-\$113,550	-\$160,365
Retail Trade	\$793,785	\$2,249,835	4.2	\$1,064,175	\$1,703,355
Information	\$0	\$144,645	0.1	\$28,605	\$56,325
Finance & Insurance	\$0	-\$5,085	0	\$15,435	\$17,010
Real Estate & Rental	\$0	-\$1,467,630	-0.9	-\$224,580	-\$1,021,065
Professional-Scientific & Technical Services	\$0	\$76,785	0.1	\$38,355	\$53,595
Management of Companies	\$0	\$25,095	0	\$8,415	\$10,950
Administrative & Waste Services	\$0	\$41,220	0.1	\$14,445	\$18,300
Educational Services	\$0	\$60,675	0.1	\$25,785	\$28,590
Health & Social Services	\$0	\$1,986,660	2.3	\$1,051,560	\$1,207,125
Arts- Entertainment & Recreation	\$0	\$100,050	0.2	\$32,430	\$54,885
Accommodation & Food Services	\$336,990	\$1,115,940	1.8	\$352,905	\$517,305
Other Services	\$0	\$326,235	0.8	\$191,400	\$229,950
Government & non-NAICs	\$0	\$1,758,480	-0.1	-\$61,545	\$1,551,555
Institutions	\$0	\$1,127,535	0	\$0	\$0
Household Income	\$32,846,100				
Total	-\$41,693,760	-\$74,335,545	-26	-\$11,925,075	-\$38,716,680

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Table B5. Economic Impact of Conversion of Irrigated Acreage to Dryland Farming Acreage following Dismissal of Water Rights in Finney County, 2003\$

Industry	Initial Impact	Total Output	Total Employment	Labor Income	Value Added
Ag, Forestry, Fish & Hunting	-\$4,584,875	-\$4,743,829	-\$31.2	-\$801,168	-\$2,480,934
Mining		-\$35,003	-\$0.1	-\$5,981	-\$17,189
Utilities		-\$52,411	-\$0.1	-\$10,157	-\$32,580
Construction		-\$21,520	-\$0.3	-\$8,541	-\$9,711
Manufacturing		-\$181,330	-\$0.1	-\$54,775	-\$89,928
Wholesale Trade		-\$80,285	-\$0.8	-\$34,198	-\$61,064
Transportation & Warehousing		-\$46,617	-\$0.5	-\$15,493	-\$20,511
Retail Trade		-\$90,743	-\$2.3	-\$42,049	-\$67,715
Information		-\$19,233	-\$0.1	-\$3,962	-\$6,927
Finance & Insurance		-\$77,550	-\$0.6	-\$21,572	-\$47,599
Real Estate & Rental		-\$128,157	-\$1.2	-\$21,631	-\$87,737
Professional-Scientific & Technical Services		-\$22,784	-\$0.3	-\$10,736	-\$12,767
Management of Companies		-\$3,534	\$0.0	-\$1,185	-\$1,542
Administrative & Waste Services		-\$9,433	-\$0.2	-\$3,486	-\$4,477
Educational Services		-\$2,497	\$0.0	-\$1,061	-\$1,176
Health & Social Services		-\$99,444	-\$1.8	-\$51,788	-\$59,272
Arts- Entertainment & Recreation		-\$5,687	-\$0.2	-\$1,835	-\$3,078
Accommodations & Food Services		-\$43,828	-\$1.1	-\$13,830	-\$20,267
Other Services		-\$58,801	-\$1.1	-\$23,149	-\$30,048
Government & non-NAICs		-\$118,986	-\$0.2	-\$9,022	-\$74,418
Total	-\$4,584,875	-\$5,841,669	-\$42	-\$1,135,619	-\$3,128,941

Table B6. Overall Regional Economic Impact and Share of Total Activity Associated with Implementation of CREP and Conversion to Dryland Farming following Dismissal of Water Rights in Finney County, \$2003

Industry	Industry Output	Employment	Employee Compensation	Total Value Added
Total Regional Activity	3,328,700,000	24,338	598,222,000	1,254,828,000
Full CREP Implementation	-\$4,955,703	-26	-\$795,004	-\$2,581,112
Share of Regional Activity	-0.15%	-0.11%	-0.13%	-0.21%
Dryland Conversion	-\$5,841,669	-42	-\$1,135,619	-\$3,128,941
Share of Regional Activity	-0.18%	-0.17%	-0.19%	-0.25%

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Table B7. Estimated Annual Tax Impacts Associated with Full Implementation of CREP in Finney County, 2003 (2003\$)

		Employee Compensation	Proprietary Income	Household Expenditures	Enterprises (Corporations)	Indirect Business Taxes	Total
Federal Government NonDefense	Corporate Profits Tax				-\$90,211		-\$90,211
	Indirect Bus Tax: Custom Duty					-\$2,271	-\$2,271
	Indirect Bus Tax: Excise Taxes					-\$7,248	-\$7,248
	Indirect Bus Tax: Fed NonTaxes					-\$2,462	-\$2,462
	Personal Tax: Estate and Gift Tax						\$0
	Personal Tax: Income Tax			-\$18,162			-\$18,162
	Personal Tax: NonTaxes (Fines- Fees)						\$0
	Social Ins Tax- Employee Contribution	\$2,989	-\$31,660				-\$28,671
	Social Ins Tax- Employer Contribution	\$3,090					\$3,090
Total		\$6,079	-\$31,660	-\$18,162	-\$90,211	-\$11,981	-\$145,935
State/Local Government NonEducation	Corporate Profits Tax				-\$7,498		-\$7,498
	Dividends				-\$22,052		-\$22,052
	Indirect Bus Tax: Motor Vehicle License					-\$562	-\$562
	Indirect Bus Tax: Other Taxes					-\$1,393	-\$1,393
	Indirect Bus Tax: Property Tax					-\$23,005	-\$23,005
	Indirect Bus Tax: S/L NonTaxes					-\$3,648	-\$3,648
	Indirect Bus Tax: Sales Tax					-\$31,154	-\$31,154
	Indirect Bus Tax: Severance Tax					-\$812	-\$812
	Personal Tax: Estate and Gift Tax						\$0
	Personal Tax: Income Tax			-\$11,979			-\$11,979
	Personal Tax: Motor Vehicle License			-\$777			-\$777
	Personal Tax: NonTaxes (Fines- Fees)			-\$5,261			-\$5,261
	Personal Tax: Other Tax (Fish/Hunt)			-\$324			-\$324
	Personal Tax: Property Taxes			-\$365			-\$365
	Social Ins Tax- Employee Contribution	\$26					\$26
	Social Ins Tax- Employer Contribution	\$84					\$84
	Total		\$109	\$0	-\$18,706	-\$29,550	-\$60,573
Total		\$6,188	-\$31,660	-\$36,868	-\$119,761	-\$72,554	-\$254,655

Source: Minnesota IMPLAN Group, Inc., 2006

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Table B8. Estimated Annual Tax Impacts Associated with Dryland Conversion following CREP in Finney County, 2003 (2003\$)

		Employee Compensation	Proprietary Income	Household Expenditures	Enterprises (Corporations)	Indirect Business Taxes	Total
Federal Government NonDefense	Corporate Profits Tax				-\$103,587		-\$103,587
	Indirect Bus Tax: Custom Duty					-\$5,971	-\$5,971
	Indirect Bus Tax: Excise Taxes					-\$19,057	-\$19,057
	Indirect Bus Tax: Fed NonTaxes					-\$6,473	-\$6,473
	Personal Tax: Estate and Gift Tax						\$0
	Personal Tax: Income Tax			-\$31,262			-\$31,262
	Personal Tax: NonTaxes (Fines- Fees)						\$0
	Social Ins Tax- Employee Contribution	-\$23,069	-\$33,895				-\$56,964
	Social Ins Tax- Employer Contribution	-\$23,849					-\$23,849
Total		-\$46,918	-\$33,895	-\$31,262	-\$103,587	-\$31,501	-\$247,163
State/Local Government NonEducation	Corporate Profits Tax				-\$8,610		-\$8,610
	Dividends				-\$25,322		-\$25,322
	Indirect Bus Tax: Motor Vehicle License					-\$1,477	-\$1,477
	Indirect Bus Tax: Other Taxes					-\$3,662	-\$3,662
	Indirect Bus Tax: Property Tax					-\$60,484	-\$60,484
	Indirect Bus Tax: S/L NonTaxes					-\$9,591	-\$9,591
	Indirect Bus Tax: Sales Tax					-\$81,911	-\$81,911
	Indirect Bus Tax: Severance Tax					-\$2,135	-\$2,135
	Personal Tax: Estate and Gift Tax						\$0
	Personal Tax: Income Tax			-\$20,609			-\$20,609
	Personal Tax: Motor Vehicle License			-\$1,337			-\$1,337
	Personal Tax: NonTaxes (Fines- Fees)			-\$9,050			-\$9,050
	Personal Tax: Other Tax (Fish/Hunt)			-\$558			-\$558
	Personal Tax: Property Taxes			-\$628			-\$628
	Social Ins Tax- Employee Contribution	-\$199					-\$199
	Social Ins Tax- Employer Contribution	-\$645					-\$645
Total		-\$843	\$0	-\$32,182	-\$33,931	-\$159,259	-\$226,216
Total		-\$47,762	-\$33,895	-\$63,444	-\$137,518	-\$190,760	-\$473,379

Source: Minnesota IMPLAN Group, Inc., 2006