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The Value of Tradable Credits for Rice Straw Burning

Market-based pollution control systems are rapidly gaining acceptance throughout the world as policy mechanisms that may alleviate pollution problems at a lower cost than conventional environmental regulations. Researchers, however, are just beginning to explore the potential of such systems in agriculture.

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Sacramento Valley rice farmers are participating in a market-based approach to pollution control in conjunction with regulation of rice straw burning. In 1991, the California state government passed a law mandating a 10-year phasedown of rice straw burning by the Valley rice industry. Each year, growers have been allowed to burn a declining share of their planted rice acreage. They must dispose of the excess stubble and straw left on their remaining fields through more costly alternative methods, primarily straw decomposition—plowing straw back into the soil. Meanwhile, growers have been allowed to buy and sell transferable burn credits.

The phasedown schedule was later relaxed and is currently scheduled to be complete in 2001, when burning will be allowed only to combat rice disease on at most 25% of the planted acres in the Valley.

This *AIC Issues Brief* summarizes an analysis of the cost savings available to the Sacramento Valley rice industry through trading of burn credits. Rice straw burning restrictions—and thus the mandated use of alternative disposal techniques—have increased not only the cost of straw disposal for most growers, but also the variation in straw disposal costs among growers. Variation across farms creates opportunities to reduce industry-wide disposal costs through the burn credit market, since growers who face higher disposal costs may buy burn credits from those with lower-cost alternatives. Therefore, trading can reduce aggregate disposal costs and may leave some or all parties better off.

Several decomposition techniques are alternatives to burning, but each increases both disposal costs and the variation in costs. In wet soil decomposition, harvest residue is rolled and matted against the soil. The field is then re-flooded to accelerate the decomposition process. This technique has

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become increasingly popular, especially among growers with access to relatively inexpensive winter water. Dry soil incorporation is usually even more expensive, as it often requires chopping the straw during harvest as well as several passes with disking machinery to mix the straw into the soil. Decomposition costs may be increased even more by lower yields due to rice diseases such as stem rot and aggregate sheath spot. Recent seasons also saw a sharp rise in the incidence of rice blast. Many growers and scientists believe that burning helps control these diseases.

Other cost factors that vary by farm or field include soil type and grower expertise. All these factors—in particular, the price of winter water and susceptibility to disease damage—have increased the variation in disposal costs among Valley growers.

(Another alternative, baling and removal of straw from the field, is usually far more expensive. Because straw is bulky and transport costs are high, this straw management alternative is practiced on only a tiny share of the acreage.)

Analysis of savings from trading

Assessing disposal costs under a variety of burn credit scenarios can provide important insights into the total cost of achieving local air quality objectives and also into the effectiveness of tradable burn permits in reducing air pollution in an agricultural setting.

Accordingly, this analysis seeks to answer three central questions:

- What have been the cost savings of burn credit trading for the rice industry so far?
- What would be the potential cost savings of extending burn credit trading indefinitely, assuming that burning for disease control will be allowed on 25% of the planted acreage?
- Or, alternatively, how much further reduction in burning could be achieved with trading, at the same cost as the mandated 25% level without trading?

We began by developing an economic simulation model to assess how growers would have responded to restrictions on burning if trading of burn permits had not been allowed. To provide data for our simulation, we surveyed several hundred growers about acreage burned, decomposition costs and other characteristics.

To answer the first of the questions, annual aggregate disposal costs were estimated under two scenarios: a baseline "no-trade" scenario and an "observed-trade" scenario. In the no-trade model, the share of burned acreage on each individual farm can be no more than the share mandated in a given year. The observed-trade scenario uses observed behavior to implicitly account for additional costs that the farmer considers, but which are difficult to capture in a survey. Specifically, this model requires that in each county-level air district, burn acreage can be no more than the actual observed levels with trading.

For both of these scenarios, simulation runs were conducted for each year of the phasedown period for which the burn restriction is known (1992-2000), as well as two hypothetical runs for future years. Decomposition costs, farm burn shares, and expanded acreage survey data for 1997 were used in all years.

Table 1 provides details of the annual net costs of the phasedown policy. As the restrictions tighten over time, aggregate disposal costs rise under both scenarios. The $28.8 million in net costs under the observed-trade scenario translates to an average of $8 per acre in extra disposal costs during this seven-year period. The annual cost imposed by the 10% restriction in 1992 is $1.3 million or roughly $2.6 per acre with or without trading.

New legislation prior to the 1998 season limited burning to 200,000 acres, or about 40% of the total rice area—slightly more than in 1997. However, this law required the shifting of some burning from the fall to the more costly spring burn season. As Table 1 shows, industry costs were higher in 1998 than in 1997 even though more total burning may have been allowed.

Table 1: Aggregate Net Disposal Costs

Year	Annual Burn Limit	Scenario: No-Trade	Scenario: Observed Trade
		($ Millions)	
1992	90%	1.3	1.3
1993	80%	2.5	2.4
1994	70%	3.6	3.1
1995	60%	4.8	3.9
1996	50%	6.0	4.8
1997	38%	7.5	6.2
1998	>.2 Mil. Acres	8.0	7.1
Total		**33.7**	**28.8**

By 1998, trading was saving about $0.9 million annually ($7.1 million in costs compared to $8 million if no trading were allowed). Without the trading provision, the simple sum of excess straw disposal costs over seven years would have been $33.7 million, or almost $10 per acre higher than if no burn restrictions existed.

Future cost savings

When the phasedown period ends, trading of burn credits among growers is also scheduled to end. Burn credits will then only be issued where the county agricultural commissioner's office has determined that burning is necessary to combat the spread of rice disease—and then only to a maximum of 25% of the annual planted rice acreage in the Valley. Given the recent problems with rice disease, and the high cost of alternative straw handling, it seems likely that in most years these conditional permits will be granted for the maximum number of acres allowable. This system will further entail significant administrative costs associated with verifying growers' claims of rice disease damage.

One alternative would be to fix the overall burn share at 25% and extend burn credit trading, thus allowing growers to reallocate burn credits among themselves. Those with the worst disease problems would be able to purchase burn credits in excess of 25% from other growers in the market. This approach has two important advantages: (1) county agricultural offices would no longer have the administrative costs associated with disease verification, and (2) as demonstrated above, the market allocation of burn credits entails lower aggregate straw disposal costs for the industry.

When considering this option, policy makers need to have a good idea of the magnitude of the potential benefits. Our simulation model was used to calculate net disposal costs under both scenarios described above, assuming the 25% annual burn allowance for control of rice disease. The present value of the annual cost savings was calculated over an infinite time horizon using a discount rate of 4%. At the level of trading observed in 1997, the indefinite extension of the trade allowance would be worth $22 million to the California rice industry.

More acreage for the same cost

The potential benefits of the burn credit market may also be seen in another way. Instead of asking how much cost savings the burn credit market can provide for a fixed level of pollution abatement, one may ask how much additional pollution abatement trading can be provided for a given cost to the industry. In other words, how much additional reduction in burning would occur under a trading scenario that cost the rice industry the same as a 25% burn restriction with no trading?

Figure 1 illustrates the change in total net straw disposal costs over the course of the phasedown period under the observed trade and no-trade scenarios. The horizontal axis shows the percent of planted rice acres required to be registered as phasedown acres. The vertical axis is total annual straw disposal costs. (The slight kink in the cost curves results from the change in seasonal burn requirements in 1998.) The horizontal difference between these cost curves represents the difference in the burned acreage that can be achieved for the same aggregate cost under the no-trade and observed-trade scenarios. For ex-

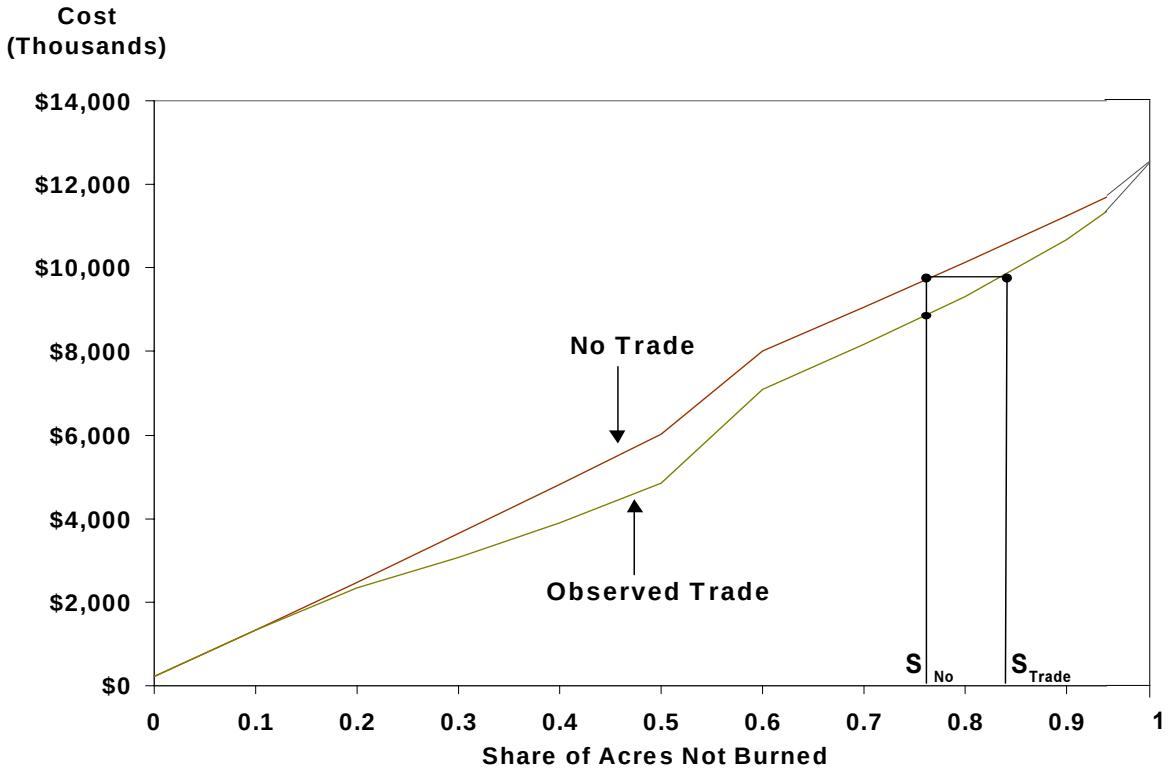
ample, for the same aggregate net cost as a 75% phasedown requirement (S_{No}) with no trading allowed (about $9.6 million), it would be possible to achieve roughly an 82% phasedown level (S_{Trade}) if burn credit trading were allowed and the observed-trading level is assumed.

Conclusion

This research was motivated by the 1991 Rice Straw Burning Reduction Act (AB-1378) and the ensuing debate over its economic impact on California's rice industry. Our primary goals were to measure (1) the aggregate costs of compliance with the state-mandated rice straw burning restrictions for the California rice industry, and (2) the potential of the burn credit market to defray some of these costs. We also had a unique opportunity to assess the effectiveness of a tradable pollution permit system in an agricultural setting.

Our research indicates that the phasedown of rice straw burning cost the rice industry around $28.8 million between 1992 and 1998 and trading burn credits saved the industry about $5 million. It also suggests that an extension of the burn credit trading allowance could be valuable for all interested parties. In addition to reducing administrative costs for local agricultural agencies, burn credit trading would be worth around $22 million to the Valley's rice industry, assuming current trading patterns and a 25% allowable burn for the indefinite future. It may also be possible for environmental and public health interests to realize important gains through extension of the trading allowance. An extension could reduce burning to around 18% of planted rice acreage at the same cost to industry as a 25% burning allowance with no trading.

Figure 1: Additional Reduction in Burning Available at the Same Cost



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