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Using Cotton Crop Insurance to Set an Income Floor

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There are four major types of crop insurance: 1) self-insurance, 2) catastrophic, 3) multi-peril, and 4) crop revenue coverage/revenue assurance. The lowest cost among these is self insurance, and the most expensive is crop revenue coverage.

The objective of this paper is to evaluate the total income that may be insured by buying different types of crop insurance. Using crop insurance to insure yield per acre and using marketing alternatives to insure price are also discussed.

Minimum total income may be used to compare the benefits of the various types of crop insurance. Other management factors that may be considered are premiums and coverage level. Calculating the total return per acre at various production levels allows the comparison of the different types of crop insurance. A profit function may be used to show the relationship between yield per acre and income.

For the following analysis, it is assumed that expected cotton yield and actual production history (APH) was 480 pounds/acre. The current cotton loan rate, 51.7 cents/pound, is used as the expected price. APH is calculated by dividing production (proven by receipts for buyers) by the number of acres planted. Additional information on calculating the APH may be obtained from any crop insurance agent.

Price Levels

When comparing crop insurance coverage, there are four major prices: expected cash price, market price, base price, and harvest price. The only unknown price will be the expected cash price. Each type of insurance has fixed prices. For the 2000 cotton crop, the market price was 59 cents/ pound, the base price was 61 cents/pound, and the harvest price was 44 cents/pound.

The cash price is used to calculate the return from selling production. Catastrophic (CAT) insurance and Multi-Peril Crop Insurance (MPCI) payments are based on the market price. Crop Revenue Coverage (CRC) payments are based on the higher of the base price and the harvest price. Both the market price and base price are established during sign-up. The harvest price is based on the futures market closing price during harvest.

Self-Insurance

Being self-insured is the least expensive and the most risky type of insurance (Figure 1). A producer self-insures by not buying any type of insurance.

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Expected total return with 480 pounds/acre yield at 51.7 cents/pound is about $248/acre (480 pounds x 51.7 cents). The payoff function shown in Figure 1 shows that without insurance, total returns can be zero. As yield increases, total returns increase.

If both the average yield and standard deviation of yield is known, the probability of income levels may be calculated. For example, if the average yield is 480 pounds and the standard deviation is 120 pounds, about 84 percent of the time per-acre yield will be above 360 pounds (480 lb. - 120 lb.). At 51.7 cents/pound, about 84 percent of the time total income will be greater than $187 per acre.

Catastrophic

For $100 per crop per farm, producers may insure production at 50 percent of the average production history (APH) and 55 percent of the established market price. In this case, CAT insures against yield loss below 240 pounds/acre (480 lb. x 0.50). Insurance payments are based on 55 percent of the established market price (32.45 cents = 59 cents x 0.55) and loss of production below 240 pounds/acre.

Total return for production above 240 pounds/acre is yield times price. For production less than 240 pounds/acre, total return is yield times price plus the insurance payment (Figure 2). The insurance payment is calculated by subtracting production from 240 pounds/acre and multiplying by the adjusted market price (32.45 cents/pound).

If production were 100 pounds/acre, total return would be $97/acre (100 pounds x 51.7 cents + 140 pounds x 32.45 cents). If production were zero, total return would be $78/acre (240 pounds x 32.45 cents).

Catastrophic insurance provides a minimum total return of $78/acre compared to a minimum total return of zero if no insurance is purchased. With an average production of 480 pounds/acre and a standard deviation of 120 pounds/acre, there is a 97 percent chance that yields will be above 240 pounds and total income will be above $78 per acre. This implies that the CAT policy will pay off about 3 percent of the time.

Multi-Peril Crop Insurance

Multi-peril crop insurance allows producers to raise the yield coverage in 5 percent increments between 55 percent and 85 percent. Government subsidies are highest for the 65 percent and 70 percent coverage levels. In this example, the 70 percent coverage level is used. For the 2000 cotton crop with a 480 pounds/acre APH, the premium was $14.02/acre (Figure 3).

Payments for yield loss are based on the market price (59 cents/pound for the 2000 crop). At the 70 percent coverage, insurance payments will be made for production less than 336 pounds/acre (480 pounds x 0.70).

For the 2000 cotton crop on a farm with an APH of 480 pounds/acre, MPCI with 70 percent coverage would cost $14.02/acre. If production were 100 pounds/acre, the total return would be $177/acre (100 pounds x 51.7 cents + 140 pounds x 59 cents - $14.02). This is $52 from production and $125 from insurance. The minimum total return would be $184/acre (336 pounds x 59 cents - $14.02).

With MPCI at the 70 percent level, yield coverage begins at 336 pounds. Given a 480-pound average yield and 120-pound standard deviation, 88 percent of the time yield will be above 336 pounds/acre, and total income will be above $175 per acre. This implies that this MPCI policy will pay off about 12 percent of the time.

Crop Revenue Coverage

Crop revenue coverage or revenue assurance insures against both low yields and low prices (Figure 4). Insurance payments are triggered by total return going below an insured level. The level of insured return is calculated by multiplying the APH by the highest of the base price or harvest price and the percentage coverage. The payment is determined by subtracting the product of yield/acre times the harvest price from the insured income level.

For the 2000 cotton crop with an APH of 480 pounds/acre, the base price was 61 cents/pound, the harvest price was 44 cents/pound and the loan rate was 51.7 cents. The premium for 70 percent coverage was $17.28/acre. The minimum gross return would be $188 (336 pound x 61 cents - $17.28).

If production were 100 pounds/acre, the total return would be $196 (100 pound x 51.7 cents + $161 - $17.28); ($161 = (336 pound x 61 cents) - (100 pound x 44 cents)). Cotton production income is $52, and the income from insurance is $144 after the premium is subtracted.

It is more difficult to establish a probability for CRC. As price increases, the yield level that triggers an insurance payment declines. If 52 cents is used as the cash price, as it was for CAT and MPCI, then the insurance payment is triggered when yield goes below about 360 pounds/acre. Thus, at 52 cents/pound, there is an 84 percent chance that CRC at the 70 percent level will not be used. This implies that CRC policies will pay off about 16 percent of the time.

Coverage Comparison

Three important considerations when comparing crop insurance coverage options are minimum return, premium, and probability of using the insurance policy. The first two—minimum return and premium—are the most important. Table 1 shows a comparison of these two factors.

If the crop is a total loss, total return with self-insurance is zero, $78/acre with CAT, $184/acre with MPCI, and $188/acre with CRC (Figure 5-). CAT coverage starts when yield goes below 50 percent of APH (240 pound/acre in this example), 70 percent MPCI coverage starts when yields goes below 70 percent of APH (336 pounds/acre), and CRC coverage at 70 percent goes into effect when yield goes below 360 pounds/acre if the cotton price is 51.7 cents/pound. As the cotton price goes up, the effective yield coverage level with CRC declines.

Given this analysis, CRC provides the highest income support and has the highest probability of paying off. The probability of a payoff is only an estimate and will vary as yield variability changes. The higher the standard deviation (variability), the higher the probability of a payoff.

Crop Insurance and Marketing Alternatives

One problem with using some marketing alternatives before harvest is that production is unknown. It has been proposed that producers use crop insurance to establish a minimum yield and then use marketing tools to lock in a price.

There are two problems with this strategy. First, crop insurance may be used to insure only about 70 percent of average production (assuming expected production = actual production history). As shown in Figures 3, 4 and 5, 84 percent of the time production will be greater than 70 percent of the APH.

The second problem is that crop insurance does not insure a yield level. Crop insurance insures an income level. For the 2000 cotton crop, CAT set a minimum income at about $78, MPCI set a minimum income of about $184 and CRC set a minimum income level at about $188 per acre.

The reason crop insurance does not cover production is that the price level is set for each insurance policy. If the cash price at harvest is less than the insured price, yield coverage is greater than expected. If the cash price at harvest is greater than the insured price, the yield coverage insured is less than expected.

Figures 2 through 5. show that buying crop insurance sets a minimum total income level. Using forward contracts, hedges, puts, or other marketing alternatives before harvest does not set a minimum price for all production.

A minimum price may be set with marketing alternatives for production guaranteed by CAT or MPCI, but these insurance policies already have a minimum price set for the insured yield. The additional cost of puts or hedges appears to just add unnecessary expense.

These results are only applicable to the yields and prices used in this paper. Yields and prices change by farm. Each year new market, base, and harvest prices are established. Thus, a comparison of each insurance alternatives must be completed for each farm.

Table 1. Comparison of Self, Catastrophic, Multi-Peril, & Crop Revenue Coverage Insurance

Insurance	Total Return With Zero Yield (65% coverage)	Premium/Acre
Self	$ 0	$ 0
CAT	$78	$100/crop
Multi-Peril	$184	$14.02
CRC	$188	$17.28

Figure 1. Profit Function: No Insurance

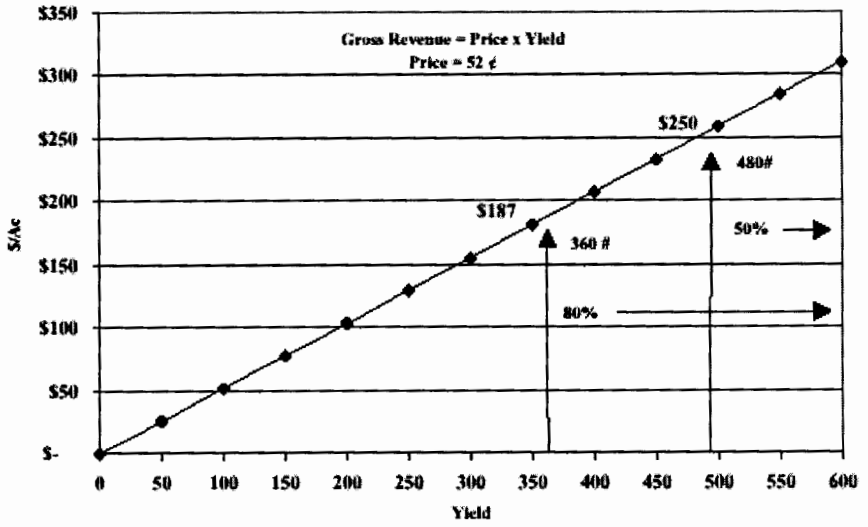


Figure 2. Payoff Function: Self Insured vs. Catastrophic Insurance

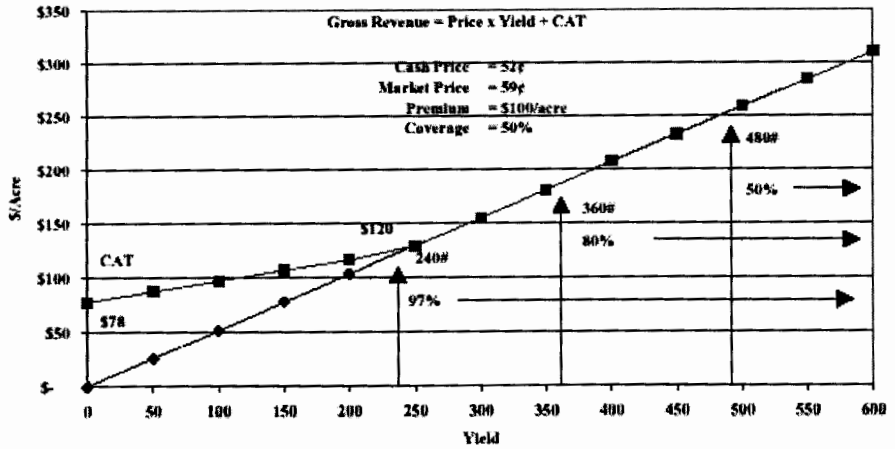


Figure 3. Payoff Function: Multi-Peril Crop Insurance

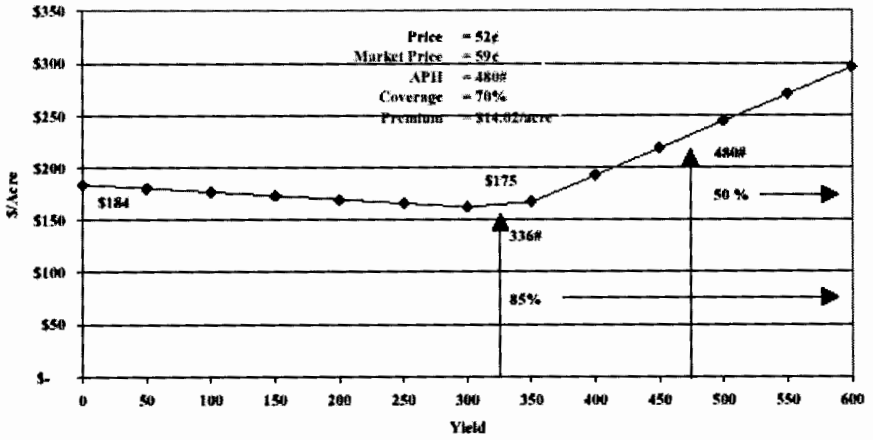


Figure 4. Payoff Function: Crop Revenue Coverage

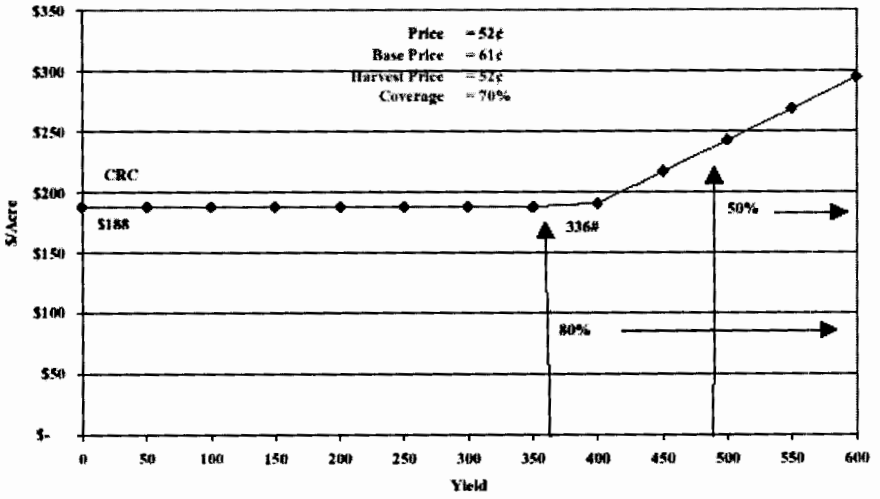
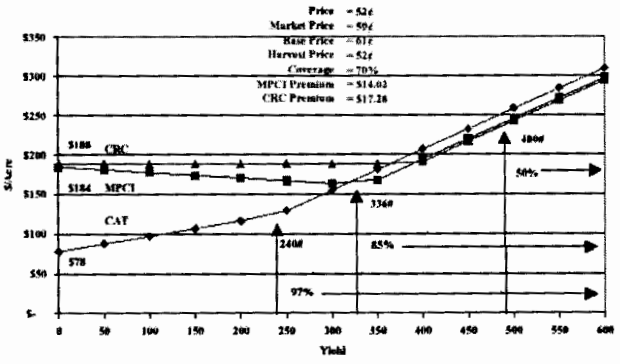


Figure 5. Payoff Function: Catastrophic, Multi-Peril & Crop Revenue Coverage



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