GROWER-LEVEL BENEFIT COST ANALYSIS OF BOLL WEEVIL ERADICATION IN THE SOUTHERN ROLLING PLAINS OF TEXAS

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Abstract

The Texas Boll Weevil Eradication Foundation has operated a boll weevil eradication program in the Southern Rolling Plains of Texas since the fall of 1994. In 2000, this region became the first area in Texas to achieve the designation of "functionally eradicated." This paper uses historical cotton price data and estimates of boll weevil induced yield losses and treatment costs to assess the economic implications of the boll weevil eradication program to Southern Rolling Plains cotton producers. Only direct grower benefits and costs are considered in this analysis. The benefit cost ratio suggests direct grower benefits to date provided $1.45 of benefits for every $1 expended by the producer.

Introduction

The Southern Rolling Plains (SRP) of Texas is an area which has historically planted 200,000 to 350,000 acres of cotton. Approximately 85 percent of the cotton production in this region is dryland with about 15 percent receiving supplemental or full irrigation. In the fall of 1994, the Texas Boll Weevil Eradication Foundation (TBWEF) initiated a boll weevil eradication program in the SRP. Prior to this program, the boll weevil was the key pest that annually caused the highest losses among different insect pests (Fuchs and England, 1989). An added significance of the boll weevil eradication (BWE) program in the SRP is that this is the first program conducted in a minimum input area. The number of insecticide applications rarely averaged more than four prior to eradication. As with eradication programs in other areas, the SRP effort has had its share of controversy and problems which were thoroughly detailed by Sansone et al. (1999). In addition, the SRP is the first region in Texas to achieve the designation of "functionally eradicated" indicating no evidence of boll weevil reproduction in SRP cotton fields for two consecutive years and thus serves as a case study for other statewide programs.

Economic analysis of programs in other cotton growing areas indicates that the BWE program has been (or may be) a profitable investment by positively impacting cotton yield, acreage, and production and reducing the cost of production (Carlson et al. (1989); Ahouissoussi et al. (1993); Duffy et al. (1994); Paxton et al. (1995); Haney et al. (1996); Tribble et al. (1998); and Larson et al. (2000). While the impact of eradication continues to be experienced in the SRP of Texas, the reduction of the boll weevil to a non-economic pest provides a sufficient reference period to evaluate the BWE program. The purpose of this paper is to evaluate benefits and costs which have accrued to SRP producers to date. While it is widely recognized that cotton growers are not the only sector affected by the program, no attempt is made to address the spillover effects likely to occur throughout the region or within other linked aspects of the industry. Also, funds contributed by state or federal sources were not included in this analysis. Further, this paper focuses solely on the impact of the BWE program on boll weevil control, without attempting to speculate on the positive and negative impacts related to other pests.

Methods and Data

The first step in evaluating the grower-level benefits and costs associated with BWE involved establishing a baseline of control costs and boll weevil induced yield losses during the pre-BWE program period and then comparing these metrics for each of the post-BWE years. The data used to provide this historical description of boll weevil impacts on the SRP were taken from yield and acres harvested estimates from the Texas Agricultural Statistics Service (1988-1999) and estimates for number of insecticide applications for boll weevil control, cost per application, and percentage yield reduction from boll weevil damage from cotton insect loss reports published in proceedings of the Beltwide Cotton Conferences for the crop years 1987 through 2000 (King et al. (1988); Head (1989-1993); Williams (1994-2000)). The 1996 estimate for number of insecticide applications for boll weevil control was revised upward (to 0.75) from that level reported in the cotton insect loss reports (0.00) based upon updated unpublished information. Table 1 presents this relevant information during this fourteen year period and averages for the seven-year pre-BWE years as well as the seven-year post-BWE period. The baseline level of cotton grower losses from the boll weevil was defined as the pre-BWE period (1987-1993) average number of insecticide applications for boll weevil control (2.14 applications) and average yield reduction caused by boll weevil damage (6.94 percent). A review of the average yield levels between the pre-BWE period (353 pounds of lint per acre) and the post-BWE period (300 pounds of lint per acre) illustrates the differences in the overall production environment (including weather) during this period.

Direct economic benefits of boll weevil eradication stem largely from the reduction in insect control costs and the yield gain or reduction of crop losses to insect damage. These effects represent permanent gains realized by boll weevil eradication. Boll weevil control savings during the post-BWE period was defined as the reduction in insecticide applications by the grower versus the pre-BWE period multiplied by the cost per application. The value of post-BWE period yield savings was determined by taking the difference in percentage yield reduction from boll weevil damage versus the pre-BWE period, multiplying it by the average yield, and then multiplying by the average price received. Data identifying this average price received by farmers were obtained from the Texas Agricultural Statistics Service (1994-1999). Cotton lint prices per pound used in this analysis for 1994 through 1999 were $0.696, $0.746, $0.656, $0.601, $0.561, and $0.414, respectively. A cotton price estimate of $0.53 per pound was used for 2000 to account for the typical basis in the area applied to the closing December cotton contract price. No attempt was made to incorporate various government payments to growers, which would obviously inflate the price levels actually realized by producers.

Total program assessments for the BWE program in the SRP were obtained directly from the TBWEF. These assessments were reported by year as the annual grower assessments for the program. The actual grower assessments for the SRP totaled $2,098,140, $2,479,620, $1,743,077, $2,105,801, $1,769, 846, $1,347,712, and $3,746,192 for years 1994 through 2000, respectively. The actual grower-level assessments for the program for the seven-year period totaled $15,291,975. Dividing these levels by the program acres yields the estimate for SRP grower-level per acre assessments for BWE.

This typical investment framework (in per acre nominal form) for evaluating the impacts of the BWE program to SRP producers is shown in Table 2. It includes the annual grower program cost as reported by the TBWEF and converted to per-acre levels as described above. It should be noted that in 1999 the assessment would have been $12.87 per acre, but the State of Texas appropriated funds to the program which effectively cut the grower assessment by 50 percent (to $6.44 per acre). The summation of boll weevil spray cost savings and the value of yield savings from the BWE program are also shown to represent the benefits accruing to SRP cotton producers. The nominal per acre net benefit is simply the cumulative benefits minus the program cost to the grower.

The Benefit Cost (BC) ratio is defined as the ratio of the discounted benefits over the discounted costs. It measures the relative size of the benefits to the costs of a project. The criterion for project acceptability is BC > 1; that is, the discounted project benefits should be greater than the discounted project costs. The nominal per acre grower benefits and costs in Table 2 were discounted using a five percent discount rate.

Results and Discussion

The results from discounting the nominal per acre BWE benefits and assessments are reported in Table 3. These per acre grower benefits and assessments are now depicted in constant (1994) dollars. The purpose of discounting the stream of benefits and costs is to weigh the timing of costs associated with initiating a program against the value of benefits accruing in the future so that the investment decision and payback period can be determined. While BWE required investment beginning at the program onset in 1994, economic benefits to producers are limited the first year of the program because of the initial increased cost of insect control. Benefits begin to be realized the second year of the program because fewer weevils are present to damage fruit during the growing season. Discounting these future benefits and costs serves to recognize the time oriented balance between program costs and program benefits.

In 1994 the BWE program produced an average reduction in grower revenue of $2.87 per acre. This loss to growers was primarily the result of only a slight reduction in boll weevil induced yield damage (5.56 percent) versus the 6.94 percent pre-BWE baseline. In the second year of the BWE program, SRP producers realized an average reduction in revenue of $1.33 per acre. By 1996, positive returns from the program began to accrue to producers ranging from an increase of $3.49 per acre in 2000 to an increase of $11.99 per acre in 1999. It should be noted that these impacts represent the effects of the BWE program on the average SRP cotton producer. It is likely that some producers reaped benefits in excess of these estimated averages and others failed to recuperate their program assessment. It would be difficult to presume that this program resulted in a Pareto optimum, but the evidence suggests that, on average, SRP producers have benefitted in excess of their required expense.

The per acre impacts of the BWE program were easily converted to aggregate SRP impacts to growers by multiplying per acre values by the harvested acreage (from Table 1). These aggregate estimates of benefit and cost are reported in Table 4. During the seven year BWE program period, the discounted value (constant 1994 dollars) of total program assessments to growers ranged from $1.1 - $2.8 million annually and to date have amounted to roughly $13.2 million. Discounted total program benefits to growers ranged from $1.7 - $3.8 million annually and have to date amounted to approximately $19.0 million. Therefore, the benefit cost ratio of the BWE program in the SRP is estimated to be 1.45. This implies that growers have received $1.45 in benefits for every $1 of program cost. This estimate relates only to the benefits and costs to cotton producers in the SRP as it relates solely to the boll weevil and does not address any positive or negative impacts to other pest management efforts, or the external effects to linked industries (ginning, transportation, etc.), or surrounding communities.

Summary

This analysis provides a snapshot of the grower-level benefits and costs resulting from the BWE program in the SRP after seven years of program activity. Now that the region has been declared "functionally eradicated," it could be anticipated that program costs going forward would decline (as only maintenance levels of monitoring and treatment are necessary) while benefits continue to accrue to producers. The seven-year post-BWE period was characterized by overall poor growing conditions for SRP producers as characterized by the 53 pound of lint per acre average yield reduction

between the pre-BWE and post-BWE periods. Even accounting for this yield differential, the BWE program in the SRP appeared to provide an excess of benefits to SRP growers relative to the grower-level costs of the program.

The SRP is a relatively low input production area with low historical yields as compared to other regions of the state and country. With much of the benefits dependent upon a reduction in yield losses, it would seem logical that BWE would stand to benefit areas or regions with traditionally higher yields even more than was documented for the SRP, provided these other regions faced similar or increasing levels of boll weevil induced yield damage.

While this analysis strongly supports the premise that the BWE program in the SRP has generated positive impacts to the region, it should be recognized that financial analyses like benefit cost ratios seldom capture all of the relevant information about the projects under consideration. Additionally, financial criteria are not usually the sole factor in selecting a preferred alternative. This analysis focused solely on the grower-level impacts of the BWE program, but recognizes the widely acknowledged premise that changes in the production sector permeate throughout other linked and general sectors of the economy. Taking all of these factors into account, this analysis could therefore, be viewed as an analysis of the BWE program in a region that has provided a worst-case scenario. In spite of these circumstances, the BWE program in this region still appears to have generated positive average results for SRP producers.

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Table 1. Acres harvested, yield, insecticide applications for boll weevil control, cost per application, and percentage yield reduction from boll weevil damage in the Texas Southern Rolling Plains, 1987 - 1994.

Year	Acres Harvested	Average Yield (lbs./ac.)	Appls. for Boll Weevil	Cost per Appl.	Yield Loss from BW Damage
1987	128,300	449	1.40	$5.50	2.80%
1988	154,100	289	3.60	$5.00	13.33%
1989	124,200	340	3.10	$5.50	10.67%
1990	157,800	471	0.00	$2.50	0.04%
1991	177,100	318	2.20	$6.00	5.82%
1992	149,900	303	2.90	$6.00	9.50%
1993	144,100	303	1.80	$4.50	6.40%
Pre BWE Average 1987-93	147,929	353	2.14	$5.00	6.94%
1994	139,800	302	0.70	$5.00	5.56%
1995	138,700	201	0.60	$3.00	1.00%
1996	100,700	372	0.75	$6.85	1.03%
1997	143,400	392	0.56	$7.75	0.36%
1998	90,600	375	0.00	$7.30	0.00%
1999	172,000	280	0.00	$7.06	0.00%
2000 [a]	35,000	178	0.00	$7.00	0.00%
Post BWE Average 1994-2000	117,171	300	0.37	$6.28	1.14%

[a] Values for 2000 are estimates as of 12/31/00.

Table 2. Nominal per-acre costs and benefits from the boll weevil eradication program to Southern Rolling Plains cotton producers.

Year	Eradication Grower Assessment	Boll Weevil Treatment Cost Savings	Boll Weevil Eradication Yield Savings	Net Benefit
1994	$12.50	$ 7.21	$ 2.41	($ 2.87)
1995	$12.00	$ 4.63	$ 5.98	($ 1.40)
1996	$ 8.26	$ 9.54	$ 6.88	$ 8.16
1997	$11.30	$12.27	$11.92	$12.89
1998	$11.10	$15.64	$ 8.29	$12.84
1999	$ 6.44	$15.13	$ 6.60	$15.30
2000	$11.00	$15.00	$ 0.67	$ 4.67
7-Year Total				$49.59

Table 3. Discounted per-acre costs and benefits from the boll weevil eradication program to Southern Rolling Plains cotton producers (all values in 1994 dollars) .

Year	Eradication Grower Assessment	Boll Weevil Treatment Cost Savings	Boll Weevil Eradication Yield Savings	Net Benefit
1994	$12.50	$ 7.21	$ 2.41	($ 2.87)
1995	$11.42	$ 4.41	$ 5.69	($ 1.33)
1996	$ 7.49	$ 8.65	$ 6.24	$ 7.40
1997	$ 9.76	$10.60	$10.30	$11.14
1998	$ 9.14	$12.87	$ 6.82	$10.56
1999	$ 5.05	$11.86	$ 5.18	$11.99
2000	$ 8.21	$11.19	$ 0.50	$ 3.49
7-Year Total				$40.38

Table 4. Aggregate estimates of benefit and cost from the boll weevil eradication program to Southern Rolling Plains cotton producers (all values in 1994 dollars) .

Year	Grower Program Cost	Boll Weevil Treatment Cost Savings	BWE Yield Savings	Net Benefit
1994	$ 2,098,140	$ 1,210,927	$ 337,043	($ 550,171)
1995	$ 2,360,598	$ 910,516	$ 789,039	($ 661,043)
1996	$ 1,580,971	$ 1,826,169	$ 628,281	$ 873,479
1997	$ 1,819,412	$ 1,975,132	$1,477,308	$1,633,027
1998	$ 1,456,583	$ 2,052,714	$ 618,327	$1,214,458
1999	$ 1,056,606	$ 2,484,063	$ 890,560	$2,318,017
2000	$ 2,794,659	$ 3,810,899	$ 17,561	$1,033,801
Total	$13,166,970	$14,270,419	$4,758,120	$5,861,569
	Benefit	$19,028,538		
	Cost	$13,166,970		
	BC Ratio	1.45		