Estimation of Farm-Forward Regional Economic Impacts for the North Plains Groundwater Conservation District in Texas

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Selected Paper prepared for presentation at the Southern Agricultural Economics Association Annual Meeting, Birmingham, AL., February 4-7, 2012

Abstract

Impacts of alternative agricultural water conservation strategies are being evaluated in the Texas Panhandle. Stakeholders have expressed concern that all effects need to be accounted for including the regional economy. A methodology was developed to evaluate the effects on the backward and forward-linked processing sectors and differentiated results are presented.

Key Words: backward-linked, forward-linked, IMPLAN, Ogallala Aquifer, water policy

JEL Classifications: Q18, Q32, Q38

Introduction

The North Plains Groundwater Conservation District (NPGCD), along with much of the U.S., is facing some critical decisions regarding potential water conservation policies. The NPGCD relies on the Ogallala Aquifer as the primary source of water for irrigated agricultural production due to the semi-arid nature of the region. However, the aquifer is being depleted because withdrawals are exceeding the small amount of recharge. It was projected in the Senate Bill 1 and Senate Bill 2 planning efforts that the four western counties of the District will fall well short of the goal of having 50% of the groundwater remaining in 50 years.

Studies have been conducted for the NPGCD, as well as several other water districts in the state, which have evaluated the economic implications of alternative water conservation strategies being considered. Results of these studies indicate the impact of aquifer decline on saturated thickness, irrigated acreage, producer income, and the regional economy through backward-linkages from input suppliers. Stakeholders from water districts and commodity organizations are concerned that not all of the regional economic impacts are being counted. Traditional regional analysis identifies the impacts of the backward-linked sectors within the area. However, a significant number of value added businesses exist in the area including; grain elevators, feedlots, and dairies, which are dependent upon, to some degree, regional production. Agricultural crop production undergoes further processing in the region past the farm gate, which can have significant additional economic impacts to the region. Thus, this study was initiated to estimate the economic impacts of forward-linked, or farm-forward, agricultural commodity production and processing systems under various scenarios by linking traditional backward-linked socioeconomic impact models along and across processing chains. By doing so, industrywide “spillover effects” of changes in water availability on other economic sectors linked directly and indirectly to irrigated crop production are able to be more fully captured.

Relatively few examples of forward-linked impacts are found in the literature. Examples include Harris, Rader, and Johnson (1992) for the greenhouse industry, Fox (1998) for hydropower, and Dudensing and Falconer (2010) for cotton. The objective of this study is to develop the capacity to estimate the forward-linked regional economic impacts for agricultural products from the farm gate forward in the NPGCD in Texas. Three water conservation strategies identified by the NPGCD were evaluated using an economic optimization model, the traditional backward-linked input-output regional economic model, IMPLAN, and the newly formulated forward-linked regional economic model and compared to a *status quo* baseline scenario. Results of this study allow a comparison of farm-forward impacts with the traditional backward-linked impacts in order to provide an avenue from which the magnitude of forward impacts can be interpreted in similar studies.

Data and Methods

The study area is the region overlying the Ogallala Aquifer in the NPGCD. The specific counties included in the analysis are Dallam, Hartley, Moore, and Sherman Counties in the western portion of the District and Hansford, Hutchinson, Ochiltree, and Lipscomb Counties in the eastern portion, Figure 1.

The original study conducted for the NPGCD by Amosson, Guerrero, and Johnson (2010) was used as the basis for generating forward-linked results. The general methods and results of this report are reiterated in this paper. However, for more detailed information, please refer to the original report (Amosson et al., 2010).

There are three types of economic models that were used in the policy analyses. Economic optimization models consist of individual models for each of the eight counties in the study area that estimate changes in the aquifer and farm net income over a 60 year planning period (Brooke et al., 1998). Backward-linked regional economic models evaluate impacts of agricultural crop production on the regional economy through the supply of inputs for crop production (farm gate backward) (MIG, 2009). Forward-linked regional economic models evaluate the impact of agricultural crop production on the regional economy through the processing and warehousing of crops after they have been produced (farm gate forward). The forward and backward-linked socioeconomic models aggregate the gross receipts from agricultural crop production from the county optimization models to explain changes in the regional economy and regional employment.

The county optimization models begin with the initial county values for crop acreage, irrigated acreage, average saturated thickness, and depth to water. Given the initial conditions, the models estimate the level of crop production and water use that optimize farm net income over a 60 year planning period. The underlying assumptions for the model include county, aquifer, and crop parameters. The parameters for each county include the number of acres planted in each crop, the number of irrigated acres, and the percentage of the county overlying the Ogallala Aquifer. The aquifer characteristics for each county include the average saturated thickness, depth to water, specific yield, and recharge.

The crop parameters for each crop include crop price, cost of production, and crop yield. Crop yield was determined by a production function which estimates yield as a response to applied water. Each crop in each county has a unique production function. As available water decreases, the crop yield decreases in response to reduced irrigation. Cost of pumping was calculated using the energy price and energy requirement due to the changing depth to water over the planning period. One of the unique aspects of this model is that water demand incorporates costs of pumping, changes in depth to water, and changing yields and crop mix as they respond to changing water availability over time. The results of the model include changes in crop acres, irrigated acres, and farm net income over the planning horizon.

The results of the county optimization models were aggregated into sub-regional results for the socioeconomic analyses (backward and forward-linked) to forecast the effects of the policies on overall economic activity in the study areas. These models capture the often-cited "spillover effects" of changes in water availability on other economic sectors linked directly and indirectly to irrigated crop production. The input-output IMpact analysis for PLANning (IMPLAN) model was used to evaluate the backward-linked socioeconomic impacts on the overall study area from the baseline and alternative scenarios analyzed (MIG, 2009). Input-output modeling is a method used to understand the linkages between elements of an economy and estimate the impacts of changes in the economy.

To measure impacts, the IMPLAN model produces multipliers which estimate the total economic impact of expenditures within an economy. These impacts are referred to as direct, indirect, and induced effects. An example is when a producer pays to have his crop custom harvested (direct effect). Then, the custom harvester purchases additional equipment (indirect effect). As a result of profits received, the producer and the custom harvester can spend money at the local grocery store (induced effect). The IMPLAN model contains comprehensive and detailed data coverage of the entire U.S. by county and the ability to incorporate user-supplied data at each stage of the model building process. In addition, particular crop production costs for each crop were input into the model to get more detailed and region-specific results. These models generated the impact projections of employment, regional income, and industry output for the study area.

Forward-linked regional economic models were then created to evaluate the impact of agricultural crop production on the regional economy through the processing and warehousing of crops after they have been produced (farm gate forward) in order to provide a more comprehensive estimate of the total impact of agriculture in the district. The forward-linked impacts were estimated by identifying the processing industries in the study area that were forward-linkages to local crop production and determining the amount of output of those industries that was attributable to local crop production. The relative industry output was determined by estimating the value of crops that the processing industries purchase overall and then applying the percentage of crops that are purchased or available locally. The industry output, excluding the purchase of crops as to avoid double counting the contributions of earlier stages of production, were then input into the IMPLAN model in order to generate the forward-linked direct, indirect, and induced effects of the processing industries. The processing industries identified included cattle production, dairy cattle and milk production, poultry and egg production, swine production, animal food manufacturing, oilseed processing, tortilla manufacturing, and wholesale trade through elevators. Other forward-linked industry sectors were considered for the analysis, however, did not have any economic output in the NPGCD study area.

A baseline and three scenarios were analyzed which examined the impact of meeting alternative desired future conditions and the effects of potential production advancements. The baseline scenario assumes no changes from current water policies over the planning period. A detailed description of the alternative strategies identified by the District included in the analysis is given below:

1) **<u>Desired Future Conditions</u>:** The implementation of conservation measures for the NPGCD including two separate Desired Future Conditions (DFC). Two DFC's are analyzed due to substantial differences in water uses and aquifer conditions between the four western counties and the four eastern counties in the District. Specifically, the four western counties must achieve at least 40% of the current aquifer storage remaining in 60 years while the eastern counties must have at least 50% of the baseline aquifer storage remaining in 60 years.
2) **<u>Productivity Advancement</u>:** The District, through policies, goals, and working with agricultural producers and research partners, induces the development of a conservation method with increased productivity. This would allow agricultural producers to yield 200 bushels of corn per irrigated acre from 12 acre-inches of groundwater applied. The resultant changes in cost of other inputs are unknown at this time, therefore, no change in cost structure was assumed except for irrigation costs.
3) **<u>Combined</u>:** The implementation of desired future conditions as stated in (1) coupled with the productivity advancement of corn as stated in (2).

Results

The original study conducted for the NPGCD by Amosson, Guerrero, and Johnson (2010) was used as the basis for the forward-linked study. The results of the original study are presented below and are followed by the results of the forward-linked analysis.

The baseline, which assumes no changes in current water policies, was run for both the western and eastern four counties of the water district over a 60 year time horizon. The economic optimization models predicted a decrease in saturated thickness from 160 to 54.69 feet in the western counties of the district and a decrease from 201 to 165.57 feet in the eastern counties, respectively, Tables 1A and 1B. The percentage of irrigated acres relative to total cropland in the baseline dropped from 73.7% to 31.2% and 34.7% to 34.4% in the western and eastern counties, respectively, Tables 2A and 2B. The projected net income per acre decreased from $271.62 to $83.90 in the western counties and actually increased ($134.22 to $146.01) in the east, Tables 3A and 3B. The total backward-linked regional economic output over the 60 years for the western counties was estimated at 33.2 billion dollars which is more than double the eastern counties (16.4 billion dollars), Tables 4A and 4B and Figures 2A and 2B.

The Desired Future Conditions (DFC) were actually modeled to constrain water use to have a minimum of 40% saturated thickness remaining in the western four counties and 50% in the eastern counties. This scenario had a major impact on the western counties but no impact on the eastern counties since their baseline water policies and use was unaffected by the restriction. In year 60, the western counties were projected to have 10 more feet of saturated thickness relative to the baseline and the percentage of land irrigated was expected to drop 3.2%. Producer income which was originally estimated to be $271.62 per acre in year one was expected to fall from $83.90 per acre (baseline) to $62.95 per acre (DFC) in year 60. Overall, the economy of the four counties is expected to lose a total $1.8 billion dollars in backward-linked economic activity over the 60 years from implementing the DFC policy.

The second scenario (Productivity Advancement) assumed that 200 bushel corn could be produced on 12 acre-inches pumped. No additional cost changes were assumed. In addition, it was assumed that no more than 2% of acreage could change from one crop to another in any given year. This scenario relative to the baseline resulted in saturated thickness improving

16.39% by year 60 in the western counties and 3.5% in the eastern counties. However, it should be noted that the restriction on acreage shifts between crops may have biased the results. The percentage of irrigated acres remaining improved 73.19% and producer income increased 59.07% over the baseline in year 60 for the western counties. Total backward-linked economic activity increased 2% or approximately 775 million dollars over the baseline for the 60 years. However, examining the flow of economic output over time suggests this policy alternative tends to even out the impact of falling saturated thickness.

One final scenario was added to look at the impact of coupling the Productivity Advancement with the DFC policy. The results of this scenario were minimally different from the Productivity Advancement policy alternative since the only two counties impacted were Dallam and Hartley.

The regional economic backward-linkages for the baseline and alternative scenarios were rerun to include three additional crops, alfalfa, corn silage, and sorghum silage, which have an increasing presence in the NPGCD study area due to the development of dairies. The backward-linked IMPLAN results including these additional crops and combined for the western and eastern counties are presented in Table 5. These results represent the regional economic impacts of commodity production. The forward-linked impacts estimated for the processing of agricultural crops including the additional crops and combined for the western and eastern counties are shown in Table 6. Finally, the impacts of both commodity production (backward-links) and commodity processing (forward-links) were added together to get the total economic effects of agricultural crop production in the NPGCD region, Table 7.

The total regional economic impacts (including forward-linkages) are approximately 1.21, 1.17, and 1.08 times the backward-linkages for industry output, value added, and employment, respectively. The total regional economic impacts for the baseline scenario indicate that crop production generates almost $63.0 billion in industry output, $23.5 billion in value added, or income, and an annual average of 9,575 jobs over the 60-year horizon.

Summary

An original study conducted for the NPGCD by Amosson, Guerrero, and Johnson (2010) was used as the basis for generating forward-linked results in this paper. Stakeholders were concerned that the regional economic value of agricultural crop production was underestimated as much of the commodities produced are further stored, fed, or processed within the region beyond the farm gate. The addition of the forward-linkages for crop production increased the estimated economic value of the agricultural sector in the region. Including the forward-linked crop sectors in the region increased baseline industry output 21%, value added 17% and employment 8%. Results from the new baseline analysis indicates that crop production generates almost $63.0 billion in industry output, $23.5 billion in value added, or income, and an annual average of 9,575 jobs over the 60-year horizon.

References

Amosson, S., B. Guerrero, and J. Johnson. 2010. Evaluation of Alternative Water Conservation Strategies for the North Plains Groundwater Conservation District. Texas AgriLife Extension Service and Texas Tech University. pp. 19.

Brooke, A., D. Kendrick, A. Meerdus, R. Raman, and R. E. Rosenthal. 1998. *GAMS: A User's Guide*. Washington, D.C.: GAMS Development Corporation.

Dudensing, R. M. and L. L. Falconer. 2010. Estimation of Economic Impact Multipliers for the Texas Coastal Bend Cotton Industry. *Beltwide Cotton Conference*, New Orleans, LA, January 4-7.

Fox, A. 1998. The Role of Hydropower in the National and Regional Economies. *1998 National IMPLAN User's Conference*, October 15-16, Washington, DC.

Harris, T., L. Rader, and W. Johnson. 1992. Economic linkages of the U.S. greenhouse and nursery products industry. *Journal of Environmental Horticulture* 10(1): 4-7.

MIG. 2009. *IMPLAN Professional Version 3.0*. Stillwater, Minnesota.

Dallam	Sherman	Hansford	Ochiltree	Lipscomb
Hartley	Moore	Hutchinson		

Figure 1. North Plains Groundwater Conservation District

Table 1A. NPGCD West Weighted Average Saturated Thickness (feet)*

Policy Scenario	Year 10	Year 20	Year 30	Year 40	Year 50	Year 60
Baseline Year 1 = 160	136.25	112.10	92.00	76.00	63.59	54.69
Desired Future Conditions	137.91	116.46	98.34	83.32	72.06	64.19
Change from Baseline	*1.22%*	*3.89%*	*6.89%*	*9.63%*	*13.32%*	*17.37%*
Productivity Advancement	144.09	125.97	108.05	91.12	75.89	63.65
Change from Baseline	*5.75%*	*12.38%*	*17.45%*	*19.90%*	*19.34%*	*16.39%*
Combined	144.32	126.48	109.03	92.86	78.30	66.43
Change from Baseline	*5.92%*	*12.83%*	*18.50%*	*22.18%*	*23.13%*	*21.48%*

*Averages are weighted by the area overlying the aquifer in each county.

Table 1B. NPGCD East Weighted Average Saturated Thickness (feet)*

Policy Scenario	Year 10	Year 20	Year 30	Year 40	Year 50	Year 60
Baseline Year 1 = 201	196.05	190.00	183.92	177.81	171.69	165.57
Desired Future Conditions	196.05	190.00	183.92	177.81	171.69	165.57
Change from Baseline	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*
Productivity Advancement	197.04	192.05	186.95	181.77	176.57	171.36
Change from Baseline	*0.51%*	*1.08%*	*1.65%*	*2.23%*	*2.84%*	*3.50%*
Combined	197.04	192.05	186.95	181.77	176.57	171.36
Change from Baseline	*0.51%*	*1.08%*	*1.65%*	*2.23%*	*2.84%*	*3.50%*

*Averages are weighted by the area overlying the aquifer in each county.

Table 2A. NPGCD West Irrigated Acres as a Percentage of Total Acres*

Policy Scenario	Year 10	Year 20	Year 30	Year 40	Year 50	Year 60
Baseline Year 1 = 73.7%	70.2%	61.9%	54.8%	46.7%	38.1%	31.2%
Desired Future Conditions	66.5%	58.8%	52.1%	43.7%	35.7%	30.2%
Change from Baseline	*-5.25%*	*-4.87%*	*-4.99%*	*-6.44%*	*-6.44%*	*-3.20%*
Productivity Advancement	73.7%	73.7%	73.1%	69.1%	62.5%	54.0%
Change from Baseline	*4.89%*	*19.08%*	*33.40%*	*48.00%*	*63.95%*	*73.19%*
Combined	73.7%	73.7%	71.0%	67.4%	61.3%	54.1%
Change from Baseline	*4.89%*	*19.08%*	*29.59%*	*44.35%*	*60.81%*	*73.48%*

*The percentage is based on the total irrigated acres in the target area (at time = t) divided by total irrigated and nonirrigated cropland acres in the target area.

Table 2B. NPGCD East Irrigated Acres as a Percentage of Total Acres*

Policy Scenario	Year 10	Year 20	Year 30	Year 40	Year 50	Year 60
Baseline Year 1 = 34.7%	34.4%	34.4%	34.4%	34.4%	34.4%	34.4%
Desired Future Conditions	34.4%	34.4%	34.4%	34.4%	34.4%	34.4%
Change from Baseline	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*
Productivity Advancement	34.7%	34.7%	34.7%	34.7%	34.7%	34.7%
Change from Baseline	*0.78%*	*0.82%*	*0.85%*	*0.88%*	*0.90%*	*0.92%*
Combined	34.7%	34.7%	34.7%	34.7%	34.7%	34.7%
Change from Baseline	*0.78%*	*0.82%*	*0.85%*	*0.88%*	*0.90%*	*0.92%*

*The percentage is based on the total irrigated acres in the target area (at time = t) divided by total irrigated and nonirrigated cropland acres in the target area.

Table 3A. NPGCD West Average Net Income per Acre*

Policy Scenario	Year 10	Year 20	Year 30	Year 40	Year 50	Year 60
Baseline Year 1 = 271.62	264.53	231.68	190.43	154.00	111.90	83.90
Desired Future Conditions	241.65	210.50	182.25	144.81	101.99	62.95
Change from Baseline	*-8.65%*	*-9.14%*	*-4.30%*	*-5.96%*	*-8.86%*	*-24.97%*
Productivity Advancement	201.40	204.00	202.98	191.46	172.86	133.46
Change from Baseline	*-23.87%*	*-11.95%*	*6.59%*	*24.33%*	*54.47%*	*59.07%*
Combined	200.35	202.52	195.17	183.78	165.64	142.10
Change from Baseline	*-24.26%*	*-12.59%*	*2.49%*	*19.34%*	*48.02%*	*69.37%*

*The average is based on the total irrigated and nonirrigated net revenue (at time = t) divided by total irrigated and nonirrigated cropland acres.

Table 3B. NPGCD East Average Net Income per Acre*

Policy Scenario	Year 10	Year 20	Year 30	Year 40	Year 50	Year 60
Baseline Year 1 = 134.22	137.68	140.53	142.68	144.24	145.31	146.01
Desired Future Conditions	137.68	140.53	142.68	144.24	145.31	146.01
Change from Baseline	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*
Productivity Advancement	132.79	136.40	139.19	141.32	142.85	143.91
Change from Baseline	*-3.55%*	*-2.94%*	*-2.44%*	*-2.02%*	*-1.69%*	*-1.43%*
Combined	132.79	136.40	139.19	141.32	142.85	143.91
Change from Baseline	*-3.55%*	*-2.94%*	*-2.44%*	*-2.02%*	*-1.69%*	*-1.43%*

*The average is based on the total irrigated and nonirrigated net revenue (at time = t) divided by total irrigated and nonirrigated cropland acres.

Table 4A. NPGCD West 60 Year Regional Economic Impacts

	Direct	Indirect	Induced	Total	Change from Baseline	% Change from Baseline
Baseline						
Output*	17,653	10,543	5,021	33,218		
Value Added*	4,607	5,439	2,897	12,943		
Employment	3,195	1,774	773	5,743		
Desired Future Conditions						
Output*	16,654	9,992	4,735	31,382	-1,836	-6%
Value Added*	4,314	5,161	2,733	12,207	-736	-6%
Employment	3,010	1,692	730	5,432	-311	-5%
Productivity Advancement						
Output*	17,890	10,986	5,117	33,993	775	2%
Value Added*	4,498	5,685	2,953	13,136	193	1%
Employment	3,020	1,936	789	5,745	3	0%
Combined						
Output*	17,672	10,853	5,060	33,585	368	1%
Value Added*	4,447	5,619	2,920	12,985	42	0%
Employment	2,980	1,916	780	5,676	-66	-1%

*Millions of dollars

Table 4B. NPGCD East 60 Year Regional Economic Impacts

	Direct	Indirect	Induced	Total	Change from Baseline	% Change from Baseline
Baseline						
Output*	8,534	5,390	2,428	16,352		
Value Added*	1,983	2,842	1,401	6,226		
Employment	1,439	1,017	375	2,831		
Desired Future Conditions						
Output*	8,534	5,390	2,428	16,352	0	0%
Value Added*	1,983	2,842	1,401	6,226	0	0%
Employment	1,439	1,017	375	2,831	0	0%
Productivity Advancement						
Output*	8,495	5,616	2,476	16,587	235	1%
Value Added*	1,858	2,990	1,429	6,277	51	1%
Employment	1,244	1,149	383	2,777	-55	-2%
Combined						
Output*	8,495	5,616	2,476	16,587	235	1%
Value Added*	1,858	2,990	1,429	6,277	51	1%
Employment	1,244	1,149	383	2,777	-55	-2%

*Millions of dollars

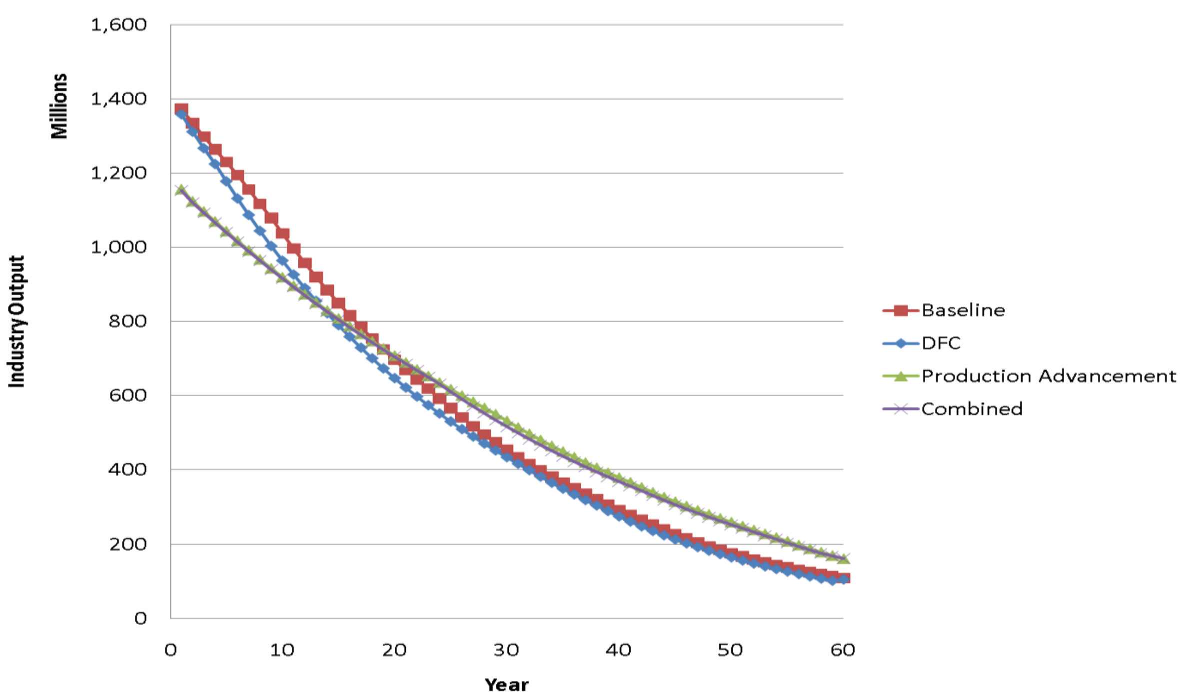

Figure 2A. NPGCD West Total Industry Output Impacts for a 60 Year Planning Horizon

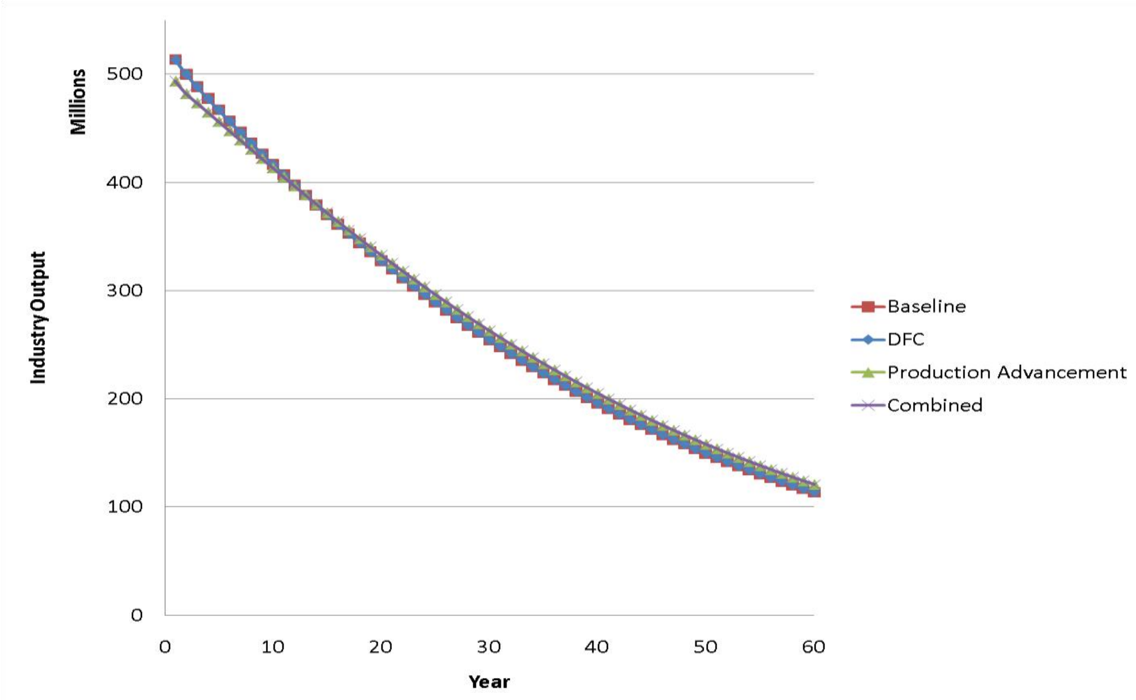

Figure 2B. NPGCD East Total Industry Output Impacts for a 60 Year Planning Horizon

Table 5. NPGCD Commodity Production (Backward-linked) 60 Year Regional Economic Impacts

	Direct	Indirect	Induced	Total	Change from Baseline	% Change from Baseline
Baseline						
Output*	$27,343	$16,782	$7,731	$51,856		
Value Added*	$6,975	$8,730	$4,442	$20,147		
Employment	4,724	2,977	1,191	8,892		
Desired Future Conditions						
Output*	$26,344	$16,231	$7,446	$50,021	-$1,836	-4%
Value Added*	$6,682	$8,452	$4,277	$19,411	-$736	-4%
Employment	4,538	2,896	1,147	8,581	-311	-3%
Productivity Advancement						
Output*	$27,540	$17,451	$7,875	$52,867	$1,010	2%
Value Added*	$6,742	$9,124	$4,525	$20,391	$244	1%
Employment	4,354	3,271	1,214	8,840	-52	-1%
Combined						
Output*	$27,323	$17,318	$7,818	$52,459	$603	1%
Value Added*	$6,690	$9,058	$4,492	$20,240	$93	0%
Employment	4,314	3,251	1,205	8,771	-121	-1%

*Millions of dollars

Table 6. NPGCD Commodity Processing (Forward-linked) 60 Year Regional Economic Impacts

	Direct	Indirect	Induced	Total	Change from Baseline	% Change from Baseline
Baseline						
Output*	$8,405	$2,366	$349	$11,120		
Value Added*	$2,447	$725	$207	$3,379		
Employment	466	160	57	684		
Desired Future Conditions						
Output*	$8,032	$2,254	$334	$10,620	-499	-4%
Value Added*	$2,344	$691	$198	$3,233	-146	-4%
Employment	446	153	55	654	-30	-4%
Productivity Advancement						
Output*	$8,371	$2,363	$346	$11,081	-39	0%
Value Added*	$2,427	$724	$205	$3,356	-23	-1%
Employment	462	160	57	679	-5	-1%
Combined						
Output*	$8,288	$2,339	$343	$10,969	-151	-1%
Value Added*	$2,403	$716	$203	$3,322	-56	-2%
Employment	458	158	56	672	-12	-2%

*Millions of dollars

Table 7. NPGCD Commodity Production and Processing (Backward-linked and Forward-linked) 60 Year Regional Economic Impacts

	Direct	Indirect	Induced	Total	Change from Baseline	% Change from Baseline
Baseline						
Output*	$35,748	$19,148	$8,081	$62,976		
Value Added*	$9,421	$9,455	$4,649	$23,526		
Employment	5,190	3,138	1,248	9,575		
Desired Future Conditions						
Output*	$34,376	$18,485	$7,780	$60,641	-$2,335	-4%
Value Added*	$9,025	$9,144	$4,475	$22,644	-$881	-4%
Employment	4,984	3,049	1,202	9,235	-341	-4%
Productivity Advancement						
Output*	$35,912	$19,814	$8,221	$63,948	$972	2%
Value Added*	$9,169	$9,848	$4,730	$23,747	$221	1%
Employment	4,816	3,431	1,271	9,519	-57	-1%
Combined						
Output*	$35,610	$19,657	$8,161	$63,428	$452	1%
Value Added*	$9,093	$9,774	$4,695	$23,562	$37	0%
Employment	4,772	3,410	1,262	9,443	-132	-1%

*Millions of dollars