United States General Accounting Office

GAO

Report to the Ranking Minority Member, Committee on Agriculture, House of Representatives

April 1998

CROP REVENUE INSURANCE

Problems With New Plans Need to Be Addressed

GAO/RCED-98-111

GAO

United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

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April 29, 1998

The Honorable Charles W. Stenholm
Ranking Minority Member
Committee on Agriculture
House of Representatives

Dear Mr. Stenholm:

This report responds to your request that we study various issues pertaining to the U.S. Department of Agriculture's new crop revenue insurance plans. The report contains a recommendation to the Secretary of Agriculture to correct deficiencies in the methods used to establish premium rates for these plans.

We are sending copies of this report to appropriate House and Senate committees; interested Members of Congress; the Secretary of Agriculture; the Administrator of the Risk Management Agency; the Director, Office of Management and Budget; and other interested parties. We will also make copies available to others upon request.

If you or your staff have any questions, I can be reached on (202) 512-5138. Major contributors to this report are listed in appendix VII.

Sincerely yours,

Robert A. Robinson
Director, Food and
Agriculture Issues

Executive Summary

Purpose

Farming is an inherently risky enterprise. In conducting their operations, farmers are exposed to both production and price risks. Over the years, the federal government has played an active role in helping to mitigate the effects of these risks on farm income. A new tool, crop revenue insurance, has been introduced to help farmers manage their risks. Three federally subsidized crop revenue insurance plans—Crop Revenue Coverage, Revenue Assurance, and Income Protection—are now being sold to farmers in various parts of the country. The plans protect farmers from the effect of declines in either crop prices or yields by guaranteeing an agreed-upon level of revenue.

In light of the rapid expansion of the new crop revenue insurance plans and the government's significant financial participation in them, the Ranking Minority Member of the House Committee on Agriculture asked GAO to (1) identify the differences between the three new revenue insurance plans, (2) report on the plans' sales and claims experience, and (3) analyze the methodologies used to set the plans' premium rates.

Background

Farm production levels can vary significantly from year to year, primarily because farmers operate at the mercy of nature and frequently are subjected to weather-related and other natural disasters. Farmers can also experience wide swings in the prices they receive for the commodities they grow, depending on domestic and international production levels and demand.

Prior to 1996, the U.S. Department of Agriculture (USDA) administered programs known as deficiency payment programs for several major crops—wheat, feed grains, cotton, and rice. These programs protected farmers' income against declines in prices through a complicated array of pricing mechanisms. The government's role in agricultural production changed with the passage of the Federal Agriculture Improvement and Reform Act in 1996. Under the 1996 act, farmers are encouraged to produce in response to market forces, rather than to the expectation of federal payments. As part of this new direction in policy, the act replaced the income support programs with "production flexibility contracts"—agreements between the federal government and participating farmers that provide for fixed but declining 7-year annual payments that are not tied to market prices. USDA estimates that the production flexibility contracts will cost a total of $35.6 billion over the 7-year period.

Since the 1930s, federally subsidized multiple-peril crop insurance has been farmers' principal means of managing the risk associated with crop losses. The Federal Crop Insurance Corporation, a wholly owned government corporation under the management of USDA's Risk Management Agency, administers the federal crop insurance program. Between 1980 and 1998, USDA expanded the availability of crop insurance from 30 to 67 crops and from about one-half of the nation's counties to virtually all areas of the country. The federal government's crop insurance costs totaled about $8.9 billion from 1990 through 1997.

To manage the risk to their incomes resulting from price fluctuations, many farmers use crop insurance in combination with nongovernmental strategies such as forward contracting or hedging on national commodity exchanges. As an alternative to using crop insurance and forward contracting or hedging separately, new government-supported revenue insurance plans allow farmers to buy a single policy that protects against both production and price risks. Crop Revenue Coverage and Revenue Assurance were developed by private insurance companies that requested and received federal support for the plans, whereas the Federal Crop Insurance Corporation developed Income Protection. The new revenue insurance plans are also administered by the Federal Crop Insurance Corporation as part of its overall responsibility for the crop insurance program.

As it does for traditional multiple-peril crop insurance, USDA supports the revenue insurance plans by (1) subsidizing the premiums farmers pay, (2) paying private insurance companies to sell the insurance and process claims, and (3) agreeing to pay a large portion of any underwriting losses that occur if claims exceed premiums.

Results in Brief

The three government-subsidized revenue insurance plans differ in the revenue guarantees they provide to farmers and in their relative cost to the government. Two of the plans, Revenue Assurance and Income Protection, set the revenue level that is to be protected at the time that crops are being planted, while the third, Crop Revenue Coverage, determines the protected revenue at either planting or at harvest, depending on when crop prices are higher. In terms of potential government costs, Crop Revenue Coverage is likely to cost the government significantly more than the other two plans because of its higher reimbursements for administrative expenses and because of potentially higher total underwriting losses (the excess of claims payments over total premiums).

Furthermore, the plan's promise to base the revenue guarantee on the price at planting or the price at harvest, whichever is higher, exposes the government to higher claims payments in the years when widespread crop losses are coupled with rapidly increasing prices.

In their first 2 years of availability to farmers, the crop revenue insurance plans, especially Crop Revenue Coverage, achieved a significant share of the crop insurance market, accounting for about one-third of the total crop insurance sales in the areas where they were offered. In terms of the claims payments for 1997, all types of crop insurance experienced much lower than average levels of claims as a result of favorable growing conditions in most of the country. Moreover, primarily because revenue insurance plans were often marketed in lower-risk areas, they experienced lower levels of claims payments than did multiple-peril crop insurance.

GAO identified shortcomings in each revenue insurance plan's approach to establishing premium rates. Crop Revenue Coverage is especially problematic because its rate structure does not take into account the interrelationship between crop prices and yields—an essential component of actuarially sound rate setting. While good weather and stable crop prices generated very favorable claims experience over the first 2 years of the plans' availability, GAO has doubts about whether the rates established for each plan are actuarially sound over the long term and are appropriate to the risk each farmer presents. Furthermore, while the plans were initially approved on a limited basis only, the Federal Crop Insurance Corporation, acting within its authority, approved the substantial expansion of one of these plans—Crop Revenue Coverage—before initial results were available.

Principal Findings

Three Plans' Approaches to Insuring Revenue Result in Different Levels of Protection and Government Costs

For both Revenue Assurance and Income Protection, the farmer's revenue guarantee is established when crops are planted by multiplying the farmer's historical average production per acre by the prevailing futures market price. If the farmer's revenue at harvest is below the guaranteed level, the farmer receives an insurance payment. A farmer whose revenue is at or above the guaranteed level does not receive a payment. The farmer's total revenue is the determining factor; no payment would be made if a price decline is offset by an increase in production or a loss in

production is offset by an increase in prices. In contrast, the calculation of the amount of revenue guaranteed under Crop Revenue Coverage is more complicated. At planting, Crop Revenue Coverage guarantees a minimum revenue that is determined by multiplying the prevailing futures market price at planting by the farmer's historical production per acre. At harvest, the revenue guarantee calculation is revisited, and the final guarantee is determined by multiplying the farmer's historical production by the higher of the price at planting or the price at harvest. If the price has increased in the period between planting and harvest, the farmer receives a payment for any lost production at the higher harvest price. This upward price protection feature assures the farmer that any lost production will be replaced at the prevailing market price, thus facilitating forward contracting by the farmer. If, however, the harvest price is lower, and production was lost, the original guarantee is in force.

The revenue insurance plans also differ in several operational features. Although futures prices form the basis for all the revenue guarantees, the plans adjust these prices differently to account for variations between local and national prices. In addition, the methods used for establishing which fields will be covered for insurance purposes vary from plan to plan. Finally, only Crop Revenue Coverage is available in most areas of the country.

Crop Revenue Coverage is likely to be more costly to the government than multiple-peril crop insurance and the other revenue insurance plans because of its higher reimbursements for administrative expenses and higher potential underwriting losses. First, with respect to administrative expenses, the reimbursements for Crop Revenue Coverage are likely to be higher than those for multiple-peril crop insurance. This is because the premiums per acre are much higher and the administrative expense reimbursements are based on a percentage of these premiums. While the reimbursement rate paid by the Federal Crop Insurance Corporation is lower for Crop Revenue Coverage than the rate paid for multiple-peril crop insurance, it is not low enough to offset Crop Revenue Coverage's much higher premium levels. Second, with respect to underwriting losses, because both plans are expected to generate such losses at a fixed percentage of premiums paid over time, the higher volume of premiums for Crop Revenue Coverage is likely to result in higher losses than for multiple-peril crop insurance. Furthermore, the claims experience with Crop Revenue Coverage is likely to have a more exaggerated, or magnified, impact during any given year because of the plan's unique upward price protection feature. For example, if Crop Revenue Coverage

had been available for winter wheat in 1996, when widespread wheat losses were coupled with significant increases in commodity prices, the Federal Crop Insurance Corporation would have had to pay an additional 43 percent, or $172 million more, in claims than it actually paid under traditional multiple-peril crop insurance. However, part of the potential underwriting loss would have been offset by the higher premiums paid for this plan. Nevertheless, the government's exposure to loss would have been substantially increased. Alternatively, because the price increases that occurred in 1996 more than offset the average production loss, the provisions of Income Protection or Revenue Assurance would have resulted in claims payments that were about $200 million less than the claims actually paid under multiple-peril crop insurance.

New Insurance Plans Achieving Significant Share of Crop Insurance Market

Crop revenue insurance plans as a group had strong sales, obtaining a significant portion of the total crop insurance sales in 1997, the first year that all three plans were available. Crop Revenue Coverage, the most widely available of the three revenue insurance plans, took away a considerable amount of business from multiple-peril crop insurance—obtaining a 32-percent share of the market—in the areas where it was sold. In contrast, neither Revenue Assurance nor Income Protection attracted many purchasers—obtaining 6-percent and 3-percent shares, respectively—in the areas where they were sold.

All types of crop insurance experienced relatively low levels of claims in 1997. The crop insurance industry discusses the extent of losses in terms of the claims paid per premium dollar collected. For 1981 through 1996, traditional multiple-peril crop insurance paid an average of $1.26 in claims per $1 of premium. However, in 1997, because of relatively favorable growing conditions in the country overall, the crop insurance program experienced a much lower level of claims—$0.49 per $1 of premium. Moreover, the revenue insurance plans experienced even lower levels of claims payments than did multiple-peril crop insurance—ranging from $0.06 to $0.36 per $1 of premium. According to the Risk Management Agency, the lower claims experience could have occurred for several reasons, such as a concentration of sales in lower-risk areas, stable crop prices, or a combination of these and other factors.

Crop Revenue Coverage policies written in 1997 insured higher acreage levels and were associated with operations having lower production variability over time. Crop insurance research has shown that policies with these characteristics tend, on average, to have a lower incidence of claims

payments. This lower level of risk may have occurred because the initial marketing efforts were targeted to operators of larger farms in the most consistently productive areas. As such, the differences in risk may diminish over time as marketing expands into the general farming community. With respect to Income Protection and Revenue Assurance, GAO could not analyze their risk characteristics because of their small sales volume.

Approaches Used to Establish Premium Rates May Not Adequately Protect the Government From Financial Losses

GAO identified shortcomings in the way premium rates are established for each of the revenue insurance plans. Appropriate methods for setting rates for these plans are critical to ensuring the financial soundness of the crop insurance program over time. GAO found that the Crop Revenue Coverage plan does not base its rate structure upon the interrelationship between crop prices and farm-level yields—an essential component of actuarially sound rate setting. For example, a decline in yields is often accompanied by an increase in prices, which mitigates the impact of the decline in yields on a farmer's revenue. Because this plan does not recognize this interrelationship, the premium adjustments may not be sufficient over the long term to cover claims payments and may not be appropriate to the risk each farmer presents. GAO is not able to determine whether premium rates for this plan are too high or too low. In contrast, the rate-setting approaches for Revenue Assurance and Income Protection are based on a likely distribution of revenues that reflects the interrelationship between crop prices and yields. However, the plans have several shortcomings that are not as serious as the problem GAO identified for Crop Revenue Coverage. For example, in constructing its revenue distribution, Revenue Assurance uses only 10 years of yield data (1985-94), which is not a sufficient historical record to capture the fluctuations in yield over time. Furthermore, 3 of these 10 years had abnormal yields: 1988 and 1993 had abnormally low yields, and 1994 had abnormally high yields. Additionally, Income Protection bases its estimate of future price increases or decreases on the way that prices moved in the past. This approach could be a problem because price movements in the past occurred in the context of past government programs. In the absence of these government programs, the price movements may be considerably more pronounced. While favorable weather and stable crop prices generated very favorable claims experience over the first 2 years that the plans were available to farmers, these shortcomings raise questions about whether the rates established for each plan will be actuarially sound and are fair—that is, appropriate to the risk each farmer presents over the long term.

Furthermore, while the plans were initially approved only on a limited basis, the Federal Crop Insurance Corporation authorized the substantial expansion of Crop Revenue Coverage before the initial results of claims experience were available. In doing so, the Corporation was acting within its authority to approve privately developed crop insurance plans and in response to strong demand from farmers. USDA's Office of General Counsel advised against the expansion, noting that an expansion without any data to determine whether the plans or rates are sound might expose the Corporation to excessive risk. While Crop Revenue Coverage was expanded rapidly, Revenue Assurance and Income Protection essentially remain pilot plans with no nationwide availability.

Recommendation

To be more certain that the revenue insurance plans are actuarially sound over the long term and are appropriate to the risk each farmer presents, GAO recommends that the Secretary of Agriculture direct the Administrator of the Risk Management Agency to address the shortcomings in the methods used to set premiums. Specifically, with respect to all three plans, the Secretary should direct the Risk Management Agency to reevaluate the methods and data used to set premium rates to ensure that each plan is based on the most actuarially sound foundation. With respect to Crop Revenue Coverage, which does not incorporate the interrelationship between crop prices and farm-level yields, the Risk Management Agency should base premium rates on a revenue distribution or another appropriate statistical technique that recognizes this interrelationship.

Agency Comments and Our Evaluation

In commenting on a draft of this report, the U.S. Department of Agriculture expressed concern with GAO's recommendation that the agency reevaluate the data and methods used to set premiums for the three revenue insurance plans. Specifically, the Department noted that while it does not necessarily endorse or feel fully comfortable with all aspects of the rating models, it does not believe GAO's report provides evidence that there are "fatal flaws" in the rating methods for the revenue insurance plans. Therefore, the Department believes that the plans' continued use of these rating methods is appropriate.

GAO believes that its recommendation is appropriate. While GAO does not state in this report, nor does it believe, that the plans contain "fatal flaws," GAO does believe that the shortcomings identified in all three revenue insurance plans are serious enough to warrant a reevaluation of the methods and data used to set premium rates to ensure that each plan is

based on the most actuarially sound foundation. This is especially the case for Crop Revenue Coverage, which does not base its rate structure upon the interrelationship between crop prices and farm-level yields.

The Department also provided clarifying comments to the report that have been incorporated where appropriate. The Department's comments and GAO's responses are presented in detail in appendix VI.

Contents

Abbreviations

APH	actual production history
CRC	Crop Revenue Coverage
FCIC	Federal Crop Insurance Corporation
IP	Income Protection
MPCI	multiple-peril crop insurance
NASS	National Agricultural Statistics Service
RA	Revenue Assurance
USDA	U.S. Department of Agriculture

Introduction

Farming is inherently risky because farmers are exposed to both production and price risks. Farm production levels can vary significantly from year to year, primarily because farmers operate at the mercy of nature and frequently are subjected to weather-related and other natural disasters. Farm operators can also experience wide swings in the prices they receive for the commodities they grow, depending on total domestic and international production and demand.

Over the years, the federal government has played an active role in helping to mitigate the effects of risk on farm income. On the production side, the government has subsidized the federal multiple-peril crop insurance program, allowing covered farmers to receive an indemnity payment when production falls below a certain level. To help mitigate price risk, the government administered price and income support programs for farmers of major field crops such as wheat, feed grains, cotton, and rice. However, the Federal Agriculture Improvement and Reform Act of 1996, commonly known as the 1996 farm bill, terminated the previous income support programs and replaced them with fixed but declining 7-year annual payments. Because these payments are not tied to market prices, farmers now have to take greater responsibility for managing their risk.

To help farmers manage their risk, the U.S. Department of Agriculture (USDA), has introduced a new risk management tool, revenue insurance. Unlike the traditional multiple-peril crop insurance program, which insures against losses in the level of crop production, revenue insurance plans insure against losses in revenue. The plans protect the farmer from the effects of either declines in crop prices or declines in crop yields. The guarantees are based on market prices and on the historical yields associated with the insured acreage. As it does for traditional crop insurance, USDA shares in the cost of these plans by (1) subsidizing the premiums farmers pay, (2) paying private insurance companies to sell the insurance and process claims, and (3) paying a large portion of the plans' underwriting losses (the difference between premiums and claims).

Federally Subsidized Multiple-Peril Crop Insurance Protects Farmers From Production Losses

Since the 1930s, federally subsidized multiple-peril crop insurance has been a principal means of managing the risk associated with crop losses. The Federal Crop Insurance Corporation (FCIC) administers the crop insurance program.[1] Over time, this program has grown from covering a few crops and areas to covering most crops and areas. In addition, the Congress has periodically appropriated funds for disaster assistance to farmers when farming areas have suffered widespread crop losses because of weather conditions, such as drought or flooding.

Between 1980 and 1998, USDA expanded the availability of crop insurance from 30 to 67 crops and from about one-half of the nation's counties to virtually all areas of the country. Participation, measured in terms of the percent of eligible acres insured, rose from about 10 percent in 1980 to about 40 percent in the early 1990s. Under the Federal Crop Insurance Reform and Department of Agriculture Reorganization Act of 1994, the Congress required farmers wishing to participate in other USDA farm programs to purchase a minimum amount of crop insurance. This requirement helped increase participation to over 70 percent of eligible acres.

As the crop insurance program was expanded, federal costs (in constant 1997 dollars) averaged over $1.1 billion annually during the 1990s. As shown in table 1.1, the government's costs for crop insurance totaled about $8.9 billion from 1990 through 1997.

[1]FCIC is a wholly owned government corporation. It is governed by a board of directors composed of USDA officials, an insurance industry representative, and farming industry representatives. It is under the management of USDA's Risk Management Agency.

Table 1.1: Government's Cost of Federal Crop Insurance

Constant 1997 dollars in millions

Fiscal year	Claims paid in excess of premiums and other income	Premium subsidy	Administrative expense reimbursements	FCIC's operating costs	Government's total cost
1990	$279	$255	$325	$104	$963
1991	285	226	282	97	890
1992	261	221	277	99	858
1993	822	217	274	115	1,428
1994	(136)	264	312	83	524
1995	196	807	389	109	1,501
1996	90	996	499	65	1,650
1997 (estimated)	(373)	945	450	74	1,096
Total	**$1,423**	**$3,931**	**$2,808**	**$747**	**$8,909**

Note: Totals may not add because of rounding.

Source: USDA.

Several types of government costs are associated with the traditional crop insurance program. For every dollar of premium established, the government pays an average of 40 cents and the farmer pays 60 cents. The government's portion of the premiums totaled $3.9 billion from 1990 through 1997. In addition, for every dollar of premium, the government pays the participating insurance companies another 27 cents for the administrative costs of selling and servicing the policies.[2] These administrative expense reimbursements to the private insurance companies totaled $2.8 billion from 1990 through 1997. Furthermore, the government paid a portion of program losses (the difference between premiums and claims). Over the years, the established premiums have not been sufficient to pay the claims on the policies. Under the 1994 reform act, USDA is required to achieve a loss ratio of 1.10—that is, for every dollar in premiums taken in, the claims paid would be expected to average no more than $1.10.[3] For 1981 through 1996, the claims paid have averaged $1.26 per $1 of premium, but the increases in premium rates in recent years by the Risk Management Agency are now expected to lower the loss

[2]The reimbursement rate declined from 34 cents per $1 of premiums for 1988 through 1991, to 33 cents in 1992, 32.5 cents in 1993, 31 cents in 1994 through 1996, 29 cents in 1997, and 27 cents in 1998. In 1997, we reported that FCIC could further lower the reimbursement rate in the range of 24 cents per $1 of premiums and still adequately compensate participating companies for the reasonable costs associated with selling and servicing multiple-peril crop insurance. See Crop Insurance: Opportunities Exist to Reduce Government Costs for Private-Sector Delivery (GAO/RCED-97-70, Apr. 17, 1997).

[3]The target reduces to $1.075 per $1 of premium after Sept. 30, 1998.

ratio to about 1.10. Under the government's standard reinsurance agreements with the companies, the companies share a limited portion of any program losses, but the government absorbs the vast majority of them, totaling $1.4 billion over the period. Finally, the government paid $747 million for FCIC's own operating costs.

In 1993, we reported the high costs associated with crop insurance through the years, and we pointed out that the insurability problems faced by the program hindered its actuarial soundness.[4] Unlike insurers in other insurance industries, such as property and casualty, crop insurers cannot minimize their risk of loss by pooling participants with different levels of risk in their insurance program. In these other industries, the losses for one insured are independent of the losses for another insured. For the agriculture sector, however, losses are not generally independent of each other. For example, weather conditions, such as widespread drought, can cause production losses for many of the farmers in the same insurance pool.

Furthermore, as we pointed out in the 1993 report, the crop insurance program is subject to conditions known as adverse selection and moral hazard. Because FCIC does not have sufficient farm-level information to differentiate among farmers' risks, it may charge similar premiums to both high-risk and low-risk farmers. Consequently, high-risk farmers are more likely to find premiums attractive and therefore participate in the program in greater numbers than do low-risk farmers—a situation referred to as adverse selection. The report also noted that FCIC lacks sufficient information about individual farmers to detect moral hazard—when an insured farmer's actions increase the chance for or the extent of loss. For example, when insurance payments seem to offer a better financial return than marketing a partial crop, a farmer may reduce inputs, such as fertilizer or pesticides, thereby increasing the risk of a production loss.

Income and Price Support Programs Mitigated Price Risks

The federal government also used income and price support programs in an effort to protect farmers' incomes. Prior to 1996, USDA administered programs known as deficiency payment programs for several major crops—wheat, feed grains, cotton, and rice. These programs were designed to protect farmers' incomes against declines in prices through a complicated array of pricing mechanisms. In return for participating in these programs, farmers agreed to limits on the number of acres they

[4]Crop Insurance: Federal Program Faces Insurability and Design Problems (GAO/RCED-93-98, May 24, 1993).

placed into production. Unlike the deficiency payment programs, which were not reauthorized by the 1996 farm bill, a number of price support programs, such as the marketing loan program, are still in place. Marketing loan programs are designed, among other things, to help farmers in periods of severely low prices.

Under the 1996 farm act, farmers' were encouraged to produce in response to market forces alone, rather than to the expectation of federal payments. As part of this new direction in policy, the 1996 act replaced the previous income support programs with "production flexibility contracts"—agreements between the federal government and participating farmers that provide for fixed but declining 7-year annual payments through 2002. These annual payments are not tied to market prices. Farmers who signed these agreements are not restricted to the type or amount of any crop they plant. USDA estimates that the production flexibility contracts will cost a total of $35.6 billion over the 7-year period.

Other Ways Farmers Manage Risk of Price Fluctuation

Many farmers also use crop insurance in combination with nongovernmental strategies to manage the risk to their income resulting from price fluctuations. A common strategy is forward contracting. With this technique, farmers contract to sell the crop, well before it is actually harvested, and thus are able to establish a pre-harvest selling price and guarantee an outlet for the crop. Additionally, some farmers use hedging—a process whereby the farmer directly uses the commodity futures markets to establish a pre-harvest price for the crop. The farmers using these techniques to manage their price risk generally continue to use traditional multiple-peril crop insurance to manage the risk of crop loss.

New Federally Subsidized Crop Revenue Insurance Plans Protect Farmers From Both Price and Yield Declines

As an alternative to buying crop insurance and separately forward contracting or hedging, three new government-supported revenue insurance plans—Crop Revenue Coverage, Revenue Assurance, and Income Protection—provide farmers with a single policy that protects against both production and price risk. Crop Revenue Coverage and Revenue Assurance were developed by private insurance companies that requested and received federal reinsurance for the plans,[5] whereas FCIC developed Income Protection as a pilot project under the terms of the 1994

[5]Under reinsurance, FCIC agrees to subsidize the purchasers' premiums, pay the companies an administrative fee, and limit the amount of loss that the companies could suffer under the policies. Reinsurance for privately developed plans is authorized under the 1990 farm act. Crop Revenue Coverage was developed by Redland Insurance Company, and Revenue Assurance was developed by Farm Bureau Mutual Insurance Company. Once a new plan is approved for reinsurance, it may be sold by any participating company.

crop insurance reform act, which called for a risk protection plan based on the cost of production.

Income Protection and Revenue Assurance are similar in that each plan pays indemnities when the income from crop production is less than the revenue guaranteed at planting. Crop Revenue Coverage adds an additional dimension that allows the farmer to receive a larger payment if market prices have increased in the intervening period. For all three plans, market prices are tied to the futures prices on the commodity exchanges, such as the Chicago Board of Trade. Premiums for Crop Revenue Coverage are established as surcharges to the traditional multiple-peril crop insurance rates, whereas Income Protection and Revenue Assurance use methods to establish new rates that are independent of the traditional rate.

USDA shares in the cost of these new plans in a manner similar to the method used to support traditional multiple-peril crop insurance. First, just as with traditional multiple-peril crop insurance, USDA subsidizes the premiums farmers pay. The subsidy, which averages 40 percent of premiums for multiple-peril crop insurance, is limited, in the case of the new revenue plans, to the same dollar amount that would apply to the comparable multiple-peril insurance policy. Second, just as with traditional multiple-peril crop insurance, USDA pays private insurance companies a reimbursement for administrative expenses to sell the revenue insurance policies and process claims. This administrative reimbursement is a preestablished percentage of the premiums paid by the farmers. In 1998, USDA will pay the companies 27 percent of premiums to sell and service the multiple-peril, Income Protection, and Revenue Assurance policies. Because the premiums are significantly higher for Crop Revenue Coverage policies, USDA has limited the administrative payment on these policies to 23.25 percent of premiums. Finally, just as with multiple-peril crop insurance, USDA pays a large portion of any underwriting losses that may result if premiums are not high enough to pay all claims arising under the revenue policies. For 1998, USDA increased the portion of these losses that the companies must absorb, but the government continues to absorb most of the losses. Conversely, if underwriting gains occur—when premiums are higher than claims—the insurance companies and the federal government share in the gains.

Objectives, Scope, and Methodology

In light of the rapid expansion of, and the government's significant financial participation in, the new crop revenue plans, the Ranking

Minority Member of the House Committee on Agriculture asked us to (1) identify the differences between the three new revenue insurance plans, (2) report on the plans' sales and claims experience, and (3) analyze the methodologies used to set the plans' premium rates.

We identified the differences in the various revenue insurance plans by reviewing USDA's documentation for each plan as provided by the plans' developers and comparing the plans' features and protection levels. We confirmed our understanding of the various features of each plan by interviewing the Administrator of USDA's Risk Management Agency at USDA's headquarters in Washington, D.C., and the Senior Actuary at the Risk Management Agency's main field office in Kansas City, Missouri; and by interviewing the developers of the revenue plans at Kansas State University, Iowa State University, and Montana State University.

To determine the sales and claims experience of the three revenue insurance plans and traditional multiple-peril crop insurance, we obtained USDA's computer files for crop years 1996 and 1997—the first years in which revenue insurance policies were sold. We identified national sales and claims information for each plan and analyzed this information, controlling for the differences in availability because of location, crop, and level of protection. We also examined the characteristics of Crop Revenue Coverage policies by measuring average acres insured, variability of year-to-year crop yields, and average yields per insured policy unit and comparing this information with the characteristics of multiple-peril crop insurance policies. Because Income Protection's and Revenue Assurance's sales were limited, we could not analyze their risk characteristics.

To analyze the methods used to set premium rates and to identify uncertainties pertaining to premium rates, we reviewed academic literature on setting insurance rates and agricultural economics literature on crop revenue insurance and other issues such as the correlation between local crop yields and national prices. We also interviewed officials at USDA's Economic Research Service, Office of the Chief Economist, and Risk Management Agency; the academic consultants on the plans at Kansas State University, Iowa State University, and Montana State University; and agricultural economists at several other universities who have performed research on crop and/or revenue insurance issues. In order to examine each revenue insurance plan, we interviewed the developers of the plans and reviewed the documentation they had provided to USDA as well as additional information they provided to us. We also evaluated each plan in light of our economic analysis, our discussions

with the experts in these fields, and our review of the pertinent insurance and agricultural economics literature. We discussed our analysis with the developers of the plans and several independent reviewers.

We conducted our review from July 1997 through March 1998 in accordance with generally accepted government auditing standards. We used the same files USDA uses to manage the crop insurance program. These files provide the most comprehensive information on farmers who have purchased crop revenue insurance.

Three Plans' Approaches to Insuring Revenue Result in Different Levels of Protection and Government Costs

The three government-subsidized revenue insurance plans—Income Protection, Revenue Assurance, and Crop Revenue Coverage—differ in the revenue guarantees they provide to the farmer and in their relative cost to the government. Two of the plans, Income Protection and Revenue Assurance, set the revenue level that is to be protected at the time that crops are being planted, while the third, Crop Revenue Coverage, determines the protected revenue at either planting or at harvest, depending on when prevailing crop prices are higher. In terms of potential government costs, Crop Revenue Coverage is likely to cost the government significantly more than the other two plans over time.

Plans Differ in the Revenue Protection They Offer

The three government-subsidized revenue insurance plans—Income Protection, Revenue Assurance, and Crop Revenue Coverage—establish a revenue target, or guarantee, for farmers. But they differ in how that guarantee is determined.

For both Income Protection and Revenue Assurance, the farmer's revenue guarantee is established when crops are planted. To determine that guarantee, the insurer multiplies the farmer's expected production by a price established at planting. If the farmer's revenue at harvest is below that expected preseason income, the farmer receives an insurance payment. Farmers whose revenue is at or above the guaranteed level do not receive a payment. Total revenue from the crop is the determining characteristic, not the level of production or the price alone. No payment would be made if a price decline is sufficiently offset by an increase in production or if a loss in production is offset by a sufficient increase in price.

In contrast, the calculation of the amount of revenue guaranteed under Crop Revenue Coverage is more complicated. Crop Revenue Coverage guarantees a minimum revenue at planting that is determined by multiplying the prevailing futures market price at planting by the farmer's historical production per acre. At harvest, the revenue guarantee is revisited, and the final guarantee is determined by multiplying the farmer's historical production by the price at planting or at harvest, whichever price is higher. If the price has increased in the period between planting and harvest, the farmer receives a payment for any lost production at the higher harvest price. This upward price protection feature assures the farmer that any lost production will be replaced at the prevailing market price, thus facilitating forward contracting by the farmer. If, however, the

harvest price is lower, the original guarantee is in force. (For additional information on how the revenue payment is calculated, see app. I.)

Operational Features Are Somewhat Different in the Three Revenue Insurance Plans

The revenue insurance plans also differ in several operational features. Although futures prices form the basis for the payments under all three plans, the plans adjust these prices differently to account for variations between local and national prices. In addition, the methods used to establish which parcels of land will be covered for insurance purposes vary from plan to plan. Finally, only one of the plans is available across the country.

Price Used in Revenue Calculation Varies by Type of Insurance Plan

The insurance payment for all three plans is determined by subtracting the revenue realized at harvest from the revenue guarantee. The starting point for determining revenue is the futures prices for a particular commodity on its commodity exchange. However, each plan adjusts those prices somewhat differently. The differences center around how the national price prevailing on a commodity exchange is adjusted for local conditions. Generally, prices in local markets are a few cents per bushel less than the national price on the board of trade. These local differences are generally greater in the areas more distant from major market centers, and the differences decline nearer to the market centers. Income Protection and Crop Revenue Coverage do not adjust for this factor, while Revenue Assurance makes a county-by-county adjustment. Table 2.1 shows the revenue guarantee features of the three plans.

Table 2.1: Revenue Guarantee Features for Three Risk Management Plans, for Corn

Plan feature	Income Protection	Revenue Assurance	Crop Revenue Coverage
Revenue guarantee calculation	Historical production multiplied by 100% of the Chicago Board of Trade's February price for the December contract	Historical production multiplied by 100% of a projected county price (the Chicago Board of Trade's February price for the December contract, adjusted by a county factor)	Historical production multiplied by the higher of (1) 95% or 100% of Chicago Board of Trade's February price for December delivery or (2) 95% or 100% of the Chicago Board of Trade's price in November for the December contract
Actual harvest revenue calculation	Actual production multiplied by 100% of the November price for the December contract	Actual production multiplied by USDA's posted county price	Actual production multiplied by 95% or 100% of the November price of the December contract

Source: USDA.

As the table shows, Income Protection makes no adjustment for the difference in prices that occur from county to county. Instead, the plan uses one national price for all policies in all counties. For corn, the price used to determine the revenue guarantee for all policies is the Chicago Board of Trade's average corn futures price in February for the December contract. Similarly, Income Protection determines actual revenue for all policyholders by multiplying the farmer's actual production by the Chicago Board of Trade's corn futures average price in November for the December contract.

In contrast, Revenue Assurance determines the revenue guarantee for each farmer using the Chicago Board of Trade's February prices for the December corn contract, adjusted by a county-specific factor. Revenue Assurance establishes this adjustment on the basis of the historical relationship of local harvest prices in each county to the Chicago Board of Trade's prices in the harvest month. To determine the value of the harvested crop, Revenue Assurance departs from the Chicago Board of Trade's prices. Instead, it uses a price USDA establishes for other purposes in each county—referred to as the posted county price.

During 1996 and 1997, Crop Revenue Coverage calculated each farmer's revenue guarantee using the higher of (1) 95 percent of the average corn futures price on the Chicago Board of Trade in February for the December contract, or (2) 95 percent of the average corn price on the Chicago Board of Trade in November for the December contract. To determine the crop's harvested value, Crop Revenue Coverage used 95 percent of the average corn price on the Chicago Board of Trade in November for the December contract. For 1998, farmers may choose to insure at either 95 or 100 percent of the futures price.

Land Covered Varies by Plan

The three risk management plans differ in the choices they offer the farmer to combine the various individual fields on their farm or farms for insurance purposes. These differences in the way farmers can insure the land they farm are important because revenue payments differ depending on the actual configuration. Four land configuration arrangements are available to farmers: (1) whole farm (combining coverage on all fields for all combinations of covered crops in the county in which the farmer has a share in the crops produced); (2) enterprise unit (combining each of the fields in which the farmer owns or has a share of the crop produced in the county, regardless of ownership arrangement); (3) basic unit (combining each of the fields of a crop under a single type of ownership arrangement);

and (4) optional unit (essentially, insuring on a field-by-field basis). In general, the more a farmer's land is consolidated, the less likely it is that the farmer will have a loss large enough to trigger an insurance payment. This is because a farmer's production, for insurance purposes, is averaged across all the insured fields.

Income Protection is available only on the basis of the enterprise unit. In contrast, for Revenue Assurance, farmers can choose to configure their farm with any type of units. Initially, Revenue Assurance establishes the premium rate for those choosing the basic unit. If the farmer wants to further divide the basic unit into optional units, the policy imposes a surcharge. However, if the farmer elects to consolidate coverage on the basis of an enterprise unit, the policy offers a discount from the initial basic unit rate. The policy provides an additional discount for the farmer who chooses whole farm coverage. Finally, Crop Revenue Coverage allowed basic and optional coverage in 1996 and 1997 and received approval from FCIC to add enterprise coverage for 1998. In 1997, 61 percent of Crop Revenue Coverage policies were based on optional units.[1]

The Three Plans Vary in the Crops Covered and Areas of Availability

As table 2.2 shows, the three plans are not available for all crops in all areas, although Crop Revenue Coverage is rapidly expanding to cover more crops in more states. All three plans are relatively new, which accounts for their limited availability in some areas of the nation.

Table 2.2: Differences in Crops Covered and Areas of Availability for Three Risk Management Plans

Income Protection Plan	Revenue Assurance Plan	Crop Revenue Coverage Plan
1996: Corn farmers in 14 pilot counties, cotton farmers in 8 pilot counties, and spring wheat farmers in 7 pilot counties	1996: Not available	1996: Corn and soybean farmers in Iowa and Nebraska
1997: Continued 1996 coverage and added farmers of grain sorghum in 25 counties, soybeans in 56 counties, and winter wheat in 18 counties	1997: Corn and soybean farmers in Iowa 1998: No change	1997: Continued 1996 coverage and added corn farmers in 11 more states, wheat farmers in 8 states, cotton farmers in 4 states, grain sorghum farmers in 6 states, and soybean farmers in 10 additional states
1998: Continued 1996 and 1997 coverage and added winter wheat farmers in 12 additional counties		1998: Continued 1996 and 1997 coverage and added wheat farmers in 25 additional states, soybean farmers in 12 additional states, and cotton farmers in 13 additional states

Source: USDA.

[1]In comparison, 54 percent of multiple-peril policies were based on this configuration.

Crop Revenue Coverage, since its introduction in 1996, has rapidly expanded to all major crops in the major growing areas. Income Protection, developed by USDA in 1996, has been expanded slightly but is only available in scattered counties covering certain crops around the nation. Finally, Revenue Assurance, which became available in 1997, only covers corn and soybeans in Iowa.

Hypothetical Example of How Different Crop Insurance Plans Would Cover Different Production and Price Situations

To illustrate the differences between traditional multiple-peril crop insurance and the three revenue insurance plans, we examined the premiums and insurance claim payments for a hypothetical Iowa corn farmer. For this illustration, we assumed the farmer purchased crop insurance at the 75-percent coverage level and established a record of normal production of 120 bushels per acre. We also used 1997 prices under various combinations of 30-percent price and production increases and declines. Of course, payment amounts at other combinations of production and prices would be different. As shown in table 2.3, premiums for Crop Revenue Coverage would be higher than for traditional multiple-peril crop insurance because Crop Revenue Coverage provides additional benefits. In contrast, for this example, premiums for Income Protection and Revenue Assurance would be lower than for traditional crop insurance. The table also shows that, in the event of normal production combined with 30-percent decline in prices, no payment would be due under the traditional multiple-peril crop insurance policy, but each of the revenue policies would provide payments. In the event of 30-percent declines in both production and price, each type of policy would pay, but the amounts paid would vary. However, in the event of a 30-percent decline in production combined with a 30-percent increase in price, the traditional policy and Crop Revenue Coverage would result in claims payments, but no claim payment would result under the terms of Income Protection and Revenue Assurance.

Table 2.3: Hypothetical Illustration of Insurance Premium and Insurance Claim Payment Per Acre for a Corn Farmer at Different Levels of Production and Prices

	Multiple-peril crop insurance	Crop Revenue Coverage	Income Protection	Revenue Assurance
Premiums	$11.20	$16.50	$5.90	$8.40
Payments				
Normal production and 30% price increase	0	0	0	0
Normal production with 30% price decline	0	15.90	16.50	13.80
Production decrease by 30% with 30% price decline[a]	14.70	81.06	85.26	73.92
Production decrease by 30% with 30% price increase	14.70	20.22	0	0

[a]This situation is unlikely to occur in the aggregate, but it may occur for individual farmers.

Source: GAO's analysis of USDA's data.

Appendix I describes how the premiums and payments shown in table 2.3 were calculated.

Crop Revenue Coverage Is Likely to Cost the Government Significantly More Than Other Plans

Crop Revenue Coverage is likely to be more costly to the government than the other insurance plans because of its higher reimbursements for administrative expenses to participating companies and because of potentially higher total underwriting losses (the excess of claims payments over total premiums). Furthermore, the plan's promise to base the revenue guarantee on the price at planting or at harvest, whichever is higher, exposes the government to higher claims payments in years when widespread crop losses are coupled with rapidly increased prices.

Administrative Costs Are Likely to Be Higher for Crop Revenue Coverage Than for Other Plans

The government pays insurance companies a smaller fee per premium dollar to sell and service Crop Revenue Coverage than the other revenue plans or multiple-peril crop insurance. However, the total cost of administrative reimbursements for Crop Revenue Coverage is greater because the reimbursement rate is not low enough to offset the much higher premiums under this plan. That is, the government reimburses the

companies at a rate of 23.25 cents for every dollar of premium sold, which is less than the rate of 27 cents per dollar of premium for the other plans; but because Crop Revenue Coverage's premiums per acre average about 30-percent higher than the premiums for the other crop insurance plans, the effective cost to the government is actually higher for Crop Revenue Coverage than for the other insurance plans.

For example, for insurance sales that generate $1 million of premiums, the government's costs for reimbursing administrative expenses under Income Protection and Revenue Assurance is $270,000 (27 percent in administrative costs multiplied by $1 million in premiums). In contrast, the government's equivalent cost for Crop Revenue Coverage for the same number of insured acres is $302,250 (23.25 percent in administrative costs multiplied by the higher premiums—$1.3 million), an increase of $32,250.

Assuming Crop Revenue Coverage premiums of $300 million for crop year 1998,[2] the government's administrative reimbursement cost for this plan will be over $7 million higher than for either of the other two revenue insurance plans or traditional multiple-peril crop insurance. The participating companies receive higher reimbursements but also incur some additional expenses, including higher processing and training costs, and higher loss adjustment costs in the years when Crop Revenue Coverage makes payments while multiple-peril crop insurance does not.

Total Losses Are Likely to Be Higher

Crop Revenue Coverage's higher volume of premiums also results in higher costs to the government than multiple-peril crop insurance, given equal levels of underwriting losses. Under current law, both multiple-peril crop insurance and the new revenue insurance plans are expected to operate over time with an underwriting loss of $1.10 paid in claims for every $1 in premium. In other words, the government expects, over time, to pay claims averaging $1.10 for every $1 in premium. Therefore, by applying the same loss rate to Crop Revenue Coverage's larger volume of premiums, the absolute dollar value of the loss will be higher.

Exposure to High Payouts in a Single Year Are More Likely

In addition to generating potentially higher total losses, the claims experience with Crop Revenue Coverage is likely to have a more exaggerated, or magnified, impact during any given year because of the plan's unique upward price protection feature. This feature, which gives the farmer an increased revenue guarantee when market prices rise

[2]In 1997, Crop Revenue Coverage premiums totaled $281 million.

between the time the farmer plants and harvests the crop, significantly raises the government's exposure to large claims payments in years when widespread crop losses are coupled with rapidly increased prices. The two other plans reduce the government's exposure during such years.

For example, in 1996, adverse weather conditions destroyed winter wheat in sections of the Great Plains and Midwest, contributing to an increase in prices from $3.65 a bushel at planting to $5.47 per bushel at harvest. If Crop Revenue Coverage had been available for winter wheat in 1996, FCIC would have had to pay an additional 43 percent, or $172 million more, in claims than it actually paid under traditional multiple-peril crop insurance. As shown in table 2.4, assuming Crop Revenue Coverage had been available and protected 50 percent of the acres insured in 1996, FCIC would have paid an estimated $569.8 million in wheat claims instead of the $397.7 million it actually paid. Alternatively, because the price increase that occurred in 1996 more than offset the average production loss, the provisions of the Income Protection or Revenue Assurance plans would have resulted in claims payments that were much less than those actually paid under multiple-peril crop insurance—an estimated $198.8 million.

Table 2.4: Estimated Winter Wheat Claims Payments Assuming Crop Revenue Coverage, Income Protection, or Revenue Assurance on 50 Percent of Acres Insured, 1996

Dollars in millions

State	Actual claims payments under traditional multiple-peril crop insurance	Estimated claims payments under Crop Revenue Coverage[a]	Estimated claims payments under Income Protection or Revenue Assurance[a]
Kansas	$137.6	$200.5	$68.8
Oklahoma	59.8	84.1	29.9
Texas	48.8	69.2	24.4
Colorado	26.9	38.6	13.4
Illinois	20.5	32.9	10.3
South Dakota	18.7	24.1	9.3
Nebraska	14.4	19.0	7.2
All other states	71.0	101.4	35.5
Total	**$397.7**	**$569.8**	**$198.8**

Note: This analysis may reflect some spring wheat losses because the records in USDA's databases do not always distinguish between the types of wheat that were insured.

[a]Assumes revenue insurance protection on 50 percent of the acres insured and traditional multiple-peril crop insurance on the other 50 percent. This is a hypothetical example: The plans were not available for this crop in these states.

Source: GAO's analysis of USDA's data.

This example involves one crop. Widespread droughts often affect a number of crops, in which case the government's financial exposure under Crop Revenue Coverage would increase more. However, part of the potential underwriting loss for Crop Revenue Coverage is reduced by the increased premiums in effect. Additionally, under reinsurance agreements, underwriting losses are borne in part by the participating companies, but the majority of the losses are paid by USDA. Furthermore, during years with favorable claims experience, Crop Revenue Coverage would generate higher underwriting gains than either multiple-peril crop insurance or the other two revenue insurance plans.

New Insurance Plans Achieving Significant Share of Crop Insurance Market

In their first 2 years, the crop revenue insurance plans, especially Crop Revenue Coverage, have already achieved a significant share of the crop insurance market, accounting for about one-third of crop insurance premiums in the areas where they were offered. In the initial years, the new plans' claims payment experience was similar to the experience of traditional multiple-peril crop insurance.

With respect to the characteristics of the farming operations covered by the plans, Crop Revenue Coverage policies written in 1997 insured higher acreage levels and were associated with operations having lower production variability, over time, than traditional multiple-peril crop insurance. Therefore, the Crop Revenue Coverage policies, on average, appear to be less risky. This lower level of risk may have occurred because initial marketing efforts were targeted to larger farmers in the most consistently productive farm areas. As such, the differences in risk may diminish over time as the marketing expands into the general farming community.

Crop Revenue Insurance Sales Strong in 1997, While Claims Were Low

Crop revenue insurance plans, as a group, had strong sales, claiming a significant portion of crop insurance sales in 1997, the first year that all three plans were available. Crop Revenue Coverage, the most widely available of the three revenue insurance plans, took away a considerable amount of business from multiple-peril crop insurance—obtaining a 32-percent share of the market—in the areas where it was sold. In contrast, neither Revenue Assurance nor Income Protection were able to attract many purchasers—obtaining 6-percent and 3-percent shares, respectively—in the areas where they were sold.

Crop Revenue Coverage Captured About One-Third of Market Where Available

By its second year, Crop Revenue Coverage had captured a significant portion of the crop insurance business from traditional multiple-peril crop insurance in areas where both were available. As shown in table 3.1, Crop Revenue Coverage in 1997 accounted for 32 percent of the premiums, 29 percent of the acres insured, and 25 percent of the policies in the areas where it was sold. According to a senior Risk Management Agency official, this plan has attracted many purchasers in part because the premiums for the plan, on a cost-per-acre basis, were relatively low in the areas where the plan was introduced, and in these locations, the premiums appeared reasonable for the potential additional benefits they provide.

Table 3.1: Market Share of Crop Revenue Coverage and Multiple-Peril Crop Insurance Where Both Plans Were Offered, 1997

	Measures of market share		
Insurance plan	Percent of total premiums	Percent of insured acres	Percent of policies
Crop Revenue Coverage	32	29	25
Multiple-peril crop insurance	68	71	75

Source: GAO's analysis of USDA's data.

Income Protection Has Not Captured Significant Market Share

In the counties where Income Protection is available for purchase, few farmers have opted to buy it. As shown in table 3.2, Income Protection obtained from 3 to 5 percent of the total crop insurance market, depending on the measure used. In the 41 counties where both Income Protection and Crop Revenue Coverage were offered in 1997, the sales achieved by Income Protection appear to come at the expense of Crop Revenue Coverage rather than multiple-peril crop insurance.

Table 3.2: Market Share of Revenue Insurance Plans Where Income Protection Was Offered, 1997

	Measures of market share		
Insurance plan	Percent of total premium	Percent of insured acres	Percent of policies
Income Protection	3	4	5
Crop Revenue Coverage	25	22	18
Multiple-peril crop insurance	72	74	76

Source: GAO's analysis of USDA's data.

Revenue Assurance Has Not Captured Large Market Share in Iowa

In the one state where it was sold—Iowa—Revenue Assurance met with only moderate success. For crop year 1997, Iowa was the only state where farmers were able to choose between traditional multiple-peril crop insurance and all three revenue insurance plans. As shown in table 3.3., in terms of total premiums, Revenue Assurance achieved a 6-percent share of the Iowa corn insurance market and an 8-percent share of the Iowa soybean insurance market. In contrast, Crop Revenue Coverage achieved higher market penetration in Iowa—52 percent of the corn and 49 percent of the soybean market—than it did nationally. Income

Protection—available in six counties in Iowa—achieved less than 1 percent of the sales for both corn and soybeans.

Table 3.3: Market Share of Revenue Insurance Plans, Iowa, 1997

	Measures of market share		
Crop and insurance plan	**Percent of total premiums**	**Percent of insured acres**	**Percent of policies**
Corn			
Revenue Assurance	6	9	7
Income Protection	0[a]	0[a]	0[a]
Crop Revenue Coverage	52	41	37
Multiple-peril crop insurance	42	50	55
Soybeans			
Revenue Assurance	8	9	7
Income Protection	0[a]	0[a]	0[a]
Crop Revenue Coverage	49	40	35
Multiple-peril crop insurance	43	52	58

[a]Rounds to less than 1 percent.

Source: GAO's analysis of USDA's data.

Multiple-Peril Crop Insurance and Revenue Insurance Plans Had Relatively Low Levels of Claims in 1997

All types of crop insurance had relatively low levels of claims in 1997. The crop insurance industry discusses the extent of losses in terms of the claims paid per premium dollar collected. For 1981 through 1996, traditional multiple-peril crop insurance paid an average of $1.26 in claims per $1 of premium (including the government's subsidy). However, in 1997, because of the relatively favorable growing conditions in the nation, the crop insurance program had a much lower level of claims—$0.49 per $1 of premium. Moreover, the revenue insurance plans had lower levels of claims payments than did multiple-peril crop insurance—ranging from $0.06 to $0.36 per $1 of premium, as shown in table 3.4. According to the Risk Management Agency, the lower claims experience could have occurred for several reasons, such as a concentration of sales in lower-risk areas, stable crop prices, and/or a combination of these and other factors.

Table 3.4: Claims Experience by Insurance Plan, 1997

Dollars in millions

Insurance plan	Total premiums	Claims payments	Claims per $1 of premium
Multiple-peril crop insurance	$1,331.1	$689.9	$0.52
Crop Revenue Coverage	280.7	100.4	0.36
Income Protection	2.7	0.6	0.23
Revenue Assurance	8.1	0.5	0.06
Total	**$1,622.5**	**$791.4**	**$0.49**

Source: USDA.

The generally low level of claims experienced for the revenue insurance plans also may be attributed in part to the fact that the new insurance products were generally purchased by larger, slightly lower-risk farmers. See appendix II for detailed sales and claims data by state and insurance plan.

Crop Revenue Coverage Policies Insured More Acres and Had Lower Risk Characteristics Than Traditional Crop Insurance

Crop Revenue Coverage policies written in 1997 insured a higher number of acres and were associated with operations having lower production variability over time, thus appearing to be less risky, on average, than traditional multiple-peril crop insurance. Crop insurance research has shown that policies with these characteristics tend, on average, to have a lower incidence of claims payments. The differences between Crop Revenue Coverage and traditional multiple-peril crop insurance may have occurred because initial marketing efforts were targeted to larger farmers in the most consistently productive farm areas. As such, the differences may diminish over time as marketing expands into the general farming community. While the two plans differ in these respects, we found that they were similar in other respects, such as the average yield per acre. Because Income Protection's and Revenue Assurance's sales were limited, we could not analyze their risk characteristics.

Crop Revenue Coverage Insured Higher-Than-Average Acreage Levels

In 1997, Crop Revenue Coverage insured more acres, on average, than did traditional multiple-peril crop insurance. Specifically, the policies for traditional multiple-peril crop insurance, insured, on average, about 132 acres per policy in 1997,[1] while Crop Revenue Coverage policies insured

[1]Generally, a farmer has one policy for each crop insured. Thus, a farmer who insures both corn and soybeans would have two policies.

about 160 acres, or 21 percent more. According to a senior Risk Management Agency official, these differences may have occurred because crop insurance agents' initial marketing efforts may have targeted larger farming operations, and this difference may decline over time as marketing expands into the general farming community.

Crop Revenue Coverage Policies Insured Operations With Lower Production Variability

In 1997, Crop Revenue Coverage policies insured farming operations with slightly less variation in their production history over time, on average, than traditional crop insurance. Specifically, these policies had an average variation of 22 percent, compared with an average variation of 25 percent for traditional multiple-peril crop insurance. These percentages represent the average deviation of each insured unit's actual yield per acre each year from the unit's average yield over the period for which production history was provided. As we noted in 1993, farmers having a high variation in their production are more likely to experience a loss than farmers having low variation in their production and, thus, are riskier to insure.[2] With a variation in production that is 3 percentage points lower, the holders of Crop Revenue Coverage policies are less likely to experience a loss.

Crop Revenue Coverage and Traditional Multiple-Peril Crop Insurance Share Some Characteristics Associated With Risk

While Crop Revenue Coverage and traditional multiple-peril crop insurance differ in some respects, they are similar in others. For example, multiple-peril crop insurance and Crop Revenue Coverage policies generally were based on similar years of production history provided by the policyholders—an average of 7.3 years for insured units under multiple-peril insurance compared with 7.4 years under Crop Revenue Coverage. Similarly, multiple-peril crop insurance policies and Crop Revenue Coverage policies had levels of insured production per acre that exceeded the average yield for all farmers in the particular county by about the same percentage. The multiple-peril crop insurance policy units insured yields per bushel that were 115 percent of the average yield per bushel for all farmers in the particular county, while Crop Revenue Coverage policy units had insured yields that were 116 percent of their county's average yield per bushel.

[2]Crop Insurance: Federal Program Faces Insurability and Design Problems (GAO/RCED-93-98, May 24, 1993).

Approaches Used to Establish Premium Rates May Not Adequately Protect the Government From Financial Losses

We identified shortcomings in the way premium rates are established for each of the revenue insurance plans. While favorable weather and stable crop prices generated a very favorable claims experience over the first 2 years that the plans were available to farmers, these shortcomings raise questions about whether the rates established for each plan are actuarially sound over the long term and are appropriate to the risk each farmer presents. Furthermore, while the plans were initially approved on a limited basis only, FCIC approved the substantial expansion of one of these plans—Crop Revenue Coverage—before the initial results of claims experience were available. Since this initial expansion, FCIC has made and proposed a number of changes to provide safeguards in its process for approving new plans.

Problems With Methods Used to Establish Premiums

According to insurance principles, insurance companies need information on likely future losses in order to establish premium rates that would cover those losses. For crop revenue insurance, reliably projecting future losses requires an accurate depiction of the revenues that insured farmers are likely to generate. Premium rates can then be established on the basis of the probability that actual revenues will diverge from insured revenues in a given year. Such a depiction of revenues for farmers as a whole is commonly referred to as a revenue distribution.

Data on individual farmers' actual revenues are not available. However, a reasonable approximation of these revenues can be obtained by multiplying a farmer's yields by crop prices. In this way, a simulated revenue distribution can be developed that provides a reasonable basis for establishing premium rates.

Crop Revenue Coverage is problematic because it uses neither a revenue distribution nor another appropriate statistical technique that takes into account the relationship between prices and yields as a basis for estimating premiums and future claims payments. Instead, rate setting for this plan begins with the premium rate structure for traditional multiple-peril crop insurance and increases rates by introducing an additional charge to cover the risk of a price increase and another charge to cover the risk of revenue that is less than the guarantee. By not recognizing the interrelationship between prices and yields, the premium adjustments may not be actuarially sound over the long term or appropriate to the risk each farmer presents. Thus, we are not able to determine whether premium rates for this plan are too high or too low.

In contrast, the rate-setting approaches for Revenue Assurance and Income Protection are much less problematic because they are based on revenue distributions, although they use different approaches to develop these distributions. We also identified several shortcomings in these two plans. However, these shortcomings are less serious than Crop Revenue Coverage's lack of a revenue distribution or other statistical technique that takes into account the interrelationship between prices and yields.

Revenue Assurance has shortcomings in two respects. First, in constructing its revenue distribution, the plan uses only 10 years of yield data (1985-94), which is not a sufficient historical record to capture the fluctuations in yield over time. Furthermore, 3 of the 10 years had abnormal yields: 1988 and 1993 had abnormally low yields, and 1994 had abnormally high yields. Second, Revenue Assurance assumes that the interrelationship between crop prices and yields is the same in all production areas. This is not the case. That is, the link between yield declines and price increases or yield increases and price declines is much stronger in some areas than others. By using the same estimate of the interrelationship for all areas, the resulting estimate of claims may be too high in some areas and too low in others. As a result, there is no assurance that the plan's premiums are appropriate for all farmers and will actually cover all claims over time.

With respect to Income Protection, the plan's major shortcoming is that it bases its estimate of future price increases or decreases on the way that prices moved in the past.[1] This method of developing estimates could be a problem because past price movements occurred in the context of past government programs, and in the absence of the government programs, the price movements may be considerably more pronounced, according to some analysts. Instead, price volatility estimates based on commodity futures prices are more appropriate for forecasting expected claims payments because they reflect current expectations of the extent to which prices may increase or decrease between planting and harvest.

The methods used in the three plans to set premium rates are described and evaluated in greater detail in appendixes III, IV, and V.

[1]This shortcoming applies to Crop Revenue Coverage as well.

FCIC Expanded Crop Revenue Coverage Plan Before Initial Results Were Available

Crop Revenue Coverage was initially approved for sale in December 1995 for two crops—corn and soybeans—in two states—Iowa and Nebraska. Given FCIC's lack of experience with revenue insurance and the uncertainty surrounding the soundness of the premiums charged, restricting the initial sales to a limited area was prudent. However, in July 1996, 7 months after it initially approved Crop Revenue Coverage and, before it knew the claims experience in these areas, FCIC's board of directors approved the expansion of Crop Revenue Coverage to include wheat farmers in Kansas, Michigan, Nebraska, South Dakota, Texas, Washington State, and 19 counties in Montana. This expansion occurred under the board's authority to approve privately developed insurance products. The board required that the companies add a 10-percent surcharge, referred to as a catastrophic load factor, to the rates initially established. This surcharge was not based on the initial experiences in the original states but was a judgmental adjustment added in response to the concerns about the adequacy of premium rates expressed by USDA and university economists.

In January 1997, the board, acting again within its authority, expanded Crop Revenue Coverage to essentially cover all major crops in the major states where the crops are grown. It was clear at this time that Crop Revenue Coverage was more popular than had been initially expected. National producer organizations expressed strong interest in expanding the program to additional geographical areas and to additional crops. The board expanded Crop Revenue Coverage, although it was cautioned by USDA officials, USDA's Office of General Counsel, and USDA's Office of Inspector General about problems with the continued expansion of the plan. Specifically, the Administrator for the Risk Management Agency informed the board that no underwriting experience was available to evaluate Crop Revenue Coverage. He also noted that the amount of liability under the plan can increase between planting and harvest, thereby increasing crop insurance liability in a loss situation and potentially having a major impact on FCIC's overall loss ratio. However, the Administrator also pointed out that an expanded program would have the advantage of giving farmers in most states an additional risk management tool. Furthermore, USDA's Office of General Counsel advised the board to reject expansion because widespread expansion might expose FCIC to excessive risk in the absence of any data that could be used to determine whether the rates were actuarially appropriate. Finally, USDA's Office of Inspector General cautioned FCIC several times that expansion was occurring without adequate controls in place.

Income Protection and Revenue Assurance have not been significantly expanded since their introduction.

FCIC Has Initiated a Number of Changes to Better Safeguard the Government's Interest

To avoid problems with the introduction of future revenue insurance plans, USDA is developing new regulations that would require any new plan to undergo a preapproval review before it could be sold nationwide that is much more rigorous than the review undertaken for Crop Revenue Coverage, Revenue Assurance, and Income Protection. The draft regulations require that a company proposing a new plan include a detailed description of the rating method used, simulations of the performance of the premiums under various scenarios, and the results of a review by a peer review panel or accredited actuary. The regulations also require that the requester provide detailed information concerning plans for future expansion of the plan.

Additionally, FCIC has made changes to the gain- and loss-sharing portions of the reinsurance arrangements with the companies that better protect the government's interest with respect to the revenue insurance plans. For 1998, FCIC decreased the companies' share of underwriting gains and increased the companies' share of underwriting losses.

Conclusions and Recommendation

Conclusions

With the government's phasing out of income support for farmers, risk management tools are increasingly important. Of the available risk management tools, farmers are increasingly turning to the revenue insurance plans. Accordingly, it is important that the premium structures for the revenue policies be set in a fashion that will be appropriate to the risk each farmer presents and will protect the government from undue exposure to loss. Despite very positive early underwriting experiences, our analysis indicates that the premium structures for the three revenue insurance plans have weaknesses in their underlying assumptions and methods that could result in their being actuarially unsound. Crop Revenue Coverage, the plan that has become the most popular, is the most problematic. While we identified some problems in the methods used to set premiums for all three plans, we found the most serious deficiencies in Crop Revenue Coverage, which did not base its rates on a revenue distribution or other appropriate statistical technique that takes into account the interrelationship between crop prices and yields.

Apart from its rate-setting deficiencies, Crop Revenue Coverage is also more costly to the government than the other plans. Because Crop Revenue Coverage's premiums are higher, the federal government pays higher reimbursement costs for administrative expenses and has higher underwriting losses over time.

Recommendation to the Secretary of Agriculture

To be more certain that the revenue insurance plans are actuarially sound over the long term and are appropriate to the risk each farmer presents, we recommend that the Secretary of Agriculture direct the Administrator of the Risk Management Agency to address the shortcomings in the methods used to set premiums. Specifically, with respect to all three plans, the Secretary should direct the Risk Management Agency to reevaluate the methods and data used to set premium rates to ensure that each is based on the most actuarially sound foundation. With respect to Crop Revenue Coverage, the Risk Management Agency should base premium rates on a revenue distribution or another appropriate statistical technique that recognizes the interrelationship between farm-level yields and expected prices.

Agency Comments and Our Evaluation

In commenting on a draft of this report, USDA expressed concern with our recommendation that it reevaluate the data and methods used to set premiums for the three revenue insurance plans. Specifically, USDA noted that while it does not necessarily endorse or feel fully comfortable with all

aspects of the rating models, the agency does not believe our report provides evidence that there are "fatal flaws" in the plans' rating methods. Therefore, the Department believes that the plans' continued use of these rating methods is appropriate.

We disagree. While we do not state in this report, nor do we believe, that the plans contain "fatal flaws," we believe that the shortcomings we identified in all three revenue insurance plans are serious enough to warrant a reevaluation of the methods and data used to set premium rates to ensure that each plan is based on the most actuarially sound foundation. This is especially the case for Crop Revenue Coverage, which does not base its rate structure upon a distribution of likely revenues from farming operations. Without a distribution of likely revenues or other appropriate statistical technique, the plan does not take into account the interrelationship between crop prices and yields, and many crop insurance experts agree that such an interrelationship must be considered. Thus, we stand by our recommendation that the Risk Management Agency needs to address the shortcomings in the rating methods.

USDA also provided clarifying comments to the report that have been incorporated where appropriate. USDA's comments and our responses are presented in detail in appendix VI.

Methodology Used to Estimate Premiums and Claims Payments to Farmers

This appendix explains the methodology we used to calculate the premiums and payments for a hypothetical Iowa farmer under multiple-peril crop insurance, Crop Revenue Coverage, Income Protection, and Revenue Assurance. We assumed that the farmer would plant nonirrigated corn, have a production history of 120 bushels per acre, and would choose to buy insurance at the 75-percent coverage level. This farmer is located in Adair County, Iowa—a county in which all three revenue insurance policies were available in 1997. The prices used in the example are those that were established by the Federal Crop Insurance Corporation (FCIC) for each plan for 1997. The examples of claims payments assume various combinations of 30-percent increases and decreases in prices and production levels. We chose these percentages to illustrate the operation of the various insurance plans. Other combinations of changes in prices and/or production levels would produce different results.

Estimating Premiums

To purchase traditional multiple-peril crop insurance, our hypothetical Iowa corn farmer chose basic unit coverage and insured at 100 percent of the crop price available for 1997 ($2.45). Given our assumptions, the farmer would have paid $11.20 per acre for traditional multiple-peril crop insurance. For Crop Revenue Coverage, our hypothetical farmer also selected basic unit coverage. The projected crop price for Crop Revenue Coverage in 1997 was $2.59 per bushel for corn. On the basis of our assumptions, we determined that the farmer choosing Crop Revenue Coverage would have paid $16.50 per acre in 1997. For Revenue Assurance, with a projected price of $2.38 per bushel for corn, this same farmer would have paid $8.40 per acre. The Income Protection price we used for our estimate was $2.73 per bushel for corn, and we determined that the farmer would have paid premiums of $5.90 per acre in 1997.

Estimating Payments in the Event of Normal Production in Combination With Declining Prices

In the event of normal production combined with a 30-percent decline in price, no payment would be due under the traditional multiple-peril policy, but each of the revenue insurance policies would provide payments. No payment would be due under the traditional multiple-peril policy because, by definition, it only pays when the farmer's production falls below the guarantee, which in the case of the 75-percent coverage level, would be 75 percent of 120 bushels, or 90 bushels.

If the farmer purchased Crop Revenue Coverage, the revenue guarantee would be the 75-percent coverage level multiplied by the normal

production of 120 bushels, and the resulting production multiplied by the higher of the projected price ($2.59 per bushel in 1997) or the harvest price ($1.81 if the price declined 30 percent). The guarantee under these conditions would be $233.10 (.75 x 120 x $2.59 = $233.10). The guarantee is then compared with the value of the farmer's harvested crop, determined by multiplying the actual production by the harvest price (120 x $1.81 = $217.20). Thus, in the case of normal production combined with a 30-percent decline in price, the farmer who obtained Crop Revenue Coverage would receive a payment of $15.90 per acre ($233.10 - $217.20 = $15.90).

If, instead, the farmer had purchased an Income Protection policy, the revenue guarantee would be determined by multiplying the coverage level (.75) by the normal production (120 bushels), and multiplying the resulting production by the projected price ($2.73 per bushel in 1997). The per-acre guarantee under these conditions would be $245.70 (.75 x 120 x $2.73 = $245.70). The policy bases the payment on the difference between this guarantee and the $229.20 per-acre value of the farmer's crop—determined by multiplying the actual production (120 bushels per acre) by the harvest price ($1.91 if the price declined 30 percent). Thus, in the case of normal production combined with a 30-percent decline in the price, the per-acre payment for the farmer who purchased Income Protection would be $16.50 ($245.70 - $229.20 = $16.50).

If the farmer had purchased a Revenue Assurance policy instead, the revenue guarantee would be determined by multiplying the coverage level (.75) by the normal production (120 bushels), and multiplying the resulting production by the projected county price. The price varies by county, depending on the extent to which the price in the county has tended to be higher or lower than the price on the national commodity market. For Adair County in 1997 for corn, the projected county price was $2.38 ($2.73 per bushel national price in 1997 minus $0.35 county adjustment = $2.38). The per-acre guarantee under these conditions would be $214.20 (.75 x 120 x $2.38 = $214.20). The policy bases the payment on the difference between this guarantee and the per-acre value of the farmer's crop ($200.40)—determined by multiplying the actual production (120 bushels per acre) by the harvest price ($1.67 if the price declined 30 percent). Thus, in the case of normal production combined with a 30-percent decline in price, the per-acre payment for the farmer who purchased Revenue Assurance would be $13.80 ($214.20 - $200.40 = $13.80).

Estimating Payments in the Event of Reduced Production in Combination With Declining Prices

In the event of both a 30-percent decline in production and a 30-percent decline in price, each type of policy would pay, but the amounts paid would vary. The traditional policy pays on the basis of a decline in production, while the revenue policies pay on the basis of a decline in gross revenue.

The traditional multiple-peril crop insurance policy pays when the farmer's production falls below the guarantee, which in the case of the 75-percent coverage level, would be 75 percent of 120 bushels, or 90 bushels. If the farmer purchasing this policy experienced a 30-percent reduction in production, production would average 84 bushels per acre (70 percent of 120). Thus, the farmer would be paid for a reduction of 6 bushels per acre (90 - 84 = 6). The actual price prevailing at harvest does not affect the payment under the traditional policy. Assuming the farmer had selected the 100-percent price option, the payment would be made at $2.45 per bushel (the price election announced by the U.S. Department of Agriculture prior to the 1997 crop insurance sales period), although national prices had declined to $1.72 in this example. Thus, in the case of a 30-percent reduction in production combined with a 30-percent decline in price, the farmer who obtained traditional multiple-peril crop insurance would receive a payment of $14.70 per acre (6 bushels x $2.45 = $14.70).

If the same farmer had purchased a Crop Revenue Coverage policy instead, the revenue guarantee would be the 75-percent coverage level multiplied by the normal production of 120 bushels, and the resulting production multiplied by the higher of the projected price ($2.59 per bushel in 1997) or the harvest price ($1.81 if prices declined 30 percent). The guarantee under these conditions would be $233.10 (.75 x 120 x $2.59 = $233.10). The guarantee is then compared with the value of the farmer's harvested crop, determined by multiplying the actual production by the harvest price (84 bushels x $1.81 = $152.04). Thus, in the case of a 30-percent reduction in production combined with a 30-percent decline in price, the farmer who obtained Crop Revenue Coverage would receive a payment of $81.06 per acre ($233.10 - $152.04 = $81.06).

If the same farmer had purchased an Income Protection policy instead, the revenue guarantee would be determined by multiplying the coverage level (.75) by the normal production (120 bushels), and multiplying the resulting production by the projected price ($2.73 per bushel in 1997). The per-acre guarantee under these conditions would be $245.70 (.75 x 120 x $2.73 = $245.70). The policy bases the payment on the difference between this guarantee and the per-acre value of the farmer's crop

($160.44)—determined by multiplying the actual production (84 bushels per acre) by the harvest price ($1.91 if the price declined 30 percent). Thus, in the case of 30-percent reduction in production combined with a 30-percent decline in price, the per-acre payment for the farmer who purchased Income Protection would be $85.26 ($245.70 - $160.44 = $85.26).

If the same farmer had purchased a Revenue Assurance policy instead, the revenue guarantee would be determined by multiplying the coverage level (.75) by the normal production (120 bushels), and multiplying the resulting production by the projected county price. The price varies by county, depending on the extent to which prices in the county have tended to be higher or lower than the prices on the national commodity market. For Adair County in 1997 for corn, the projected county price was $2.38 ($2.73 per bushel national price in 1997 minus $0.35 county adjustment = $2.38). The per-acre guarantee under these conditions would be $214.20 (.75 x 120 x $2.38 = $214.20). The policy bases the payment on the difference between this guarantee and the $140.28 per-acre value of the farmer's crop—determined by multiplying the actual production (84 bushels per acre) by the harvest price ($1.67 if prices declined 30 percent). Thus, in the case of a 30-percent reduction in production combined with a 30-percent decline in price, the per-acre payment for the farmer who purchased Revenue Assurance would be $73.92 ($214.20 - $140.28 = $73.92).

Estimating Payments in the Event of Reduced Production in Combination With Increasing Prices

In the event of a decline in production combined with an increase in price, the traditional policy and the Crop Revenue Coverage policy would result in payments, but no payment would result under the terms of the Income Protection and Revenue Assurance policies.

Because the harvest price has no effect on the payment under the traditional crop insurance policy, the claim payment for a farmer with a 30-percent decline in production in combination with a 30-percent increase in price would be the same as the payment under constant or decreasing prices ($14.70 as calculated in the previous section).

If the same farmer had purchased Crop Revenue Coverage instead, the revenue guarantee would be the 75-percent coverage level multiplied by the normal production of 120 bushels, and the resulting production would be multiplied by the higher of the projected price ($2.59 per bushel in 1997) or the harvest price ($3.37 if the price increased 30 percent). The guarantee under these conditions would be $303.30 (.75 x 120 x $3.37 = $303.30). The guarantee is then compared with the value of the farmer's

harvested crop, determined by multiplying the actual production by the harvest price (84 bushels x $3.37 = $283.08). Thus, in the case of a 30-percent reduction in production combined with a 30-percent increase in price, the farmer who obtained Crop Revenue Coverage would receive a per-acre payment of $20.22 ($303.30 - $283.08 = $20.22).

If the same farmer had purchased an Income Protection policy instead, no payment would be due because the value of the harvested crop would exceed the revenue guarantee. The revenue guarantee would be determined by multiplying the coverage level (.75) by the normal production (120 bushels), and multiplying the resulting production by the projected price ($2.73 per bushel in 1997). The per-acre guarantee under these conditions would be $245.70 (.75 x 120 x $2.73 = $245.70). No payment would be due because this guarantee is less than the per-acre value of the farmer's crop ($298.20)—determined by multiplying the actual production (84 bushels per acre) by the harvest price ($3.55 if prices increased 30 percent). Thus, in the case of a 30-percent reduction in production combined with a 30-percent increase in price, no insurance payment would be made to the farmer who purchased Income Protection ($245.70 - $298.20 = –$52.50—thus, no payment is due).

Similarly, if the same farmer had instead purchased a Revenue Assurance policy, no insurance payment would be due because the value of the harvested crop would exceed the revenue guarantee. The revenue guarantee would be determined by multiplying the coverage level (.75) by the normal production (120 bushels), and multiplying the resulting production by the projected county price. The price will vary by county, depending on the extent to which the price in the county has tended to be higher or lower than the prices on the national commodity market. For Adair County in 1997 for corn, the projected county price was $2.38 ($2.73 per bushel national price in 1997 minus $0.35 county adjustment = $2.38). The per-acre guarantee under these conditions would be $214.20 (.75 x 120 x $2.38 = $214.20). No payment would be required because the guarantee is less than the $259.56 per-acre value of the farmer's crop—determined by multiplying the actual production (84 bushels per acre) by the harvest price ($3.09 if prices increased 30 percent). Thus, in the case of a 30-percent reduction in production combined with a 30-percent increase in price, no insurance payment would be made to the farmer who purchased Revenue Assurance ($214.20 - $259.56 = –$45.36—thus, no payment is due).

Crop Insurance Experience, 1997

The tables in this appendix show crop insurance results for 1997 for traditional multiple-peril crop insurance (MPCI), Insurance Protection (IP), Crop Revenue Coverage (CRC), and Revenue Assurance (RA). Table II.1 shows various sales and claims payments experience, by state and by insurance plan. Table II.2 combines all states to show sales and claims payments experience by insurance plan only.

Table II.1: Crop Insurance Experience by State and by Insurance Plan, 1997

Policies in force, acres insured, and dollars in thousands

State	Insurance plan[a]	Policies in force	Acres insured	Total premiums	Government premium subsidy	Claims payments	Loss ratio
Alabama	MPCI	6	828	$14,524	$7,374	$36,753	2.53
	IP	0[b]	3	99	42	0	0.00
Alaska	MPCI	0[b]	8	21	21	40	1.90
Arizona	MPCI	1	428	5,677	3,698	3,633	0.64
	CRC	0[b]	5	238	48	83	0.35
Arkansas	MPCI	17	3,686	32,248	27,576	8,163	0.25
	IP	0[b]	116	996	552	344	0.35
California	MPCI	20	2,884	82,478	54,540	17,869	0.22
Colorado	MPCI	16	3,357	27,801	14,960	17,569	0.63
	CRC	1	242	3,885	1,141	589	0.15
Connecticut	MPCI	0[b]	22	790	478	768	0.97
Delaware	MPCI	1	207	987	659	1,078	1.09
Florida	MPCI	1	206	6,148	3,353	5,552	0.90
Georgia	MPCI	11	1,950	33,491	21,205	13,185	0.39
	CRC	0[b]	32	1,520	515	1,490	0.98
	IP	0[b]	6	320	80	0	0.00
Hawaii	MPCI	0[b]	13	108	81	0	0.00
Idaho	MPCI	6	1,102	11,086	5,603	5,834	0.53
Illinois	MPCI	110	11,209	67,926	34,466	12,683	0.19
	CRC	10	1,252	16,384	4,004	4,167	0.25
	IP	2	197	978	339	66	0.07
Indiana	MPCI	34	4,382	30,659	13,469	18,939	0.62
	CRC	4	679	9,153	1,898	3,663	0.40
	IP	0[b]	18	67	28	16	0.23
Iowa	MPCI	101	11,068	63,304	29,003	4,791	0.08
	CRC	43	5,534	64,474	16,192	6,876	0.11
	IP	0[b]	4	18	6	1	0.04
	RA	9	1,185	8,061	2,779	494	0.06

(continued)

Policies in force, acres insured, and dollars in thousands

State	Insurance plan[a]	Policies in force	Acres insured	Total premiums	Government premium subsidy	Claims payments	Loss ratio
Kansas	MPCI	113	11,175	70,040	34,989	13,044	0.19
	CRC	17	2,929	31,104	9,597	7,707	0.25
	IP	0[b]	4	6	2	0	0.00
Kentucky	MPCI	6	963	7,197	4,478	3,465	0.48
Louisiana	MPCI	11	2,575	27,021	22,423	6,949	0.26
Maine	MPCI	1	83	2,402	1,505	885	0.37
Maryland	MPCI	3	479	3,107	1,885	6,389	2.06
Massachusetts	MPCI	1	29	1,606	951	255	0.16
Michigan	MPCI	17	2,180	20,042	13,803	4,271	0.21
	CRC	2	296	4,401	1,397	1,686	0.38
Minnesota	MPCI	81	12,123	106,790	52,208	49,526	0.46
	CRC	14	2,839	34,481	10,369	12,179	0.35
	IP	0[b]	33	179	66	163	0.91
Mississippi	MPCI	9	3,287	28,941	22,353	9,586	0.33
Missouri	MPCI	47	4,640	38,282	25,507	6,983	0.18
	CRC	4	536	8,778	2,901	2,697	0.31
Montana	MPCI	19	6,137	36,427	16,032	12,913	0.35
	CRC	1	301	2,380	774	642	0.27
Nebraska	MPCI	73	7,659	54,414	25,968	22,324	0.41
	CRC	32	4,271	48,232	13,957	17,558	0.36
Nevada	MPCI	0[b]	17	135	91	0	0.00
New Hampshire	MPCI	0[b]	9	140	94	0	0.00
New Jersey	MPCI	1	96	1,144	1,058	480	0.42
New Mexico	MPCI	2	580	4,752	3,204	880	0.19
New York	MPCI	4	474	3,818	3,197	998	0.26
North Carolina	MPCI	15	2,161	20,427	13,539	10,622	0.52
North Dakota	MPCI	82	17,386	122,807	58,140	148,928	1.21
	CRC	2	710	4,727	1,856	5,748	1.22
	IP	0[b]	0[b]	2	1	4	1.72
Ohio	MPCI	29	3,069	16,899	8,940	6,791	0.40
	CRC	3	418	5,466	1,341	1,874	0.34
Oklahoma	MPCI	26	4,837	28,457	15,066	15,494	0.54
	CRC	0[b]	67	978	329	343	0.35
Oregon	MPCI	3	715	4,000	2,180	842	0.21
Pennsylvania	MPCI	6	553	5,077	3,241	8,455	1.67
Rhode Island	MPCI	0[b]	1	22	13	22	1.02

(continued)

Policies in force, acres insured, and dollars in thousands

State	Insurance plan[a]	Policies in force	Acres insured	Total premiums	Government premium subsidy	Claims payments	Loss ratio
South Carolina	MPCI	5	872	9,133	7,055	3,510	0.38
South Dakota	MPCI	59	9,160	68,558	33,734	68,584	1.00
	CRC	12	2,369	26,375	8,503	20,102	0.76
Tennessee	MPCI	4	810	7,454	5,932	2,524	0.34
Texas	MPCI	90	13,154	205,498	107,559	114,110	0.56
	CRC	5	1,135	17,080	5,884	12,827	0.75
	IP	0[b]	3	11	4	30	2.70
Utah	MPCI	1	108	764	433	379	0.50
Vermont	MPCI	0[b]	44	239	216	204	0.85
Virginia	MPCI	5	687	7,403	3,882	11,696	1.58
Washington	MPCI	11	2,175	18,205	11,117	4,885	0.27
	CRC	0[b]	125	1,046	215	148	0.14
West Virginia	MPCI	1	52	744	457	769	1.03
Wisconsin	MPCI	30	3,032	29,042	16,806	4,892	0.17
Wyoming	MPCI	3	351	2,821	1,200	1,383	0.49
Total[c]		**1,239**	**178,334**	**$1,622,492**	**$820,561**	**$791,390**	**0.49**

[a]MPCI includes the group risk plan.

[b]Rounds to less than 1.

[c]Total excludes special plans that cover peanuts, tobacco, fruit trees, and various minor crops.

Source: GAO's analysis of the U.S. Department of Agriculture's (USDA) data.

Table II.2: U.S. Crop Insurance Experience by Insurance Plan, 1997

Policies in force, acres insured, and dollars in thousands

U.S.	Insurance plan[a]	Policies in force	Acres insured	Total premiums	Government premium subsidy	Claims payments	Loss ratio
	MPCI	1,080	153,023	$1,331,053	$735,743	$689,893	0.52
	CRC	148	23,743	280,701	80,919	100,379	0.36
	IP	3	383	2,677	1,119	624	0.23
	RA	9	1,185	8,061	2,779	494	0.06
Total[b]		**1,239**	**178,334**	**$1,622,492**	**$820,561**	**$791,390**	**0.49**

[a]MPCI includes the group risk plan.

[b]Total excludes special plans that cover peanuts, tobacco, fruit trees, and various minor crops.

Source: GAO's analysis of USDA's data.

Methodology Used to Set Premium Rates for Crop Revenue Coverage and Our Analysis

The Crop Revenue Coverage plan was developed by a private insurance company in the early 1990s. The plan is designed to guarantee farmers (1) a certain level of income and (2) the replacement value of the difference between insured yields and actual yields if actual yields are below the insured level. Crop Revenue Coverage's premiums are based on three components: "yield risk," "upward price risk," and "revenue risk." Premiums calculated for each of the components are added together to generate the total premium for each policy.

This appendix defines each component and explains how it is developed. The first section describes the calculation of the yield risk component of the premium, which is based on the multiple-peril crop insurance program. The second section describes the calculation of the upward price risk component, which refers to the expected payout by the insurer as a result of a yield loss and a price increase between planting (insurance sales period) and harvest. The third section shows how the revenue risk component is developed, which is the risk that, if prices are lower at harvest than at planting, actual revenue is less than guaranteed revenue. The fourth section demonstrates how the three components are summed to form a base premium. In these calculations, yields and prices are treated as if they are independent of one another. Finally, we present our analysis of the method used to set premiums for Crop Revenue Coverage.

Calculating the Yield Risk Component

For Crop Revenue Coverage, yield risk relates to situations in which the actual yield is lower than the insured yield and the price at harvest is not higher than the price guaranteed at planting. Through yield risk coverage, the insured farmer is eligible for a payment equivalent to the difference between the insured yield and the actual yield, multiplied by the planting price. The portion of the premium related to yield risk is derived from the premium rate schedules for multiple-peril crop insurance. The yield risk accounts for two-thirds of the expected payout by the insurer.

The yield risk premium is the product of the multiple-peril crop insurance base rate, the farmer's actual production history (APH), the coverage level, and the planting price or:

Yield risk premium = MPCI Base Rate x APH x Coverage Level x Planting Price

Equation 1 estimates the portion of the premium that relates to yield risk:

(1)

$$PR_y = R \times Y_g \times P_p \approx EL \times P_p$$

where PR_y is the calculated premium, R is the multiple-peril crop insurance base rate, Y_g is the insured yield, P_p is the planting price, and EL is expected yield loss. The premium is not exactly equivalent to the product of the planting price and expected losses because expected losses for each farm can only be approximated.

Multiple-peril crop insurance base rates are derived from historical losses relative to historical premiums for various yield and coverage levels.[1] The relevant market price is equal to 95 percent of the average closing price of the harvest period's futures contract price during the planting period. The expected yield loss equals the multiple-peril crop insurance base rate multiplied by the yield guarantee to the farmer.

Calculating the Upward Price Risk Component

Upward price risk is a component developed especially for Crop Revenue Coverage. It refers to the risk of a higher price at harvest than at planting when the actual yield is lower than the insured yield. Under the upward price risk component, the insured farmer is eligible for a payment equal to the difference between the insured and actual yields multiplied by the harvest price.

The total upward price risk equals the product of the multiple-peril crop insurance base rate, the farmer's APH, the coverage level, and the upward price factor (which is the product of the upward price rate times the maximum liability for that crop) or:

Upward Price Risk = MPCI Base Rate x APH x Coverage Level x Upward Price Factor

Equations 2 through 10 are used to estimate the upward price factor, that is, the risk of prices increasing between planting and harvest, when the farmer has a loss in yield.

[1]The multiple-peril crop insurance base premium rate is derived from the ratio of historical claims payments to historical liabilities (loss-cost method) at the midpoint of FCIC's nine premium rate levels—called "R-spans"—for the 65-percent coverage level. From that midpoint, or fifth rate span—called R05—the spans are a series of levels of rates that decrease as yield levels increase and increase as yield levels decrease.

Equation 2 estimates a premium rate for a yield loss by dividing expected crop losses by the yield guarantee:

(2)

$$R = \frac{EL}{Y_g}$$

where R is the insurance premium rate, EL is expected loss, and Y_g is the yield guarantee.

Equation 3 integrates the price distribution above the planting price in order to estimate expected loss from an upward price change:

(3)

$$EL = \int_{upperbound}^{P_p} (P_p - P_a)\, f(P)\, dp$$

where EL is the expected loss in dollars, P_p is the planting price, P_a is the actual price, and f (P) is the probability density function for price changes. The function is constrained by the maximum price difference reimbursable for each insured crop.[2]

In order to facilitate the estimation of expected losses, Crop Revenue Coverage uses the polynomial function for the integration of a normally distributed probability distribution from Abramowitz and Stegun[3] (Equations 4 and 5) along with a procedure developed by Botts and Boles[4] (Equations 6 through 9). The Botts and Boles procedure estimates the mean of a truncated normal distribution, one in which a portion is cut off and isolated for analysis. The truncated distribution is bounded by the maximum compensated price change and the mean of price changes for the entire normal distribution. This is the portion of the price distribution that reflects prices above the planting price.

[2]For example, the maximum price increase that is insured for corn is $1.50 per bushel.

[3]Abramowitz, Milton, and Irene Stegun, Handbook of Mathematical Functions (Washington, D.C.: Government Printing Office, 1968).

[4]Botts, Ralph R., and James N. Boles, "Use of Normal-Curve Theory in Crop Insurance Rate Making," Journal of Farm Economics 39 (1957): 733-40. The Botts and Boles method is a general approach that assumes it is possible to estimate expected insurers' indemnity payments once the values of the mean and standard deviation of a normal distribution of the insured factor are known. Botts and Boles apply the method to yields in their article. For Crop Revenue Coverage, the method is applied to prices and yields.

Equation 4 estimates the probability of a loss (or in this case the probability of an upward price change) using the polynomial function for integration of a normal distribution:

(4)

$$P = Z(a_1 T + a_2 T^2 + a_3 T^3)$$

where P is the probability that the insurer would be required to pay insured farmers under the "upward price risk" provision of Crop Revenue Coverage. Moreover, a_1, a_2, and a_3 are constants from Abramowitz and Stegun. Variables, Z and T are estimated in Equations 5 and 6.

Equation 5 estimates the value of T, which measures the area under a normal curve:

(5)

$$T = \frac{1}{1 + b * [\frac{EP - P_p}{SD}]}$$

where b is a parameter of the price distribution from Abramowitz and Stegun.

Equation 6 estimates Z, which is the height (measured parallel to the Y axis) of the ordinate of the truncated distribution:

(6)

$$Z = \frac{1}{\sqrt{2\pi}} * e^{-1/2[\frac{EP - P_p}{SD}]^2}$$

where EP is the expected or mean price change of the entire distribution, P_p is the planting price, and SD is the standard deviation of price changes for the entire normal distribution.

Equation 7 estimates M, the mean of the truncated normal distribution, in this case the mean of the distribution of upward price changes:

(7)

$$M = EP - \frac{Z * SD}{P}$$

where EP is the mean price for the entire normal distribution (untruncated), Z is as defined above, P is the probability of a price change above the guaranteed price, and SD is the standard deviation of price changes for the entire distribution.

Equation 8 estimates expected losses:

(8)

$$EL = P * P_p - P * M$$

where M is the mean of price changes for a truncated normal distribution, P is the probability of a loss and P_p is the planting price.

Substituting Equation 7 into Equation 8 gives Equation 9, which expresses expected loss per bushel:

(9)

$$EL = P * (P_p - EP) + Z * SD$$

Equation 10 (as in Equation 2 for a yield loss) expresses the premium rate per bushel for an upward price change as the result of dividing expected losses per bushel by the planting price:

(10)

$$R = EL / P_p$$

The premium rate calculated above, however, must be adjusted to reflect Crop Revenue Coverage regulations, which require payment for price increases under conditions of actual yield losses only. In order to account for this feature of the program, a conditional probability, that is, the probability of a price increase given a yield loss must be calculated. In order to calculate a premium rate for this factor (R adjusted for the probability of a price increase, given a yield loss), the unadjusted R (as in Equation 10) is multiplied by the multiple-peril crop insurance base rate for yield loss.

Calculating the Revenue Risk Component

Revenue risk refers to the risk of harvest revenue that is lower than the revenue guaranteed at planting. Guaranteed revenue is the product of the insured yield and the planting price. Under the revenue risk component, as long as harvest revenue is lower than guaranteed revenue, the insured farmer is eligible for a payment. When the harvest price is lower than the planting price, harvest revenue can be lower than guaranteed revenue when yield is at or above the insured yield or when yield is lower than the insured level.[5]

The revenue risk factor is the product of the revenue rate,[6] the farmer's actual production history, the coverage level, and the downward price factor (which is the downward price rate times the maximum liability for that crop) or:

Revenue Risk = Revenue Rate x APH x Coverage Level x Downward Price Factor.

In order to calculate the revenue risk, Crop Revenue Coverage estimates two factors: the downward price factor and the revenue rate. The downward price factor is calculated using the same method as the upward price factor, but here the risk evaluated is that prices will be lower at harvest than at planting. The revenue rate is derived from the area under the yield curve below the yield guarantee, given a price decline. The revenue rate must cover the risk, when price declines, of harvest revenue that is less than the planting revenue guarantee. The revenue rate does not cover the risk of a yield loss, because the yield risk factor compensates for that by paying the insured farmer the product of the yield loss and the planting price. However, the revenue rate must cover the risk of the guaranteed revenue being higher than the sum of market revenue and payments under the yield component. For a given price decline, the largest such payout under the revenue rate would occur at the yield guarantee, when no payments are made under the yield risk component. Alternatively, the greatest payment under the yield risk component would occur at zero production, when no payment is made under the revenue risk component.

[5]Crop Revenue Coverage does not guarantee price. If prices fall but yields do not decline, in most cases there will be no indemnity payments. For example, the 1997 wheat price fell by nearly 50 cents per bushel during the insurance period, but most Kansas growers received no Crop Revenue Coverage indemnity payments because they had sufficient yields to offset the revenue loss caused by lower prices.

[6]The revenue rate is also called the Crop Revenue Coverage base rate.

The Crop Revenue Coverage base rate is calculated in six steps. First, a mean yield and standard deviation are calculated by county, by crop, and by farming practice using data on APH and multiple-peril crop insurance base rates. Second, using these data, a yield curve is generated. Third, using the polynomial function for the integration of a normally distributed density function (Abramowitz and Stegun), the area under the curve below the yield guarantee is calculated to obtain the probability of collecting indemnities, given a price decline. Fourth, the expected yield loss is calculated using the Botts and Boles method. Fifth, this expected loss is subtracted from the yield guarantee because this part of the yield loss is already covered by the multiple-peril crop insurance or "yield risk" portion of the Crop Revenue Coverage premium. Sixth, the expected yield is divided by the mean yield and multiplied by the probability of collecting indemnities in any given year, given a price decline.

In steps 1 and 2 above, the yield curves are generated by using the mean and standard deviations of yield that are derived from the Risk Management Agency's published APH and base rate data.

In the third step, Equations 11, 12, and 13 calculate the area underneath the yield curve between 0 and the yield guarantee, or the probability, P, of an indemnity being paid, given a price decline:

(11)

$$P = Z(a_1 T + a_2 T^2 + a_3 T^3)$$

(12)

$$T = \frac{1}{1 + b * [\frac{y_\mu - y_g}{SD}]}$$

(13)

$$Z = \frac{1}{\sqrt{2\pi}} * e^{-1/2 [\frac{y_\mu - y_g}{SD}]^2}$$

where a_1, a_2, a_3, and b are constants, P is the probability of collecting indemnities in any given year, T measures the area underneath the normal curve, Z measures the ordinate between the x-axis and the normal curve, y_μ is the mean yield of the distribution, y_g is the guaranteed yield, and SD is the standard deviation of yields.

In the fourth step, Equation 14, the expected yield loss, EL, is calculated:

(14)

$$EL = (P * (y_g - y_\mu)) + Z * SD$$

In the fifth step, Equation 15, the expected yield, EY, is calculated by subtracting the expected loss, EL, from the yield guarantee:[7]

(15)

$$EY = Y_g - EL$$

In the sixth step, Equation 16, the revenue rate is obtained by multiplying the ratio of the expected yield to the mean yield by the probability, P, of the farmer collecting an indemnity from a price decline:

(16)

$$(EY / y_\mu) * P$$

There is no provision in this rate for the possibility that yields could be above the mean while prices are declining, triggering an indemnity.

Making the Final Calculation for the Crop Revenue Coverage Premium

The calculation of the total Crop Revenue Coverage base premium, before subsidy, is the sum of the following three products:

- Yield risk premium = MPCI Base Rate x APH x Coverage Level x Planting-Period Price
- Upward price risk premium = MPCI Base Rate x APH x Coverage Level x Upward Price Factor, and
- Revenue risk premium = Revenue Rate x APH x Coverage Level x Downward Price Factor.

Analysis of Crop Revenue Coverage

Crop Revenue Coverage differs significantly in its rate-setting method from the two other insurance plans. Unlike the methods used for Income Protection and Revenue Assurance, the method used to establish premiums for Crop Revenue Coverage is not based on a revenue distribution or another appropriate statistical technique. Instead, Crop Revenue Coverage establishes rates by adding together yield, upward price, and revenue risk factors. The yield risk component is based on rates

[7]The expected yield loss is subtracted because it is already covered under the yield risk component.

established under traditional multiple-peril crop insurance. The upward price risk component is used to estimate losses to the insurer in the case of a price increase, given a yield loss. The revenue risk component is used to estimate losses to the insurer of harvest revenue that is lower than the revenue guaranteed in the planting period. Using this additive procedure, the private insurance company developer assumed that price and yield are independent of each other and derived them separately.

However, the price-yield correlation is needed to help establish premium rates that are not too high to discourage participation or too low to cover losses. This correlation would be greatest in concentrated production areas, such as the midwestern cornbelt, where the price-yield correlation is highest, and decline as the distance from these areas increases because the price-yield correlation decreases the further production for corn is from the central area.

Analysts disagree about the impact of omitting the correlation between price and yield. Some have suggested that omitting this correlation may not be as serious a shortcoming as might be expected. Although the price-yield relationship is an important component of revenue distributions, especially for major crop production areas, Crop Revenue Coverage premiums, on average, may still be appropriate to cover losses over time, according to these analysts. This is because, although the rate for price increases (upward price risk) may be too low and the rate for price decreases (revenue rate) may be too high, they may offset each other. However, other analysts point out that there is no evidence that the failure to incorporate the price-yield correlation has a neutral effect on premiums. They say that government outlays in years of very low yields could be extensive because the plan understates the probability of a yield loss when prices increase.

Methodology Used to Set Premium Rates for Revenue Assurance and Our Analysis

In response to the Iowa Farm Bureau's proposal that federal deficiency payments be replaced with a federally subsidized insurance product, Revenue Assurance was developed to provide a payment to insured farmers when farm revenues fall below a predetermined trigger level. The payment is the difference between the trigger, or guaranteed, revenue and the actual revenue.

In order to develop premiums that will likely cover future losses over time, insurers need to accurately depict a revenue distribution, or use another appropriate statistical technique, to reflect receipts at the farm level. Three primary steps are essential to determining the revenue distribution—developing the price distribution, developing the yield distribution, and estimating the price-yield correlation.

The first section of this appendix describes how the price distribution, using futures prices adjusted for local differentials, is calculated for Revenue Assurance. The second section describes how the yield distribution is estimated. Certain parameters are imposed on the price distribution and on the yield distribution. The third section shows how the price and yield distributions are combined to form a revenue distribution that incorporates a price-yield relationship. The fourth section shows how expected losses are used to calculate premiums. Finally, we present our analysis of the methodology used to set premium rates for Revenue Assurance.

Developing the Price Distribution

Current prices, which have the advantage of reflecting current market conditions, are used for developing price distributions for Revenue Assurance. The premiums are based on the prices set during planting for futures prices during the harvest period, adjusted for local conditions. Following an analysis of the responsiveness of cash prices to changes in futures prices, the difference between futures and cash prices for each county was found to be constant over time.

Equation 1 uses current futures price and price volatility to estimate a lognormal price distribution, F(P):

(1)

$$F(P) = (P\sqrt{\pi\sigma})^{-1}\exp\left[\frac{-0.5(\log(P)-\zeta)}{\sigma^2}\right]$$

where σ and ζ are the parameters of the lognormal price distribution. The current price used is the average of the planting period price of the harvest period futures contract. The price volatility used is calculated by applying the Black options pricing formula to the price of the planting period put option on the harvest period futures contract.

Yield Distribution Development

Revenue Assurance assumes that crop yields follow a beta distribution. The beta distribution exhibits three major characteristics: First, it can exhibit negative or positive skewness; second, it has finite minimum and maximum values; and third, it can take on a wide variety of shapes.

Equation 2 describes the beta distribution of yields, y, as:

(2)

$$g(y) = \frac{\Gamma(p+q)\ (y-y_{min})^{p-1}\,(y_{max}-y)^{q-1}}{\Gamma(p)\,\Gamma(q)\,y_{max}^{p+q-1}}$$

$$y_{min} \le y \le y_{max}$$

where p, q, y_{max} ,and y_{min} are the four parameters and Γ(p+q), Γ(p), and Γ(q) refer to the gamma function of (p+q), p, and q, respectively, which is directly related to the beta distribution.

Equations 3 and 4 estimate the values of p and q using the method of moments technique:[1]

(3)

$$p = \left(\frac{\mu - y_{min}}{y_{max}-y_{min}}\right)^2 \left(1-\frac{\mu - y_{min}}{y_{max}-y_{min}}\right)\left(\frac{\sigma^2}{(y_{max}-y_{min})^2}\right)^{-1} - \frac{\mu - y_{min}}{y_{max}-y_{min}}$$

(4)

$$q = \frac{\frac{\mu - y_{min}}{y_{max}-y_{min}}\left(1-\frac{\mu - y_{min}}{y_{max}-y_{min}}\right)}{\left(\frac{\sigma^2}{(y_{max}-y_{min})^2}\right)^{-1} - 1 - p}$$

[1]The method of moments is a technique that uses a moment generating function, ϕ(t), to generate all of the moments, such as the mean or the first moment, of a random variable X and its probability distribution. Using ϕ(t), all of the moments of X can be obtained by successively differentiating ϕ(t).

where μ is the mean of yield and σ is the standard deviation of yield for each county, y_{max} is the maximum, and y_{min} is the minimum yield. P is from equation 3. The mean yield, μ, is derived from a discrete range of the farmers expected yields. The maximum and minimum yields determine the degree and direction of skewness and of kurtosis.[2]

Developing the Revenue Distribution

Using the Johnson and Tenenbein approach,[3] Revenue Assurance estimates a revenue distribution by joining the lognormal price distribution and the beta yield distribution. A continuous bivariate revenue distribution is constructed by taking random draws of variables from the specified marginal distributions for price and yield. The variables already reflect the dependence measure, ρ, Spearman's rank correlation coefficient, to account for the yield-price correlation.

The needed variables to form a revenue distribution, price and yield, x and y, are generated through the following procedure. Capital letters represent random variables and lower case letters represent drawn values of these random variables.

In Equation 5 , A and B are assumed to have a common standard normal density function with mean 0 and standard deviation of 1.

(5)

$$A \sim N(0,1) \quad B \sim N(0,1)$$

Equation 6 defines r as a, the value of the drawn variable from a standard normal distribution:

(6)

$$r = a$$

Equation 7 defines s, the linear combination of the values of a and b weighted by c, which reflects the yield-price correlation, ρ:

[2]A distribution that lacks symmetry with respect to a vertical axis is said to be skewed or to have skewness. Kurtosis has to do with the degree of peakedness that the distribution exhibits: how steeply the curve rises and falls.

[3]Johnson, Mark E. and Aaron Tenenbein, "A Bivariate Distribution Family With Specified Marginals," Journal of the American Statistical Association. Vol. 76 (Mar. 1981): 198-201. The basis for the Johnson and Tenenbein approach is that a linear combination of two independent deviates creates dependence.

(7)

$$s = ca + (1 - c)b$$

where a and b are identically and independently distributed random variables with a common density function and c is a weight reflecting the relationship between the two random variables, in this case price and yield.

Equations 8 and 9 define w and z, the cumulative density functions of R and S, respectively.

(8)

$$w = \phi(r)$$

(9)

$$z = \phi\left(s / \sqrt{c^2 + (1 - c)^2}\right)$$

where Φ(.) is the cumulative density function for a standard normal variate.

Finally, Equations 10 and 11 result in the variables price, x, and yield, y:

(10)

$$x = F_X^{-1}(w)$$

(11)

$$y = F_Y^{-1}(1 - z)$$

where $F_X(.)$ and $F_Y(.)$ are the known marginal cumulative density functions for price and for yield, and $F_X^{-1}(.)$ and $F_Y^{-1}(.)$ are the corresponding inverse functions.

After the correlated price and yield observations are drawn from the inverse marginal distributions, they are multiplied together to generate thousands of revenue observations. In this way, a revenue distribution is generated.

Calculating Expected Losses and Premium Rates

Revenue Assurance premiums are derived from an average of expected losses. The expected loss for a hypothetical policy is derived by taking the difference between the guaranteed revenue and market revenue as reflected in the revenue distribution developed above. If the guaranteed level is higher than the revenue realized, the difference is the amount of indemnity owed. Potential indemnities associated with each guaranteed revenue are totaled. The losses are averaged across all policies to develop premium rates.

To develop premium rate tables for similar production levels, every permutation of a discrete range of prices, yields, and coverage levels corresponding to average expected losses are simulated. These data are used to estimate premium rates by developing a translog equation that links expected losses with (1) expected farm and county yield, (2) yield variability, (3) price volatility, (4) coverage levels, and (5) the cross-products and squares of these variables.

Analysis of Revenue Assurance

Although the Revenue Assurance model has the advantage of being based on current prices and a revenue distribution that incorporates the price-yield interrelationship, assumptions about relevant distributions and application of a key statistical technique raise questions about the adequacy of the plan's premium rates.

The Revenue Assurance method uses prices that may be more appropriate than Income Protection's or Crop Revenue Coverage's for calculating future revenues. That is, Revenue Assurance uses prices at the pre-planting period for harvest period futures contracts as the expected prices and derives the variance of prices from current options contracts on the relevant futures contract. These current prices and variances are more likely to reflect future market conditions than historical prices because they reflect traders' expectations of prices in the future.

However, the developers use too few years of yield data to estimate yield variability. Furthermore, yields in 3 separate years during the period 1985 through 1994 reflect events that are likely to occur much less frequently than every 10 years. Exceedingly low yields were observed in 1988 and 1993, and very high yields were observed in 1994. By limiting the basis for yield analysis to the 1985-94 period, the model would forecast these unusual yields more frequently than historical yields would indicate.

Revenue Assurance uses a parametric statistical method that requires that the underlying distribution function be normal or some other specified form. If properly applied, this method generates efficient estimates that have smaller variances than those of the nonparametric method.

However, the assumptions Revenue Assurance makes about yield distributions may not reflect actual yield data at the farm level. According to several analysts, there is no consensus about the correct functional form of yield distributions. Furthermore, estimates of the yield distribution are very sensitive to the assumed minimum and maximum values for yield.

In addition, the Johnson and Tenenbein statistical technique imposes a constraint that is not appropriate. Specifically, a constant value for the price-yield correlation for all farmers in all years, which is required for the proper application of the technique, does not reflect actual experience. In the areas further from the heaviest concentration of production, the interrelationship between prices and yields is weaker than in the heart of the production area. Furthermore, in catastrophic years, the correlation between prices and yield is usually stronger than the average value over time. Because it is not appropriate to assume a constant price-yield correlation, it is difficult to have confidence that rates based on such a revenue distribution would be actuarially sound over the long term and appropriate to the risk each farmer presents.

Methodology Used to Set Premium Rates for Income Protection and Our Analysis

In response to a mandate under the Crop Insurance Reform Act of 1994, USDA developed Income Protection, an insurance plan designed to guarantee a certain level of income from crop production. Premiums for Income Protection are based on revenue distributions that show expected losses and payouts at different levels of guaranteed income.

Three primary steps occur in developing the Income Protection rating methodology—the construction of yield distributions, the construction of price distributions, and the construction and simulation of the revenue distributions on the basis of the results of the first two constructions.

The first section of this appendix describes how the components of the simulated yield distributions are calculated using regional, county, and farm-level yield data. The second section describes how the components of the price distribution are calculated by estimating an equation relating prices to the yields already estimated. The third section shows how the price and yield observations developed from the distributions are combined to construct revenue distributions. No statistical restrictions are imposed on the yield, price, or revenue distributions. The fourth section shows how average indemnities and thus rates are calculated. Finally, we present our analysis of the methodology used to set premium rates for Income Protection.

Constructing the Yield Distribution

The yield distributions for Income Protection are derived from data on three major sources of yield variability—trends over time, regional events, and individual farm production characteristics. Trends over time are represented by 50 years of regional yield data. Yield data for years when actual yields were vastly different from expected yields are included and weighted relative to the 50 years of data used.

Regional events are represented by regional yield data adjusted for differences in county yield. Regional data are also used to capture price-yield interactions, or correlations. For information on the yield on individual farms, APH records are used for farms for which actual yield data are available for 6 or more years. Additional yield data provided by farmers supplement historic records.

The regional data are the acre-weighted averages of county yields provided by USDA's National Agricultural Statistics Service (NASS) for all counties that the Federal Crop Insurance Corporation (FCIC) has specified as risk-rating regions. The county yields are NASS county yields per planted

acre. The pooled farm data consist of the most recent APH data reported by farmers and recorded in FCIC's files on yield history. For estimating rates, data are used from farms that report 6 or more years of actual yields.

To determine the Income Protection premium for a farmer, the predicted yield for the farmer's county is adjusted by the difference between the farmer's yield as reflected in the yield data provided by the farmer and the county average yield.

Regional Yield Trend Equation

Equation 1 estimates regional yields:

(1)

$$R_t = a^R + g(t) + e_t^R$$

where R is the regional yield, t is time, a^R is the region's yield intercept, g(t) is the region's estimated yield trend over time, and e_t^R is the regional residual yield variation. The same yield trend is imposed on all counties in a risk-rating region. The errors or remaining variability in yields, after the trend has been accounted for, are used to construct the revenue equation.

Equation 2 shows the method used to test for heteroskedasticity, that is, whether the variability of regional yields has changed over time:

(2)

$$|\hat{e}_t^R| = b_1 + b_2^R t$$

The results indicated that the variability had changed over time and a scaling process was applied to the errors to correct for the heteroskedasticity.

Equation 3 shows one method used to correct for heteroskedasticity. Here, the predicted values of the absolute yield errors are used to scale the original yield errors from the regional equation to 1997 units. The estimated values of these errors make up the yield distribution from which observations are drawn to develop revenue functions:

(3)

$$e_{t,97}^R = \frac{(b_1^R + b_2^R 1997)}{(b_1^R + b_2^R t)}$$

Constructing the County-Adjusted Regional Yields

After the regional trend is estimated, g(t), a county-specific intercept, a_1^C is estimated to account for county-specific differences in productivity. The intercepts are calculated as the simple averages of the differences in yields between each county and the average yield for the region. All farms in a county are used to calculate yield variations if at least 6 years of yield data are provided by 50 or more farms in the county; if fewer than 50 farms provided yield data for at least 6 years, yields for all farms in the region are used.

Equation 4 is used if the yield trend, g(t), is linear:

(4)

$$C_t = a_1^C + g(t) + u_t^C$$

where C_t is the county yield and u_t^C is the error term.

Equation 5 is used if the function of the yield trend is not linear, with the county intercept, a_1^C:

(5)

$$a_1^C = \frac{1}{T_C} \sum_{T=1}^{T_C} [C_t - g(t)]$$

where C_t is county yield and T_c is the number of years in the data set and g(t) from the regional equation detrends the county data.

Equation 6 is used to construct a county-adjusted regional yield series for each county in a risk-rating region to maintain a consistent rating process across regions:

(6)

$$R_t^C = a_1^C + g(t) + e_t^R$$

where R_t^c is the unknown county-adjusted regional yield, a_1^C is the county-specific intercept, g(t) is the regional trend function, and e_t^R is the regional residual as estimated above. The intercept, trend value, and error term are summed to construct the county-adjusted regional yield.

Calculating Differences Between Farm-Level and County-Adjusted Regional Yields

In order to determine yield variability attributable to the farm yield only, it is necessary to isolate yield variability at the county-adjusted regional level. (These two sources of variation are reconstituted during the premium estimation process.) Isolating the variability in this manner allows the county-adjusted regional data set, which is longer than the farm data set, to be used to estimate the severity and frequency of large regional events.

Equation 7 shows the construction of the yield variability attributable to the farm level only:

(7)

$$d_t^f = y_t^f - R_t^c$$

where d_t^f is the deviation from the county-adjusted regional yield for each farm in time t, y_t^f is the farm yield, and R_t^C is the county-adjusted regional yield in time t.

Equation 8 shows the construction of the farm's average yield variability attributable to the farm level only:

(8)

$$\overline{d}^f = \frac{1}{T_f}\sum_{t=1}^{T_f} d_t^f = \overline{y}^f - \overline{R}^c$$

where d^f (bar) is the average deviation from the county-adjusted regional yield for each farm. The deviation is calculated by subtracting the average county-adjusted regional yield, R^C (bar), from the average farm yield, y^f (bar):

Equation 9 shows the remaining variability after accounting for variability at the farm and county-adjusted regional levels:

(9)

$$e_t^f = d_t^f - \overline{d}^f = (Y_t^f - \overline{y}^f) - (R_t^c - \overline{R}^c)$$

The variability, or statistical errors, remaining is expressed as a function of the difference of the farm's deviation from its average yield and the county-adjusted regional's deviation from its average yield for the same period of time. If a given county has 50 or more farms with 6 years or more

of data, the residuals from the county's farms are used. However, if there are fewer than 50 farms with 6 years or more years of data, residuals from all farms in the risk-rating region are used.

Constructing Price Distributions

For the major field crops, price distributions are based on monthly average prices from planting to harvest over a 37-year period. Prices for commodity futures at planting and harvest are used to develop price distributions for the major field crops. Monthly averages of the futures price contracts for the 1960-96 period are constructed for each insured crop. The planting period price, P_t^0, is defined as the average of a 30-day period ending 2 weeks before the crop insurance sign-up for that crop and location, while the harvest period price, P_t^1, is an average 30-day price for the month prior to the close of the harvest futures contract. Since proportional prices are used, there is no need to deflate prices.

Equation 10 estimates seasonal price relationships in the futures market as a function of historical yield deviations:

(10)

$$\frac{P_t^1}{P_t^0} = a_1^p + a_2^p \left[\frac{R_t^c}{\hat{R}_t^c} - \left(\frac{1}{T_c}\right) \sum_{t=1}^{T_c} \frac{R_t^c}{\hat{R}_t^c} \right] + e_t^p$$

where P_t^1 is the harvest time futures price of the crop and P_t^0 is the planting time futures price (or forecast) of the harvest crop, a_1^p is the intercept, a_2^p measures the relationship between price and yield, R_t^C is the county-adjusted regional yield, and R_t^C (hat) is the forecasted county-adjusted regional yield for year t. The term inside the parenthesis adjusts for the lower number of price observations relative to yield observations in the calculation of revenue under Income Protection. This term is constructed in order to generate a zero mean set of proportional regional yield deviations for the subset of yield data used in the expression.

The equation is also used to estimate the price-yield correlation and the remaining statistical errors, which were not accounted for by the variation in the county prices. The error term from this equation is used in a later step to obtain a consistent estimate of revenue.

Constructing and Simulating the Revenue Distribution

In order to construct the revenue distribution, errors from three estimated equations are drawn randomly:

- e_t^R from the yield trend Equation (1),
- e_t^f from the remaining farm variability Equation (9), and
- e_t^p from the price-yield equation (10).

Equation 11 represents the construction of a simulated county-adjusted regional yield:

(11)

$$R_s^C = a_t^C + g(T) + e_t^R = \hat{R}_s^C + e_t^R$$

Equation 12 represents the construction of a simulated farm yield:

(12)

$$y_s = R_s^C + \bar{d} + e_t^f$$

Equation 13 represents the construction of a simulated price realization:

(13)

$$P_1^s = P_0 (1 + a_2^p ((R_s^C / \hat{R}_s^C) - 1) + e_t^P)$$

Equation 14 represents the construction of a simulated revenue realization:

(14)

$$REV_s = P_1^s y_s$$

If REV_S, actual revenue, is less than the guaranteed revenue, a payment or indemnity of the difference is assumed to be made and the amount recorded. The above process is repeated 10,000 times, and a running total of the payouts is recorded for each of the possible indemnity levels. The average indemnity (total indemnities divided by 10,000) is used as an estimate of the actuarially neutral premiums.

Using this method, rates were developed for discrete combinations of farm and regional average yields for use in insurance rate tables.

Analysis of Income Protection

The premium rates offered in Income Protection are developed through a nonparametric statistical model that constructs a revenue distribution on the basis of actual price and yield data. This model does not make any assumptions about the shape of the actual revenue distribution or about price and yield distributions; such assumptions could bias the estimates of expected losses.

As part of the rate-setting method, this model takes into account all of the variability in price and yield data, as well as changes in the price-yield correlation; therefore, it is not necessary to estimate these factors separately. The advantage of this approach is that the shape of the revenue distribution is generated by the actual crop data. Therefore, the error of incorrectly imposing a shape on the revenue distribution is avoided. However, if the underlying distribution is known, a nonparametric method may have an inherent disadvantage of producing less efficient estimates than a parametric method.

While Income Protection appropriately relies on an integrated statistical model to estimate probable losses, it does not consider how revenue may change in response to the new farm policy. That is, Income Protection relies on historical crop prices to estimate rates, which, as previously discussed, may not reliably predict future crop prices. Developers of the Income Protection plan believe that because of the effect of previous farm programs, historical data sets may underestimate the variances in future farm prices. This would mean that premium rates would be too low to accommodate future price fluctuations and therefore future losses. In order to account for this effect, a 20-percent loading factor was added to the premium.

Comments From the U.S. Department of Agriculture

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

USDA United States Department of Agriculture
Risk Management Agency
Stop 0801
1400 Independence Avenue, SW
Washington, DC 20250-0801

April 6, 1998

Mr. Robert A. Robinson
Director, Food and
Agricultural Issues
Resources, Community and
Economic Devleopment Division
US General Accounting Office
441 "G" Street. N.W.
Washington DC 20548

Dear Mr. Robinson;

Re: Comments From USDA's Risk Management Agency Regarding GAO's Draft Report (RCED-98-111)

See comment 1.

Risk Management Agency (RMA) does not agree with the report recommendation to "... address the shortcomings in the methods used to set premiums ..." and base premium rates for Crop Revenue Coverage (CRC) " ... on a revenue distribution of farm-level yields and expected prices rather than an addition to the rate structure for traditional multiple-peril crop insurance." The report does not provide evidence that there are fatal flaws in the rating methods for the revenue products.

See comment 2.

The document implicitly assumes that premium rates for revenue coverage (without replacement coverage) always are lesser than rates for yield coverage. But, at low levels of yield-price correlation, the price component may simply add more variability and result in higher rates than would be charged for yield coverage only. Under certain probability distributions (such as normal) for both yield and price and with certain assumptions about the coefficients of variation, the correlation must be quite strong before the revenue rate is lower. This common misconception is embedded in the report (for example, see top of page 9).

Now on p. 7.

See comment 3.

The report infers there is a lack of actuarial soundness in the premium rates for the revenue products offered in recent years. However, the term neither is defined in the report nor are there quantitative analyses that support the inference. Actuarial soundness exists in probabilities and business decisions. Statistical measures of premium rate adequacy depend upon many key variables, such as the degree of rate stability that is desired over time; the ability of the insurer to weather an adverse outcome; and many other business and financial factors.

See comment 4.

The report expresses concern about the rating model for CRC, specifically stating that it does not recognize yield-price correlation. Instead, in the words of GAO, the method "... mechanically increases [the multiple peril] rates ...." RMA does not believe this is an accurate depiction. The CRC rating model assumes that yield and price both follow normal distribution functions and that these variables are uncorrelated. If one builds a Monte Carlo model that incorporates these assumptions, as did a representative of Michigan State University, it can be shown that the premium rates obtained by the developing company using their methodology are reasonably consistent with the underlying assumptions. There is an easily correctable bias -- the premium rates from the Monte Carlo method are slightly higher at low premium rates for the multiple-peril coverage and slightly lower at high multiple-peril premium rates. It is not appropriate to describe the CRC rating method as a mechanical process. It is no more mechanical than applying a Monte Carlo model containing the assumptions about the probability distributions (as is done by Revenue Assurance).

See comment 5.

The report questions the treatment of price volatility in the various models. Both CRC and Income Protection (IP) use fluctuations in market prices since the early 1970s as a measure of the variation in prices. Revenue Assurance (RA) uses current year measures of price volatility by comparing prices for options against the price for the underlying futures contract. The premium charged for the probability of loss due to price change will be more constant over time for CRC and IP than it will for RA. Premiums for the price component of RA will fluctuate, perhaps substantially, from year to year as the market's assessment of the volatility changes. Hence, RA is likely to charge lower premiums for the price component than will be charged under CRC and IP in years of low volatility and vice versa. No one has demonstrated that either approach is superior. It is a factor that must be monitored, but one can say the same about the methods and data used to estimate the underlying yield premium rate. As farming technology changes, the rating basis must be monitored to assure it adequately captures changes in the volatility of yield.

Now on pp. 5-6.
See comment 6.

The report includes comparisons made out of context, such as on page 7, wherein a statement is made that losses paid in 1996 for wheat would have been $172 million higher under CRC. RMA does not understand the intent of this statement. Is inference being made that it would have been inappropriate to pay a loss that is guaranteed by that plan of insurance? Farmers are charged substantially more premiums for the coverage provided by CRC; therefore, it is reasonable to expect that losses at times will exceed those paid under the multiple-peril coverage.

See comment 7.

RMA notes that GAO cites the 1981-1996 loss ratio of 1.26 and report GAO/RCED-93-98 as reasons for concern about financial outcomes. However, report GAO/RCED-95-269 estimates that the expected loss ratio is significantly lower than 1.26 based on current premium rates.

See comment 8.

The rating models for each of the three revenue products have undergone review by competent professionals other than their developers. While there is disagreement about the treatment of certain variables -- such as price volatility -- no one has documented a fatal flaw in any of the models. This is very much an area in which ideas are advanced and tested, as is appropriate with any professional review. However, until one or all the models are demonstrated to contain fatal flaws, RMA believes their use is appropriate.

See comment 9.

RMA does not necessarily endorse or is fully comfortable with all aspects of the models or, more importantly, the implications that these competing methodologies have for market order or market behavior. These models will need to be continually analyzed for implications about premium rates not only for the risk associated with the price component but also with regard to the risk associated with the yield component. The yield component remains the biggest part of the premium rate. The models for these products can provide insights for the rating of multiple-peril crop insurance also. These analyses are a continuing process. RMA believes a more appropriate recommendation should read "RMA must continually evaluate all rate-making methodologies (yield as well as revenue) to assure that yield and price volatilities are incorporated in the premium rates in accordance with accepted actuarial practice and economic principles." The report infers that something is drastically wrong, but simply fails to provide any evidence to support that inference.

See comment 10.

GAO's reference to the expansion of CRC fails to acknowledge the Federal Crop Insurance Corporation's (FCIC) authority. Per section 508(h) of the Federal Crop Insurance Act, as amended, FCIC has the authority for expansion if the submission is deemed actuarially sound and is approved by the Board.

See comment 11.

Regarding CRC Administrative & Operating (A&O) subsidy, GAO states that CRC premium is 30 percent higher than MPCI, yet there is no explanation on how this percentage was developed. GAO's report contains no evaluation of the additional expenses incurred to deliver CRC. RMA is conducting an analysis of the 1997 calendar year company expenses, including the CRC related expenses. GAO should reserve its comments regarding CRC A&O subsidy until sufficient information has been collected to substantiate the actual premium increase percentage and the actual additional expenses incurred.

We appreciate the opportunity to comment on this draft report.

Sincerely

Acting for

Kenneth Ackerman
Administrator

The following are GAO's comments on the U.S. Department of Agriculture's letter dated April 6, 1998.

GAO's Comments

1. We disagree. While we do not state in this report, nor do we believe, that the plans contain "fatal flaws," we believe that the shortcomings we identified in all three revenue insurance plans are serious enough to warrant a reevaluation of the methods and data used to set premium rates to ensure that each plan is based on the most actuarially sound foundation. In particular, as we reported, the rating method for Crop Revenue Coverage is especially problematic because it does not take into account the relationship between crop prices and yields.

2. Contrary to the agency's assertion, we do not assume that the premium rates for revenue coverage (without replacement coverage) are always lower than the premium rates charged for yield coverage. We agree with the agency that the rates for these revenue plans can be higher than those for yield coverage when both yields and prices decline. For this reason, throughout the report, we say that a decline in yield is "often" accompanied by an increase in prices.

3. In using the term "actuarial soundness," we mean that the premiums established for each plan are sufficient over the long term to cover the indemnities paid, and that individual premiums are appropriate to the risk each farmer presents. We have revised the report to clarify our use of this term.

4. We have removed the word "mechanical" from the report.

5. We disagree. Estimates of future price volatility based on historical prices and estimates of price volatility based on current market expectations are not equally appropriate. Crop Revenue Coverage and Income Protection base their estimates of future price increases or decreases on the way that prices moved in the past, when certain farm programs were in place that set a price floor. This situation has changed. Under current policy, when prices are tied to market conditions, we continue to believe that the market's expectation of price volatility is the best barometer of intra-year price changes.

6. In the executive summary, we have modified the language to reflect the partially offsetting effects of Crop Revenue Coverage's higher premiums. Our discussion in chapter 2 already reflected this point. Nevertheless,

when crop prices are higher at harvest than at planting, claims payments for Crop Revenue Coverage will exceed those paid for multiple-peril crop insurance.

7. We have modified our report to reflect the fact that in recent years the agency has improved its expected loss ratio for traditional multiple-peril crop insurance to achieve the current legislatively mandated 1.10 loss ratio.

8. See comment 1. In addition, we believe that as shortcomings in the methods used to establish premium rates are identified, the Risk Management Agency should take action to correct the deficiencies to the extent possible.

9. We agree that the agency must continually evaluate all rate-making methodologies. However, when this evaluation reveals shortcomings, as we point out in this report, then evaluations should be translated into actions to ensure that each plan is based on the most actuarially sound foundation.

10. We have modified our report to reflect the agency's authority to approve expansion of Crop Revenue Coverage.

11. The Risk Management Agency's senior actuary informed us that the premium rates for Crop Revenue Coverage average about 30 percent higher than comparable premium rates for traditional multiple-peril crop insurance. Because administrative expense reimbursements are based on fixed percentage of premiums, higher premiums for Crop Revenue Coverage will result in higher administrative costs to the government. A judgment on whether the reimbursement is adequate to cover expenses was beyond the scope of our work.

Major Contributors to This Report

Robert C. Summers, Assistant Director
Thomas M. Cook, Evaluator-in-Charge
Barbara J. El Osta
Donald L. Ficklin
Mary C. Kenney
Robert R. Seely, Jr.
Carol Herrnstadt Shulman

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