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Department of Agricultural Economics
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INTRODUCTION

In January 1993, the Clinton administration proposed a broad-based energy tax. This tax would generally increase the cost of energy inputs used on farms, such as fuels for irrigation, machinery, heat, and drying. Energy-intensive inputs, such as fertilizers and chemicals, would also increase in cost. The following is a summary of the proposal as reported by the Department of Treasury (1993).

The proposal would impose an excise tax on fossil fuels (coal, oil, natural gas) at a basic rate of $0.257-per-million-BTUs plus a $0.342-per-million-BTUs supplemental tax on oil. The tax would also be imposed on alcohol fuels (ethanol and methanol produced, other than from fossil fuels, for use as a fuel). The tax would be imposed on hydro-and nuclear-generated electricity and on imported electricity at a rate equal to the national average of tax embedded in electricity generated from fossil fuel. Additionally, the tax would be imposed on imported taxable products at a rate equal to the average tax imposed on equivalent domestic products. All tax amounts would be indexed for general inflation after 1997. A single national average of BTU content would be used for oil, gas, and alcohol fuels, whereas actual BTU content would be used for coal. Nonconventional fuels (including solar, geothermal, biomass, and wind); exported taxable products; and nonfuel uses of fossil and alcohol fuels (including coke and feedstocks) would be exempt.

The collection point for the tax would be the refinery for oil, the pipeline for natural gas, the mine mouth for coal, the production facility for alcohol fuels, the utility for hydro- and nuclear-generated electricity, and the importation point for imported electricity and imported taxable products. Exemptions or downstream credits would be provided for nonfuel use and exports.

The tax at one-third of the rates specified above would be imposed beginning July 1, 1994; two-thirds beginning July 1, 1995; and the full rates beginning July 1, 1996. An appropriate delay in the phase-in of the supplemental tax on oil would be provided in the case of home heating oil.

The Clinton administration's justification for the proposal as reported by the Department of Treasury (1993) follows.

> *A broad-based energy tax would help reduce the deficit and put the government on a pay-as-you-go basis for needed public programs. In addition, the tax would advance three goals: reduction of environmental damages, energy conservation, and reduced dependence on foreign sources of energy. The tax would encourage energy efficiency and fuel mix choices better reflecting the true environmental and security costs of energy use. Moreover, an energy tax would help move the United States economy from income-based to consumption-based taxation, with attendant benefits to saving, investment, and returns to work effort.*

OBJECTIVES

The general objective of this report is to evaluate the impact of a BTU tax on Kansas crop farms. The impact on whole farm production costs are estimated for the typical farm in each Kansas Farm Management Association using actual on-farm expenditures for energy and energy-intensive inputs. More specifically, the impact of the proposed BTU tax is determined for the average farm, irrigated cash crop farm, and dryland cash crop farm in each of the Kansas Farm Management Associations. The increased production costs are estimated and reported for the whole farm. In addition, the percent each input contributes to the total increase in cost is reported. Impacts on specific enterprises are also evaluated using Kansas Farm Management Enterprise Budgets (Cooperative Extension Service, 1992a).

One of the Clinton administration's objectives is to reduce the Federal Budget Deficit. If the BTU tax collections are used to reduce debt, there is a possibility that interest rates may be reduced as a result of this reduction. The idea that the BTU tax along with other taxes and reduced government program expenditures might reduce the deficit, federal government debt, and, therefore, interest rates is an interesting proposition. However, the empirical relationship between interest rates and the deficit is not clear. In the last year interest rates have declined, while the budget deficit has continued to increase. If the BTU tax is imposed and the budget deficit decreases, interest rates could fall, remain stable, or rise. Interest rates are heavily influenced by monetary policy and the money supply. However, given that a reduced deficit and debt may have some impact on interest rates, the average rate of interest paid on total loans for the typical farm and the amount of interest payment reduction that would occur for every percentage point decline in interest rates are estimated. A breakeven interest rate reduction for each farm type in each association is calculated to determine the amount of interest rate reduction that would be required to offset the increase in production costs due to a BTU tax.

PROCEDURES FOR ESTIMATING THE BTU TAX IMPACT ON PRODUCTION COSTS.

The general procedure used in the analysis determines the dollar amount of each input used. This estimate is multiplied by the BTU tax per dollar of input for each specific input. The tax per dollar of input is determined by multiplying the tax per BTU by the BTUs contained in the number of units equivalent to a dollar of the input. Specific procedures are discussed in further detail later in this report. Appendix tables A1 to A4 report the BTU values per unit of input used in the study. Tables A5 and A6 report the tax per unit for each energy source.

The impact of a BTU tax on Kansas crop farms is evaluated in two ways. The impact of a BTU tax on specific enterprises found on Kansas farms is estimated using Kansas Farm Management Budgets (Cooperative Extension Service , 1992a). This evaluation includes the impact on energy and energy intensive inputs. The inputs include seed, herbicide, insecticides, fertilizer, fuel and oil for field operations, fuel and oil for irrigation, and grain drying expense.

The extent that production costs would increase for the average farm in each Kansas Farm Management Association is also estimated using actual expenditures on energy and energy-intensive inputs for the 1991 year (Cooperation Extension Service, 1992b). The input costs that are examined in this analysis include seed, fertilizer, fuel, oil, irrigation energy, utilities, chemicals, hired machinery fuel, and fuel used in trucking at harvest.

Procedures Using Kansas Farm Management Enterprise Budgets

The Department of Agricultural Economic and Cooperative Extension Service, Kansas State University annually publish a series of enterprise budgets for various farm enterprises in Kansas (Cooperative Extension Service, 1992a). These budgets are used to evaluate the impact of a BTU tax on individual farm enterprises typical of different production regions in the state of Kansas. The following procedures are used.

Seed. The lbs. per acre of seed reported in each enterprise budget are multiplied by the BTUs per lb. that go into production, processing, and distribution of each respective type of seed (Table A2). Once the total BTU component of seed per acre is found, this total is multiplied by the energy tax that applies to the energy sources making up the components of energy needed to produce the input. In this case, the number of million BTUs per acre in seed are multiplied by the tax per million BTUs of oil, because oil is the major energy component used to produce, process, and distribute seed (Table A7).

Herbicides and Insecticides. The lbs. per acre of herbicides and insecticides reported in each enterprise budget are multiplied by the BTUs per lb. that are used in production, processing, and distribution of the oil form of herbicides and insecticides (Table A3). Once the total BTUs of herbicides and insecticides per acre are calculated, this total is multiplied by the weighted energy tax per million BTU. The weighted energy tax is found by multiplying the energy tax of each energy source that contributes to the input by the energy source's percent contribution. The percent that each energy source contributes on average to herbicides and insecticides is found in Table A7. The energy tax per million BTUs of each energy source is reported in Table A5.

Fertilizers. The same procedure that is used to derive the tax impact on herbicides and insecticides is used for the fertilizers N, P, and K. The number of BTUs per unit of fertilizer is reported in Table A4. Anhydrous ammonia and ammonia nitrate (dry fertilizer) are used as the N source. Triple superphosphate is the source of P, and muriate potash is the source of K used in the analysis.

Fuel and Oil. Units of diesel fuel are found by dividing 85 percent of the fuel and oil costs in the enterprise budgets by $.75 per gallon. Units of lubrication oil are found by dividing 15 percent of the fuel and oil costs in the enterprise budgets by $4.00 per gallon. Once the units per acre of diesel fuel and lubrication oil are derived, they are multiplied by the BTUs per unit to determine the total BTUs per acre. This estimate is multiplied by the BTU tax for oil (Table A5). The BTU content per unit of diesel fuel and oil is reported in Table A1.

Irrigation Energy. Production cost impacts are estimated for three fuel sources; natural gas, diesel fuel, and electricity. It is assumed that 800 ft^3 of natural gas is used to pump one acre inch of water with a total dynamic head (TDH) of 325 feet for center pivot systems. For flood irrigation systems, it is assumed that 645 ft^3 of natural gas is used to pump one acre inch of water with a TDH of 260 feet. Natural gas is priced at $2.25 per 1000 ft^3. The estimates used for natural gas match the cost per acre for irrigation fuel calculated by Nelson and Dhuyvetter (1992) and found in the 1992 Kansas Farm Management Budgets (Cooperative Extension Service, 1992a). The impact on irrigation costs for those systems using diesel fuel is based upon consumption of 3.97 gallons of diesel fuel per inch of water pumped using a center pivot system and 3.18 gallons per inch for flood irrigation systems. The diesel fuel price used is $.75 per gallon. The analysis for electrically powered irrigation systems is based upon using 56 kwh per inch for center pivot systems and 45 kwh per inch for flood irrigation systems at $.07 per kwh. The energy consumption for diesel and electrically powered systems is based upon the same physical parameters assumed for the natural gas systems. Lubrication oil cost is assumed to be $.32 per acre inch for center pivot systems and $.18 per acre inch for flood irrigation systems based upon a price of $4.00 per gallon for oil.

Crop Drying. Both L.P. gas and electricity are used for drying of corn and sorghum in the crop budgets. It is assumed that corn is dried from 16 percent moisture to 14 percent and sorghum is dried from 18 percent moisture to 14 percent. Under these assumptions, 2,270 BTUs per bu. (heat value) are required to dry corn and 6,280 BTUs per bu. are required to dry sorghum. Approximately 2.0 percent of the BTU requirement is from electricity and 98.0 percent is from L.P. gas. Although only the previously listed amounts are needed for drying, additional energy is required to produce those BTUs. Therefore, to measure the impact of the tax, these additional BTUs must be included. Therefore, the total number of BTUs to dry a bushel of corn is 2,900 per bu. (151 from electricity and 2,749 from L.P. gas). The total number of BTUs to dry a bushel of grain sorghum is 8,025 per bu. (419 from electricity and 7,606 from L.P. gas). The price of L.P. gas is $.80 per gallon, and the price of electricity is $.07 per kwh.

Once the tax impact for each input is determined, these results are summed to determine the total tax impact per acre. The tax per acre is divided by the number of bushels or tons of production reported in the enterprise budgets to determine the tax per unit of production. The tax per dollar of input cost is determined by dividing the tax per acre for each input by dollar per acre cost of that input. This number is used to help allocate costs in the whole farm analysis to the appropriate crops.

Procedures Using Typical Farm Management Association Farms

The impact of a BTU tax on the cost of seed fertilizer, fuel, oil, utilities, chemicals, machine hire fuel, and trucking fuel is estimated for a typical farm management association farm in each association. The 1991 cost for seed, fertilizer, fuel, oil, utilities, chemicals, machine, and trucking expense fuel is obtained from the Kansas Farm Management Association Data Bank (Cooperative Extension Service, 1992b). This information must be allocated to the major crop grown by the typical farm; wheat, corn, grain sorghum, soybeans, and alfalfa. Some of these crops are grown under irrigation and others are grown using dryland methods. To allocate these aggregate costs to each enterprise and determine the impact of a BTU tax, the following procedures are used.

Seed Expense. Seed expense for the average farm in each association includes all seeds and all crop insurance premiums. Total crop insurance premium payments are removed from this expense (Tables 1-3). These premium payments, as well as the percent of acres insured are obtained from a recent survey by Goodwin and Kastens (1993). The per acre crop insurance premium is determined for a typical farm in each association. This figure is multiplied by the number of acres of the relevant crop and then multiplied by the percent of acres insured for that crop in that association. This calculation provides a total crop insurance premium for the typical association farm. This figure is subtracted from the seed expense category to arrive at the seed expense per farm. This is completed for each association. To allocate seed expense to the appropriate crop to determine the impact of a BTU tax, the following procedures are used. Typical seeding rates for wheat, corn, grain sorghum, soybeans, and alfalfa are determined for each practice (dryland and irrigated) for each association. The seeding rates are obtained from Kansas Farm Management Budgets. A mix of enterprise budgets is chosen to represent the enterprise on each typical association farm. Table B1 indicates which budgets are used for each farm type in each association. The seeding rate (lbs. per acre) is multiplied by the 1991 seed price (dollars per lbs.) to arrive at the cost per acre. This is then multiplied by the actual acres of the relevant crop (Tables B2-B4). Once this is completed for each crop on the typical association farm, the estimates are totaled to arrive at the total seed expense. The total seed expense estimate is used to determine the percentage of seed expense for each crop, by dividing the total estimated seed expense for each crop by the total overall cost of seed for the farm. The percentage for each crop is then multiplied by the actual seed expense from farm management association data pertaining to total seed cost to allocate the actual seed cost to the respective crops. The BTU tax per dollar of input cost for the seed type is multiplied by each crop's seed cost to determine the total cost or impact of the BTU tax on seed for each crop on each type of farm in each association.

Chemical Expense. Chemical expense from the farm management data for each association includes all herbicide and insecticide expenditures (Tables 1-3). To find the impact of a BTU tax on chemicals, it is necessary to allocate these costs between herbicides and insecticides by crop. Typical per acre herbicide and insecticide costs are determined for each practice for each crop on each typical association farm. The cost per acre used is from the Kansas Farm Management Budgets (Table B1). The cost per acre for each crop is multiplied by the number of acres of the respective crop to determine the total cost of herbicides and insecticides for each crop on each typical association farm (Tables B2-B4). Cost estimates for each crop are totaled to obtain the cost per farm. These costs are used to determine the percentage of herbicide and insecticide expense for each crop. The percent of herbicide and insecticide costs for each crop was determined by dividing the estimated herbicide and insecticide costs for each crop by the overall estimated costs of insecticides and herbicides for the farm. This percentage is then multiplied by the actual chemical expense from the farm management association data to allocate the actual costs to each crop in the herbicide and insecticide category. The BTU tax per dollar of input associated with the type of chemical (herbicide or insecticide) for the crop is multiplied by the actual crop chemical costs to arrive at the total cost or impact of the BTU tax by crop for each association.

Fertilizer Expense. Fertilizer expense for the typical farm in each farm management association includes all fertilizers (Tables 1-3). To evaluate the impact of the BTU tax, these costs must be allocated to fertilizer types (N, P, and K). Typical per acre fertilizer costs for N, P and K are determined for each crop on each typical association farm. Application rates (lbs. per acre) are based upon fertilizer input levels in the Kansas Farm Management Budgets for the respective crop in each association (Table B1). This rate is multiplied by the current price (dollar per lb.) and the actual number of acres of the crop fertilized to determine the cost of fertilizers per crop for each typical association farm. Once this is done, the total fertilizer cost is determined by summing the costs for each crop. This cost estimate is used to determine the percentage of each fertilizer cost for each crop. The percent cost for each fertilizer for each crop is then multiplied by the actual fertilizer costs from the Kansas Farm Management Association to determine the allocated fertilizer costs by crop in each association. This figure is multiplied by the tax per dollar of input for the respective fertilizer used in each crop to determine the total tax impact on the typical farm for each association.

Irrigation Fuel. Irrigation fuel cost is derived from the total fuel and oil costs from the farm management association data (Tables 1-3). The irrigation cost per irrigated acre is derived using the following procedure. The costs of pumping an inch of water using center pivot and flood irrigation systems using each fuel source, natural gas, diesel, propane, and electricity are summarized in Table C1. These costs are estimated using information provided by Nelson and Dhuyvetter (1992). For these calculations, it is assumed that the average center pivot system in use has a total dynamic head (TDH) of 325 feet and the average flood irrigation system has a TDH of 250 feet. Natural gas is priced at $3.00 per 1000 ft.^{3} in the whole farm analysis. Diesel fuel is $.75 per gallon, propane is $.80 per gallon, and electricity is $.07 per kwh. This information and the estimated energy cost per acre inch are summarized in Table C2. Once the cost per inch is derived, it is necessary to estimate the cost for the typical farm in the Northwest, Southwest, and Southcentral Kansas Farm Management Associations. Energy used for irrigation in the Northcentral, Northeast, and Southeast Associations is not estimated because the number of irrigated acres is small. To estimate the total energy used for irrigation on the typical average farm and irrigated farm, the number of irrigated crop acres (Table B2) is multiplied by the number of inches of water irrigated per acre for the crop (Table C2). This total water requirement is multiplied by the weighted irrigation energy cost per inch for each system type; center pivot and flood irrigation. The weighted energy cost is found by multiplying the cost per inch for each fuel source, given the irrigation system type (Table C1), times the percent the fuel source used in the management association and summing the results. In the next step, this result is multiplied by the percent each irrigation system type is used for irrigation of the crop (Tables C2 and C3). This is completed for each crop on the farm. This results in an irrigation cost for each crop. The result for each crop is summed to arrive at the total cost of energy for irrigation on the farm. The procedure is repeated for each of the three associations where irrigation is important. These irrigation costs are subtracted from the total fuel and oil expense to arrive at the fuel cost for operations other than irrigation for each typical association farm. Because of differences in record-keeping procedures in two of the associations, the electrical energy used for irrigation is added to the fuel for irrigation and subtracted from the utility category for southwest and southcentral Kansas. The total estimated fuel cost for irrigation is divided by the unit price ($ per 1,000,000 BTUs) for each fuel source (natural gas, diesel fuel, L.P. gas, and electricity) to determine how many BTUs would be required if all dollars spent had been for that respective irrigation fuel. Once this is completed, the percent each power source makes up of the total irrigation fuel sources is multiplied by the number of BTUs estimated in the previous step. These vary by association and are reported in Table C4. Once this is estimated, the tax per 1,000,000 BTUs for each fuel source is multiplied by the allocated BTUs (1,000,000) to arrive at the total tax impact for each fuel source.

Fuel and Oil Expense. The remaining fuel and oil expenses are assumed to be 85 percent diesel fuel and 15 percent lubrication oil. Gasoline expenses are assumed to be trucking expenses for harvesting of crops. Gasoline for trucking is assumed to be 1.2 gallon per acre. Machinery fuel use that is custom hired for harvesting is based on 1.7 gallon per acre in the southwest and northwest associations, 1.9 gallon per acre in the southcentral and northcentral associations, and 2.1 gallon per acre in the southeast and northeast associations.

Utilities. Utility expenses are assumed to be for electricity.

Table 1. Selected Expenses by Association - Average Farm.

	Farm Management Association					
Expenses	NW	SW	NC	SC	NE	SE
Seed*	$ 7,552	$ 8,355	$ 3,184	$ 6,250	$ 7,879	$ 4,769
Fertilizer	8,717	10,616	9,047	11,043	9,209	11,405
Gas, Fuel, Oil	14,879	17,078	6,778	8,501	6,834	6,628
Utilities	2,187	2,413	2,657	2,036	3,152	3,131
Chemicals	7,249	7,049	4,431	5,192	8,326	5,851
Total Farms	185	228	286	347	388	579

* Crop insurance expense is normally included in this expense category in the Farm Management Association data. The numbers reported exclude crop insurance expense.

Source: 1991 State Report, Kansas Farm Management Association

Table 2. Selected Expenses by Association - Dryland Cash Crop Farm.

	Farm Management Association					
Expenses	NW	SW	NC	SC	NE	SE
Seed*	$5,021	$4,710	$ 3,321	$ 6,190	$11,465	$ 5,657
Fertilizer	7,007	6,748	9,204	11,777	10,564	13,714
Gas, Fuel, Oil	7,997	10,762	6,209	8,783	6,724	6,743
Utilities	1,779	2,134	1,673	1,726	2,009	1,965
Chemicals	5,670	4,898	5,042	5,183	10,762	7,449
Total Farms	62	87	118	243	210	288

* Crop insurance expense is normally included in this expense category in the Farm Management Association data. The numbers reported exclude crop insurance expense.

Source: 1991 State Report, Kansas Farm Management Association

Table 3. Selected Expenses by Association - Irrigated Cash Crop Farm.

	Farm Management Association					
Expenses	NW	SW	NC	SC	NE	SE
Seed*	$15,163	$13,927	--	$11,673	--	--
Fertilizer	14,278	16,382	--	13,684	--	--
Gas, Fuel, Oil	27,117	24,629	--	11,991	--	--
Utilities	1,908	2,690	--	2,734	--	--
Chemicals	12,201	11,165	--	11,212	--	--
Total Farms	45	72	--	22	--	--

* Crop insurance expense is normally included in this expense category in the Farm Management Association data. The numbers reported exclude crop insurance expense.

Source: 1991 State Report, Kansas Farm Management Association

IMPACT OF ENERGY TAXES ON CROP ENTERPRISES IN KANSAS

Table 4 lists the increased cost of production per acre and per bushel for dryland crop enterprises in Kansas due to a BTU tax.

Table 4. Production Cost Increase Due to a BTU Energy Tax by Crop Enterprise - Dryland Practices.

Crop	Budget Number*	Increased Cost Per Acre	Increased Cost Per Unit
Wheat			
Summer Fallow Wheat (Western Kansas)	257	$1.02	$0.03/bu.
Continuous Cropped Wheat (Northeast Kansas)	572	$1.47	$0.04/bu.
Continuous Cropped Wheat (Central Kansas)	574	$1.45	$0.04/bu.
Dryland Wheat (Western Kansas WSF Rotation)	903	$0.99	$0.03/bu.
Continuous Cropped Wheat (Southeast Kansas)	992	$1.44	$0.04/bu.
Grain Sorghum			
Dryland Grain Sorghum (Northeast Kansas)	573	$2.90	$0.04/bu.
Dryland Grain Sorghum (Central Kansas)	575	$2.34	$0.04/bu.
Dryland Grain Sorghum (Western Kansas WSF Rotation)	904	$1.11	$0.02/bu.
Dryland Grain Sorghum (Southeast Kansas)	995	$2.75	$0.04/bu.
Dryland Sorghum Silage (Central Kansas)	648	$2.65	$0.22/ton
Corn			
Dryland Corn Production (Northeast Kansas)	571	$3.58	$0.04/bu.
Dryland Short Season Corn Production (Southeast Kansas)	993	$3.20	$0.04/bu.
Soybeans			
Soybean Production (Southeast Kansas)	994	$1.44	$0.06/bu.
Soybeans (Northeast Kansas)	570	$1.59	$0.045/bu.
Alfalfa			
Alfalfa (Central and Eastern Kansas)	363	$2.56	$0.73/ton
Alfalfa Haylage (Central and Eastern Kansas)	523	$2.91	$0.46/ton

* The numbers indicate the budget code number in the Kansas Farm Management Marketing Handbook (Cooperative Extension Service, 1992a).

Table 5 lists the increased cost of production per acre and per bushel for irrigated crop enterprises in Kansas.

Table 5. Production Cost Increase Due to a BTU Energy Tax by Crop Enterprise and Irrigation Fuel Source - Irrigated Practices.

Crop	Budget Number*	Increased Cost Per Acre	Increased Cost Per Unit
<u>Wheat</u>			
Center Pivot Irrigated Wheat	583		
Natural Gas		$3.81	$0.07/bu.
Diesel		$5.79	$0.11/bu.
Electricity		$3.73	$0.07/bu.
Flood Irrigated Wheat	590		
Natural Gas		$3.80	$0.07/bu.
Diesel		$5.68	$0.10/bu.
Electricity		$3.70	$0.07/bu.
<u>Grain Sorghum</u>			
Flood Limited Irrigated Grain Sorghum	579		
Natural Gas		$4.47	$0.05/bu.
Diesel		$6.36	$0.07/bu.
Electricity		$4.37	$0.05/bu.
Flood Irrigated Grain Sorghum	580		
Natural Gas		$5.84	$0.05/bu.
Diesel		$8.67	$0.075/bu.
Electricity		$5.70	$0.05/bu.
Center Pivot Irrigated Grain Sorghum	582		
Natural Gas		$5.90	$0.05/bu.
Diesel		$8.87	$0.08/bu.
Electricity		$5.79	$0.05/bu.
Center Pivot Limited Irrigated Grain Sorghum	587		
Natural Gas		$4.39	$0.05/bu.
Diesel		$6.37	$0.07/bu.
Electricity		$4.31	$0.05/bu.
Center Pivot Irrigated Sorghum Silage	998		
Natural Gas		$6.75	$0.27/ton
Diesel		$9.71	$0.39/ton
Electricity		$6.62	$0.27/ton
<u>Corn</u>			
Flood Irrigated Corn	578		
Natural Gas		$8.38	$0.055/bu.
Diesel		$12.16	$0.08/bu.
Electricity		$8.20	$0.055/bu.

Table 5. Production Cost Increase Due to a BTU Energy Tax by Crop Enterprise and Irrigation Fuel Source - Irrigated Practices (continued).

Crop	Budget Number*	Increased Cost Per Acre	Increased Cost Per Unit
Corn			
Center Pivot Irrigated Corn	585		
Natural Gas		$8.13	$0.05/bu.
Diesel		$12.08	$0.08/bu.
Electricity		$7.97	$0.05/bu.
Center Pivot Irrigated Short Season Corn	1000		
Natural Gas		$6.47	$0.05/bu.
Diesel		$9.43	$0.08/bu.
Electricity		$6.34	$0.05/bu.
Ridge-till Flood Irrigated Corn	969		
Natural Gas		$7.24	$0.05/bu.
Diesel		$10.39	$0.07/bu.
Electricity		$7.09	$0.05/bu.
Flood Irrigated Corn Silage	581		
Natural Gas		$8.70	$0.35/ton
Diesel		$12.47	$0.50/ton
Electricity		$8.51	$0.34/ton
Center Pivot Irrigated Corn Silage	589		
Natural Gas		$8.93	$0.36/ton
Diesel		$12.88	$0.52/ton
Electricity		$8.77	$0.35/ton
Soybeans			
Center Pivot Irrigated Soybeans	586		
Natural Gas		$4.54	$0.09/bu.
Diesel		$7.51	$0.15/bu.
Electricity		$4.42	$0.09/bu.
Flood Irrigated Soybeans	577		
Natural Gas		$4.48	$0.09/bu.
Diesel		$7.31	$0.15/bu.
Electricity		$4.34	$0.09/bu.
Alfalfa			
Center Pivot Irrigated Alfalfa	584		
Natural Gas		$6.82	$1.05/ton
Diesel		$11.56	$1.78/ton
Electricity		$6.62	$1.02/ton

* The numbers indicate the budget code number in the Kansas Farm Management Marketing Handbook (Cooperative Extension Service, 1992a).

The largest overall impact is on irrigated corn, and the smallest impact is on summer fallow dryland wheat and dryland soybeans. For dryland crops, the largest impact is on corn.

IMPACT OF ENERGY TAXES ON THE AVERAGE FARM IN KANSAS

The impact of the proposed BTU tax on farm production costs for dryland cash crop farm by Kansas Farm Management Association ranges from $1,311 to $1,998. The impact is greater for crop farms classified as irrigated or having substantial irrigation. The range for irrigated cash crop farms is $2,909 to $4,531. Table 6 provides a summary of the cost increase due to the energy tax by type of farm for each Kansas Farm Management Association.

Table 6. Impact of Energy Taxes on Kansas Farm Production Costs.

	Farm Management Association					
Farm Type	NW	SW	NC	SC	NE	SE
Average Farm						
Total	$2,535	$3,145	$1,085	$1,678	$1,272	$1,192
% of 1991 Net Income	9.58%	10.76%	6.62%	6.79%	6.81%	4.92%
$/Acre	$3.06	$3.28	$1.58	$1.90	$1.98	$1.60
Dryland Farm						
Total	$1,672	$1,998	$1,311	$1,811	$1,816	$1,595
% of 1991 Net Income	4.85%	5.79%	7.12%	7.13%	11.00%	6.49%
$/Acre	$1.76	$1.95	$1.67	$1.89	$3.44	$1.62
Irrigated Farm						
Total	$4,312	$4,531	---	$2,909	---	---
% of 1991 Net Income	14.59%	13.52%	---	6.50%	---	---
$/Acre	$4.84	$3.79	---	$3.62	---	---

Table 7 indicates the percent of the total increased farm production cost associated with each input. For the average farm, the impact on diesel fuel costs makes up the largest component of increased costs due to a BTU tax. The second largest amount is due to increased costs of irrigation fuel. The next largest impact is due to increased fertilizer expenses. The impact on seed costs is somewhat larger than that of chemicals and utilities, which are similar for most farms. Gasoline and oil expenses generally have the smallest impact.

Table 7. Total Tax Cost and Percent of Total by Farm Types.

	Farm Management Association					
Farm Type	NW	SW	NC	SC	NE	SE
Average Farm						
Total Tax Cost	$2,535	$3,145	$1,085	$1,678	$1,272	$1,192
Seed	6.96%	6.23%	7.30%	9.19%	15.73%	10.69%
Fertilizer	12.95%	12.58%	25.80%	20.01%	19.18%	26.01%
Chemicals	4.41%	3.72%	8.66%	5.40%	12.96%	8.41%
Irrigation Fuel	26.57%	34.21%	0.00%	21.53%	0.00%	0.00%
Diesel Fuel	41.48%	37.99%	43.05%	35.62%	37.22%	38.93%
Oil	1.20%	1.10%	1.25%	1.03%	1.08%	1.13%
Utilities	4.44%	2.57%	12.68%	5.80%	12.74%	13.51%
Gasoline	1.99%	1.59%	1.27%	1.42%	1.09%	1.32%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Dryland Cash Crop Farm						
Total Tax Cost	$1,672	$1,998	$1,311	$1,811	$1,816	$1,595
Seed	7.13%	5.57%	6.45%	8.49%	14.58%	9.77%
Fertilizer	17.64%	14.56%	20.34%	19.70%	17.80%	23.00%
Chemicals	5.14%	4.16%	7.05%	4.92%	15.42%	7.28%
Irrigation Fuel	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Diesel Fuel	60.16%	66.20%	56.98%	58.96%	44.54%	51.19%
Oil	1.74%	1.92%	1.65%	1.71%	1.29%	1.48%
Utilities	5.47%	5.49%	6.56%	4.90%	5.69%	6.34%
Gasoline	2.72%	2.09%	0.96%	1.33%	0.67%	0.94%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%$
Irrigated Cash Crop Farm						
Total Tax Cost	$4,312	$4,531	--	$2,909	--	--
Seed	8.02%	7.06%	--	9.64%	--	--
Fertilizer	12.35%	13.17%	--	15.51%	--	--
Chemicals	4.68%	4.25%	--	5.96%	--	--
Irrigation Fuel	40.36%	45.99%	--	43.89%	--	--
Diesel Fuel	29.94%	26.12%	--	19.62%	--	--
Oil	0.87%	0.76%	--	0.57%	--	--
Utilities	2.28%	1.21%	--	3.94%	--	--
Gasoline	1.50%	1.45%	--	0.87%	--	--
Total	100.00%	100.00%	--	100.00%	--	--

INTEREST PAYMENT REDUCTION AND THE BTU TAX

Table 8 indicates the average rate of interest paid on total loans for the average farm in each Kansas Farm Management Association and the state. The average for the state is 9.21 percent. Table 9 reports the amount of interest payment reduction that would occur if the BTU tax payments lead to a smaller deficit and a reduced average interest rate for farm managers. Overall, a 1 percent interest rate reduction would reduce interest costs $1,713, and a 2 percent reduction would reduce interest costs $3,427.

Table 8. Total Loans, Interest Paid and Average Interest on Debt.

	Association						
Type of Farm	NW	SW	NC	SC	NE	SE	STATE
Average Farm							
Total Loans	$230,386	$174,576	$162,431	$150,229	$158,297	$177,016	$171,332
Interest Paid	$21,593	$16,160	$15,085	$13,276	$15,541	$15,800	$15,785
Average Rate	9.37%	9.26%	9.29%	8.84%	9.82%	8.93%	9.21%
Dryland Farm							
Total Loans	$166,838	$118,328	$120,803	$139,798	$143,833	$162,747	---
Interest Paid	$15,509	$11,330	$10,897	$12,180	$13,544	$14,476	---
Average Rate	9.30%	9.58%	9.02%	8.71%	9.42%	8.89%	---
Irrigated Farm							
Total Loans	$274,166	$184,759	---	$187,042	---	---	---
Interest Paid	$26,153	$16,046	---	$16,610	---	---	---
Average Rate	9.54%	8.68%	---	8.88%	---	---	---

Table 9. Interest Rate Reduction Benefit for the Average Kansas Farm.

	Reduced Interest Cost by Association						
Interest Rate Reduction	NW	SW	NC	SC	NE	SE	STATE
1.00%	$2,304	$1,746	$1,624	$1,502	$1,583	$1,770	$1,713
2.00%	$4,608	$3,492	$3,249	$3,005	$3,166	$3,540	$3,427
3.00%	$6,912	$5,237	$4,873	$4,507	$4,749	$5,310	$5,140
4.00%	$9,215	$6,983	$6,479	$6,009	$6,332	$7,081	$6,853

Table 10 indicates the amount of interest rate reduction needed on each type of farm in each association to have the energy tax offset by lower interest costs. Although a smaller interest rate reduction will offset the cost of a BTU tax for some farms, a 2 percent interest rate reduction would offset the cost for most farms. The only exception to this would be for the average irrigated farm in southwest Kansas, where a greater interest rate reduction (2.45 percent) would be needed. This analysis does not consider the possibility that an interest rate reduction may leave more cash available for debt reduction or that the BTU tax would require the individual to borrow additional dollars for operation expenses. Also, in order for an individual to benefit from falling interest rates, he or she must either refinance or pay off existing, high-interest loans and initiate new loans. These are activities that will not occur instantaneously and will not be available to all producers equally. Altig and Gokhale (1993) report that the Congressional Budget Office (CBO) estimates that net interest payments by the federal government would be reduced by approximately 18 billion dollars. This is approximately 1 percent of the total accumulated deficit for the fiscal years 1993-98 under the proposed administration plan. This is a relatively insignificant amount, and, therefore, the impact of interest rates is expected to be extremely small, and the impact of the BTU tax on interest rates even smaller. According to Altig and Gokhale (1993), the CBO projects that the 10-year Treasury note interest rate will remain stable (averaging 5.5 percent from 1993 to 1998), and the average rate on 91-day Treasury bills will increase from 3.2 percent to 4.9 percent over the same period. Interest rate changes in recent years have not had a strong empirical relationship with the deficit. In some years, interest rates have even fallen while annual deficits have increased.

Table 10. Breakeven Interest Rate Reduction.

	Farm Management Association					
Type of farm	NW	SW	NC	SC	NE	SE
Average Farm	1.10%	1.80%	.67%	1.12%	.80%	.67%
Dryland Farm	1.00%	1.69%	1.09%	1.30%	1.26%	.98%
Irrigation Farm	1.57%	2.45%	---	1.56%	---	-- -

SUMMARY

The impact of a BTU tax on farm production costs ranges from a low of $1,085 for the average farm in northcentral Kansas to $4,680 for an irrigated crop farm in southwest Kansas. The estimated impact on production costs ranges from 4.85 percent to 14.59 percent of net income for 1991.

It is likely that the majority of the BTU tax will be passed on in the price of production inputs and incurred by the farm manager. In return, the manager will not be able to pass these costs on in terms of higher commodity prices. Farm managers may reduce the use of energy-intensive inputs to some degree, resulting in smaller production and increased commodity prices. An increase in the costs of production will reduce the supply of farm crops. Thus, assuming no change in demand, smaller supply will clear the market at a higher price. Demand for some of the energy-intensive inputs is generally considered to be inelastic or unresponsive to price increases in the short run. Therefore, higher costs of production will mean lower incomes in the short run. It would be easy for a reader to conclude from Table 6 that the BTU tax would decrease net income on Kansas farms by 4.85 to 14.59 percent. However, this would normally not be the case in the long run, because farm production, though produced at a higher cost, will also likely be sold for a higher per-unit price.

Some caution is needed when interpreting the results of this study. The estimated impact on production costs is somewhat conservative for several reasons. The whole farm analysis is based on the 1991 crop year, when energy use for irrigation in western Kansas was somewhat lower than normal due to above average precipitation. According to statistics published by the Kansas State Board of Agriculture (1992), precipitation in the western three tiers of counties in 1991 was 18 percent above the long-term average. The impact the BTU tax may have on costs of new equipment and equipment repair is not considered. Further, the impact a BTU tax may have on local grain prices due to increased transportation costs is not included. Livestock enterprises are not specifically considered, but any reduction in grain production that leads to higher feed grain prices would affect livestock producers who purchase feed. Of course, those producers who raise their own feed would absorb the increased grain production costs. Increased transportation costs will affect the profitability of livestock enterprises as well.

There are numerous other adjustments that may occur in response to higher prices of energy and energy-intensive inputs. Because energy costs will increase, producers will be more energy-conservation oriented and look for substitutes for expensive energy sources and more energy-efficient technology. The amount of irrigation would be expected to decrease because of increased pumping cost. However, irrigation could be expected to become more efficient. There would likely be numerous crop mix changes. Input adjustments and changes in technology would occur, making the impact of the BTU tax on farm income smaller in the long run than might be expected, if only the impact of increases in production costs are considered in the short run. Moreover, regional and international cropping shifts could be important. U.S. farmers could lose significant shares of world markets, if their costs are increased without corresponding increases in foreign producers' costs. In the long run, however, the actual impacts may be less than what one expect from looking only at production costs, as this study does.

REFERENCES

Altig, D. and J. Gokhale. "An Overview of the Clinton Budget Plan." In Economic Commentary. Federal Reserve Bank of Cleveland, March 1, 1993.

Cooperative Extension Service. Kansas Farm Management and Marketing Handbook. Department of Agricultural Economics, Kansas State University, Manhattan, KS: 1992a.

Cooperative Extension Service. "The Annual Report - 1991 Management Information". Kansas Farm Management Association. Department of Agricultural Economics, Kansas State University, Manhattan, KS: 1992b.

Department of Treasury. "Summary of the Administration's Revenue Proposal." February 1993. pp 64-65.

Goodwin, B.K. and T.L. Kastens. "Adverse Selection, Disaster Relief, and the Demand for Multiple Peril Crop Insurance." Research Report Prepared for the Federal Crop Insurance Corporation. March 1993.

Kansas State Board of Agriculture. Kansas Farm Facts 1991. Topeka, KS. 1992.

Nelson, M.E. and K.C. Dhuyvetter. "Irrigation Capital Requirements and Energy Costs." Cooperative Extension Service, MF-836, Kansas State University Manhattan, KS: 1992.

Pimentel, David (ed.). Handbook of Energy Utilization in Agriculture. Boca Raton FL: CRC Press, 1980.

APPENDIX A

ENERGY INPUTS AND TAX ASSUMPTIONS USED FOR ENERGY BUDGETING

BTU Values For Energy Budgeting

Table A1 presents the assumptions used to estimate the BTU value per unit for production inputs for crops in Kansas. Basic data for these estimates are from Pimentel (1980).

Table A1. BTU Values per Unit of Energy Inputs.

Diesel Fuel -	171,432 BTUs/gallon
Gasoline -	153,992 BTUs/gallon
Lubricants -	177,137 BTUs/gallon
L.P. Gas -	117,597 BTUs/gallon
Electricity -	11,365 BTUs/kwh
Coal -	22,900,000 BTUs/ton
Natural Gas -	1,021 BTUs/ft.^{3}

For natural gas and coal the numbers represent the heat value measured in BTUs per unit. For the other energy sources, the number includes the production requirements in BTUs per unit plus the heat value in BTUs per unit.

The administration's proposal calls for the tax on oil to be collected at the refinery. Because of this, the tax will be levied on approximately all BTUs used in the production of products from oil, such as diesel fuel, lubricants, and L.P. gas. Electricity is indirectly taxed because of the tax levied on fossil fuels, coal and oil used to generate electricity. Therefore, the BTUs per unit for electricity are the numbers of BTUs of heat value plus the amount of BTUs used to produce electricity that is lost in the process. Natural gas and coal are direct energy sources that will be taxed at their source, the pipeline and mine mouth, respectively. Therefore, the actual heat content is used for the energy budgets of these sources.

Seeds also require energy inputs to be produced. The BTUs per unit of seed reported in Table A2 include energy for production, processing, and distribution.

Table A2. BTU Inputs per Unit of Seed.

Alfalfa -	110,916 BTUs/lb.
Corn -	44,651 BTUs/lb.
Wheat -	5,404 BTUs/lb.
Soybean -	13,651 BTUs/lb.
Grain Sorghum -	25,596 BTUs/lb.

Source: Pimentel (1980).

Pesticides including herbicides, insecticides, and fungicides are produced from oil, coal, and natural gas. The numbers reported in Table A3 represent the BTUs per lb. of pesticides in oil form. Production, formulation, packaging, and distribution BTUs are included.

Table A3. BTU Inputs per Unit of Pesticide in Oil Form.

Herbicides -	179,838 BTUs/lb.
Insecticides -	156,438 BTUs/lb.
Fungicides -	116,838 BTUs/lb.

Source: Pimental (1980).

Nitrogen fertilizer requires substantial energy inputs in its production process, mainly in the form of natural gas, electricity, and oil. Table A4 reports the number of BTUs that comprise the production, processing, and distribution of nitrogen and other common fertilizers.

Table A4. BTU Inputs per Unit of Fertilizer.

Anhydrous Ammonia (N) -	21,600 BTUs/lb.
Urea (N) -	25,740 BTUs/lb.
Ammonium Nitrate (N) -	26,460 BTUs/lb.
Phosphate Rock (P) -	2,340 BTUs/lb.
Normal Superphosphate (P) -	4,140 BTUs/lb.
Triple Superphosphate (P) -	5,400 BTUs/lb.
Muriate Potash (K) -	2,880 BTUs/lb.
Lime -	4,695 BTUs/lb.

Source: Pimentel (1980).

BTU Taxes

The administration's proposal would impose an excise tax on fossil fuels (coal, oil, natural gas) at a basic rate of $0.257 per million BTUs plus a $0.342 per million BTUs supplemental tax on oil. This would make the tax on oil $0.599 per million BTUs. The tax would be imposed on hydro- and nuclear-generated electricity and on imported electricity at a rate equal to the national average tax embedded in electricity generated from fossil fuel. Producing 1 kwh of electricity requires 11,365 BTUs of energy. Therefore, the resulting taxes on electricity (increased cost of production) are $.0029 per kwh using coal or natural gas and $0.0068 per kwh using oil. An average of these provides a rough average for the tax on nuclear-generated electricity. The overall average is based upon using coal 61.6 percent, oil 4.3 percent, natural gas 9.7 percent and nuclear 24.4 percent of the time to generate electricity. Table A5 summarizes the tax estimate per million BTU and Table A6 summarizes the tax estimate by common unit.

Table A5. Energy Tax Rates per Million BTU.

Coal -	$ .2570/million BTU
Oil -	$ .5990/million BTU
Natural Gas -	$ .2570/million BTU
Electricity Average -	$ .3168/million BTU

Table A6. Tax per Unit of Energy Source.

Diesel Fuel -	\$ .103/gallon
L.P. Gas -	\$ .070/gallon
Lubricants -	\$ .106/gallon
Coal -	\$5.885/ton
Fuel Oil -	\$ .103/gallon
Natural Gas -	\$ .262/1,000 $ft.^3$
Gasoline -	\$ .092/gallon
Electricity	
Average -	\$ .0036/Kwh
Coal -	\$ .0029/Kwh
Natural Gas -	\$ .0029/Kwh
Oil -	\$ .0068/Kwh
Nuclear -	\$ .0049/Kwh

Energy Source for Production Inputs

To derive the impact of energy taxes on crop production costs, it is necessary to know the type of energy source that is used in producing the inputs for the crop production process. For inputs such as diesel fuel and lubricants, which are produced from oil, the answer is straightforward. Any tax on oil will affect the cost of these inputs. However, inputs such as fertilizer and pesticides may have more than one energy source. Table A7 lists the percent energy source used to derive the additional cost of production inputs due to a direct energy tax on oil, natural gas, coal and an indirect tax on electricity.

Table A7. Source of Energy for Agricultural Production Inputs.

	Source of BTUs			
Input	Oil	Coal	Natural Gas	Electricity
Seeds	100.00%	0.00%	0.00%	0.00%
Herbicide	60.00	23.00	17.00	0.00
Insecticide	61.00	23.00	16.00	0.00
Anhydrous Ammonia (N)	2.50	0.00	96.67	.83
Ammonium Nitrate (N)	5.44	0.00	91.16	3.40
Phosphorus (P)	100.00	0.00	0.00	0.00
Potash (k)	100.00	0.00	0.00	0.00
Diesel Fuel	100.00	0.00	0.00	0.00
L.P. Gas	42.00	0.00	58.00	0.00
Lubricants	100.00	0.00	0.00	0.00
Drying (L.P. Gas and Electricity)	98.00	0.00	0.00	2.00

APPENDIX B

KANSAS CROP BUDGETS AND CROP ACREAGES USED IN ALLOCATING WHOLE FARM COSTS

Table B1. Enterprise Crop Budgets Used for Allocation of Some Expenses on Typical Kansas Farm Management Association Farms.*

	Farm Management Association					
Crop	NW	SW	NC	SC	NE	SE
Wheat						
Irrigated	583	590	583	583	583	583
Dryland	257	257	574	574	572	992
Corn						
Irrigated	585	969	585	969	585	585
Dryland	904	904	904	575	571	571
Grain Sorghum						
Irrigated	582	582	582	580	582	582
Dryland	904	904	575	575	573	995
Soybeans						
Irrigated	586	577	586	586	586	586
Dryland	--	--	--	--	570	994
Alfalfa Hay						
Irrigated	584	584	584	584	584	584
Dryland	363	363	363	363	363	363

* The numbers indicate the budget code number in the Kansas Farm Management Marketing Handbook (Cooperative Extension Service, 1992a).

Table B2. Average Crop Acres by Type of Crop by Association - Average Farm.

	Farm Management Association					
Crop	NW	SW	NC	SC	NE	SE
Wheat						
Irrigated	34	120	20	9	--	--
Dryland	474	457	387	524	113	223
Corn						
Irrigated	139	139	8	54	15	6
Dryland	18	7	44	11	132	74
Grain Sorghum						
Irrigated	7	58	3	13	--	--
Dryland	51	92	148	142	95	128
Soybeans						
Irrigated	31	26	--	31	9	--
Dryland	13	--	29	12	191	234
Alfalfa Hay						
Irrigated	12	35	--	11	--	--
Dryland	50	26	48	75	88	78
TOTAL ACRES	829	960	687	882	643	743
Irrigated	223	378	31	118	24	6
Dryland	606	582	656	764	619	737
TOTAL FARMS	185	228	286	347	388	579

Source: 1991 State Report, Kansas Farm Management Association.

Table B3. Average Crop Acres by Type of Crop by Association - Dryland Cash Crop Farm.

	Farm Management Association					
Crop	NW	SW	NC	SC	NE	SE
Wheat						
Irrigated	--	41	--	--	--	--
Dryland	714	722	467	624	145	325
Corn						
Irrigated	58	50	--	41	21	--
Dryland	32	--	28	--	162	81
Grain Sorghum						
Irrigated	--	31	--	--	--	--
Dryland	93	158	150	166	97	148
Soybeans						
Irrigated	--	--	--	24	--	--
Dryland	--	--	50	22	31	352
Alfalfa Hay						
Irrigated	--	--	--	--	--	--
Dryland	52	25	88	82	72	77
TOTAL ACRES	949	1027	783	959	528	983
Irrigated	58	122	0	65	21	0
Dryland	891	905	783	894	507	983
TOTAL FARMS	62	87	118	243	210	288

Source: 1991 State Report, Kansas Farm Management Association.

Table B4. Average Crop Acres by Type of Crop by Association - Irrigated Cash Crop Farm.

	Farm Management Association					
Crop	NW	SW	NC	SC	NE	SE
Wheat						
Irrigated	101	286	--	41	--	--
Dryland	302	328	--	225	--	--
Corn						
Irrigated	350	288	--	247	--	--
Dryland	--	--	--	--	--	--
Grain Sorghum						
Irrigated	22	123	--	32	--	--
Dryland	--	54	--	38	--	--
Soybeans						
Irrigated	94	63	--	163	--	--
Dryland	--	--	--	--	--	--
Alfalfa Hay						
Irrigated	21	54	--	41	--	--
Dryland	--	--	--	17	--	--
TOTAL ACRES	890	1196	--	804	--	--
Irrigated	588	814	--	524	--	--
Dryland	302	382	--	280	--	--
TOTAL FARMS	45	72	--	22	--	--

Source: 1991 State Report, Kansas Farm Management Association.

APPENDIX C

DATA FOR ALLOCATION OF IRRIGATION ENERGY EXPENDITURES

Table C1. Energy Pumping Costs Per Acre Inch.

Fuel Source	Cost/Unit	Center Pivot	Flood
Natural Gas	$3.00/1000 ft.^{3}	$2.41	$1.85
Diesel	$0.75/gallon	$2.98	$2.29
Propane	$0.80/gallon	$5.76	$4.43
Electricity	$0.07/Kwh	$3.92	$3.02

Table C2. Irrigation Method and Acre Inches by Crop and Association - Average Farm.

		NW		SW		SC	
Crop	Irrigation Method	% Use	Acre Inches	% Use	Acre Inches	% Use	Acre Inches
Wheat	Center Pivot	90%	7"	70%	5"	70%	4"
	Conv. Flood	10%	9"	30%	7"	30%	6"
Corn	Center Pivot	85%	12"	50%	16"	70%	8"
	Ridgetill Flood	5%	12"	15%	16"	5%	8"
	Conv. Flood	10%	16"	35%	20"	25%	10"
Grain Sorghum	Center Pivot	90%	10"	50%	12"	90%	6"
	Conv. Flood	10%	13"	50%	15"	10%	8"
Soybeans	Center Pivot	85%	7"	60%	12"	90%	4"
	Conv. Flood	15%	9"	40%	15"	10%	6"
Alfalfa	Center Pivot	100%	12"	80%	16"	100%	6"
	Conv. Flood			20%	20"		

Table C3. Irrigation Method and Acre Inches by Crop and Association - Irrigated Cash Crop Farm.

Crop	Irrigation Method	NW % Use	NW Acre Inches	SW % Use	SW Acre Inches	SC % Use	SC Acre Inches
Wheat	Center Pivot	90%	7"	60%	5"	70%	4"
	Conv. Flood	10%	9"	40%	7"	30%	4"
Corn	Center Pivot	85%	12"	50%	16"	70%	6"
	Ridgetill Flood	5%	12"	15%	16"	5%	6"
	Conv. Flood	10%	16"	35%	20"	25%	8"
Grain Sorghum	Center Pivot	90%	10"	50%	10"	90%	4"
	Ridgetill Flood	--	--	15%	10"	--	--
	Conv. Flood	10%	13"	35%	14"	10%	6"
Soybeans	Center Pivot	85%	7"	60%	10"	90%	4"
	Conv. Flood	15%	9"	40%	13"	10%	6"
Alfalfa	Center Pivot	100%	12"	60%	10"	100%	4"
	Conv. Flood	--	--	40%	15"	--	--

Table C4. Percent Fuel Use for Irrigation by Farm Management Association.

Fuel Source	NW	SW	SC
Natural Gas	60%	80%	5%
Diesel	30%	10%	60%
Propane	5%	5%	30%
Electricity	5%	5%	5%

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