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MATHEMATICAL FORMULAS FOR CALCULATING NET RETURNS FROM PARTICIPATION IN GOVERNMENT PROGRAMS, CRP, AND CROP INSURANCE ALTERNATIVES

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INTRODUCTION

The purpose of this report is to provide a revised version of the publication, "Mathematical Formulas for Calculating Net Returns from Participation in Government Commodity Programs including Marketing Loans" (Williams and Barnaby, 1994). The change in design of the government commodity programs and development of several crop insurance alternatives has been significant since the previous paper was published. The formulas for calculating net returns incorporate provisions from the Farm Security and Rural Investment Act of 2002 and several crop insurance designs developed in the 1990s. Individuals conducting research or education programs will be able to use this revision for reference when estimating net returns for producers under current commodity program and crop insurance plan provisions.

The scenarios that are provided in this report are:

1. No Commodity Program;
2. No Commodity Program with Crop Insurance
    a. Yield Insurance
        i. Multiple Peril Crop Insurance (MPCI)
    b. Replacement Revenue Coverage
        i. Crop Revenue Coverage (CRC)
        ii. Revenue Assurance with Harvest Price Option (RA-HPO)
    c. Revenue Insurance
        i. Income Protection (IP)
        ii. Revenue Assurance with Base Price Option (RA-BPO)
    d. Index Insurance

        i. Group Risk Plan (GRP)
        ii. Group Risk Income Protection (GRIP)
    e. Catastrophic Coverage Insurance;
3. No Commodity Program with the Conservation Reserve Program;
4. No Commodity Program with Crop Insurance, and Conservation Reserve Program;
5. Commodity Program only;
6. Commodity Program with Crop Insurance
    a. Yield Insurance
        i. Multiple Peril Crop Insurance (MPCI)
    b. Replacement Revenue Coverage
        i. Crop Revenue Coverage (CRC)
        ii. Revenue Assurance with Harvest Price Option (RA-HPO)
    c. Revenue Insurance
        i. Income Protection (IP)
        ii. Revenue Assurance with Base Price Option (RA-BPO)
    d. Index Insurance
        i. Group Risk Plan (GRP)
        ii. Group Risk Income Protection (GRIP)
    e. Catastrophic Coverage Insurance (CAT);
7. Commodity Program with the Conservation Reserve Program;
8. Commodity Program with Crop Insurance and the Conservation Reserve Program.

The equations contained in this report can be used to calculate net returns by county for a single crop enterprise or a multicrop enterprise on a farm that may or may not be enrolled in or eligible for government programs. Calculations can be done on a cash or total cost basis: total costs including the opportunity costs required to estimate net returns to management; labor and management; or land, labor, and management.

Scenarios 1-4 describe the estimation of net returns when the farm enterprises under consideration are not enrolled in the government commodity program. Scenarios 5-8 characterize the estimation of net returns when one or more of the farm enterprises are enrolled in the government commodity program. Attention to the variable subscripts is particularly important.

Prices and parameter values that pertain to the 2002-2003 and 2004-2007 government programs can be found in Table 2. Some provisions may change or be reinterpreted from time to time. Additionally, some information is location specific, (i.e., crop insurance premium rates) or farm specific (i.e., program yields) and, therefore, must be provided by the user.

Before proceeding to the scenarios, a discussion of insurance units is appropriate. A unit is defined as acreage of an insured crop in a county which is taken into consideration when determining the guarantee, premium, and the amount of any indemnity payment for that acreage (RMA, 2002). All acreage within a county for the same crop must be insured. Basic, optional, enterprise, and whole farm insurance units are described as follows:

a. Basic insurance unit- all insurable acreage of an insured crop in a county on the date coverage begins for a crop (USDA, 2002). All owned and cash rented crop acres are insured independently as a basic unit. For each crop

share lease, growers qualify for an additional independently insured basic unit by crop. This unit is used for MCPI, RA-BPO, CRC, RA-HPO, and CAT.

b. Optional insurance unit- if certain criteria are met, then basic units can be divided into separate insurance units (Edwards, 2003). This unit is used for MPCI, RA-BPO, CRC, and RA-HPO.

c. Enterprise insurance unit- all acreage of a particular enterprise in a county are insured as a single unit (Edwards, 2003). This unit is used for IP, RA-BPO, CRC, and RA-HPO.

d. Whole farm insurance unit- all acreage of corn and soybeans insured in a county are covered under one insurance unit (Edwards, 2003). This unit is used for RA-BPO and RA-HPO.

Different crops can be insured with different insurance products and unit designations. A manager that produces a crop in more than one county can insure the same crop using different insurance plans as long as one plan is applied to all units of the crop in a single county. The equations in this report apply to a single county although they could be easily used for multiple counties by adding a county summation index.

NONPARTICIPATION IN COMMODITY PROGRAMS

The equations in this section are used to estimate net returns when a producer is not enrolled in the government program. Formulas estimating net returns for nonparticipation along with the use of crop insurance and/or participation in the conservation reserve program are also included.

Scenario 1. No Commodity Program

The following equations can be used to estimate net returns for producers that do not use government commodity programs. Net returns are a function of commodity

prices, yields, grazing values, and cost of production estimates. This scenario has no price protection, yield protection, or supplemental income.

$$TNR = \sum_{c=1}^{n} NR_c \tag{1}$$

where:

TNR	=	total net returns,
NR_c	=	net returns from crops not enrolled in a government commodity program.

$$\sum_{c=1}^{n} NR_c = \sum_{c=1}^{n} \left[\left(\left(MP_c \times HY_c \right) - VC_c - FC_c - OSMC_c + OSGV_c \right) \times PA_c \right] \tag{2}$$

where:

c	=	crop c, not enrolled in a commodity program,
MP_c	=	market price ($ per unit),
HY_c	=	harvested yield (units per planted acre),
VC_c	=	variable costs per planted acre,
FC_c	=	fixed costs per planted acre,
$OSMC_c$	=	off season maintenance cost per planted acre,
$OSGV_c$	=	off season grazing value per planted acre,
PA_c	=	planted acres.

Scenario 2. No Commodity Program with Crop Insurance

Crop insurance premiums are deducted from the gross income because they are costs of production. If a producer does collect a crop insurance indemnity payment, then it is added to gross income.

Insurable yields are determined by each producer's actual production history (APH). The APH yield is determined from producer production records for a minimum of 4, up to 10 consecutive crop years. For producers who provide less than 4 years of actual yields, variable Transitional "T" Yields are used to complete the 4-year database.

$$TNR = \sum_{c=1}^{n} NR_c + \sum_{c=1}^{n} NRCI_c \tag{3}$$

where:

TNR	=	total net returns,
NR_c	=	net returns from crops not enrolled in a government commodity program (see equation 2),
$NRCI_c$	=	net returns from crop insurance (see equation 36).

Scenario 2.a.i Multiple Peril Crop Insurance (MPCI)

MPCI is the longest running crop insurance program. Some United States Department of Agriculture (USDA) literature refers to the MPCI product as the "APH" product. However, APH rules also apply to revenue insurance products. MPCI coverage provides protection against low yields and poor quality, as well as, prevented planting, late planting, and replanting costs for most crops. Coverage is available at 50 to 75% in 5% increments (in some areas up to 85%) of APH for the farm. An indemnity price election from 55 to 100% of the Risk Management Agency (RMA) expected market price (when available on the crop) is selected at the time of purchase. If the harvest yield is less than the yield insured, the farmer is paid an indemnity based on the difference multiplied by the price election selected by the farm manager. A manager must insure all acres of a crop in a county whether or not it is produced on owned or rented land

including both irrigated and dryland practices. Producers have two choices under MPCI: 1) Yield election, and 2) Indemnity price.

Yield Guarantee

The yield guarantee is calculated by multiplying the APH yield by a producer-chosen yield election. Yield elections range from 50 to 75% of APH yield and 80 or 85% of APH yield is offered in selected locations.

Indemnity payments

MPCI pays indemnities when actual yield falls below the yield guarantee. The payment equals the yield shortfall times the indemnity price. The farm manager chooses the indemnity price at the time the insurance is purchased. The highest indemnity price possible is the price determined by the USDA Risk Management Agency (RMA). The lowest price possible is 55% of the RMA price. For example if the RMA price for corn is \$2.00, then the range of indemnity prices is \$1.10 (55% × \$2.00) and the highest is \$2.00 (100% × \$2.00).

Net revenue for MPCI which can be negative, zero or positive is calculated as follows:

$$\sum_{c=1}^{n} NRMPCI_c = \sum_{c=1}^{n} \sum_{u=1}^{m} \left[\left(\max\left\{ \left(YG_{cu} - HY_{cu} \right) \ , \ 0 \right\} \times INDP_c - MPCIP_{cu} \right) \times PA_{cu} \right] \qquad (4)$$

where:

c	=	crop c, insured with MPCI,
u	=	insurance unit u
$NRMPCI_c$	=	net returns from insurance for crops with MPCI,

YG_{cu} = yield guarantee (units per acre)

$$= APH_{cu} \times YE_c, \quad (5)$$

APH_{cu} = actual production history (units per acre),

YE_c = yield elections range from 50% to 85% in 5% increments (USDA RMA, 2003),

HY_{cu} = harvested yield (units per planted acre),

$INDP_c$ = indemnity price ranges from 55% to 100% of RMA price (USDA RMA, 2003),

$MPCIP_{cu}$ = MPCI premium ($ per acre),

$$= INDP_c \times CL_c \times APH_{cu} \times PR_{cu}, \quad (6)$$

CL_c = coverage level,

PR_{cu} = premium rate (set by RMA),

PA_{cu} = planted acres per insurance unit.

Scenario 2.b.i Crop Revenue Coverage (CRC)

CRC is revenue insurance that protects against low yields, low prices, or a combination of low yields and low prices. CRC pays an indemnity when actual gross revenue falls below a revenue guarantee. An insurable yield loss is not required for a CRC indemnity payment as it is with MPCI. Prices used to calculate revenue under CRC are based on Chicago Board of Trade (CBOT) and Kansas City Board of Trade (KCBOT) futures contracts (Table 1). Prices used to calculate the CRC spring wheat price is based on the Minneapolis Grain Exchange (MGE) futures contract. CRC's revenue guarantee increases between planting and harvest if the futures price rises. CRC can be used to insure basic, optional, and enterprise insurance units.

Revenue guarantee

CRC's revenue guarantee equals the APH yield multiplied by the higher of the base price or harvest time price, by the coverage level. Base and harvest time market prices are described below:

1. Base market prices are determined by averaging the CBOT, KCBOT, and MGE futures contract settlement prices during various months. Base prices are released prior to the deadline for purchasing crop insurance and vary year to year.

2. Harvest time market prices are determined by averaging CBOT, KCBOT, and MGE futures contract settlement prices. The only exception is for white wheat contracts in the Pacific Northwest. USDA determines this price. These prices reflect market conditions during harvest.

The producer selects the coverage level. The coverage level can be between 50 and 85% in 5% increments of expected gross revenue in most regions of the country. The process of calculating the revenue guarantee is a two-step process: 1) Determining the base guarantee and 2) Updating the base guarantee.

Determining the base guarantee

Prior to the deadline for signing up for insurance, base market prices are used to calculate a "base revenue guarantee." This base revenue provides a revenue floor. The final revenue guarantee will never be below the base revenue guarantee. For corn insured with CRC, the average of the February settlement prices at the CBOT of the December contract is used. For soybeans, it is the February average of the CBOT November contract. For wheat, the base price is calculated using the August 15 to September 14 average settlement price for July KCBOT hard red winter wheat futures contract. For grain sorghum in Kansas, the base price is 95% of the corn CBOT futures contract (i.e.,

average of the February settlement prices of the December contract). These dates for calculating prices apply to Kansas and many other Midwestern states. Alternate price measurement dates and futures exchanges are used to reflect class of wheat, planting dates and harvest dates in other states.

Updating the guarantee

The base revenue guarantee will increase if the harvest time market price based on futures prices is greater than the base market price determined by the futures price before sign up. In these cases, the harvest time market price is used in calculating the revenue guarantee. However, there are liability limits on harvest time market price increases when updating base revenue guarantee. The liability limits on the harvest time market price differences for a particular crop cannot range above or below the base market price by a pre-specified amount. For example, the harvest time market price for corn and grain sorghum cannot be $1.50/bu. above or below the base market price. The limit amount is $2.00/bu. for wheat, and $3.00/bu. for soybeans, and $.70/lb. for cotton. The final price used for the final revenue guarantee will never be below the base price. However, the harvest time price for insurance purposes may be below the base price. The harvest price is used to calculate the market revenue, which is subtracted from the revenue guarantee, but this price cannot fall below the base price minus the liability limit even if the actual harvest time market price is below the base price minus the limit. If prices rise the final revenue guarantee price can never be above the base price plus the liability limit even though the actual market price may be higher than the base price plus the limit. This limits the amount of revenue liability to CRC because the final revenue guarantee is limited.

Gross revenue

Gross revenue is used to calculate indemnity payments. Gross revenue equals actual yield multiplied by the harvest price. In most cases, gross revenue does not equal the revenue a producer receives for the crop. Prices used to calculate revenue under CRC are based on CBOT futures contracts. For corn insured with CRC, the average of the October settlement prices of the December contract is used. For soybeans, the value is the October average of the November contract. States that have a contract closing date before March 15 use earlier months for setting base and harvest prices on corn and soybeans based on the September CBOT futures contract. For wheat in Kansas, it is the June average of the Kansas City July contract. These dates also apply to wheat grown in states located south of Kansas, while states located north of Kansas use a later date for measuring harvest prices. Appropriate monthly wheat prices based on the MGE, CBOT, and Portland are used to set base and harvest prices for other classes of wheat. CRC defines the grain sorghum harvest price as 95% of the corn CBOT futures contract (i.e., average of the October settlement prices of the December contract). In most cases, cash prices at harvest time do not equal futures prices. CRC and the other insurance products, which will be discussed, do not require sales of the crop at harvest-time. Prior to harvest, a producer may also forward contract, hedge grain production using futures contracts, or employ options. A producer is also free to store grain for later sale.

Net revenue for CRC is calculated in the following equation:

$$\sum_{c=1}^{n} NRCRC_c = \sum_{c=1}^{n} \sum_{u=1}^{m} \left[\left(\max\left\{ \left(RG_{cu} - GR_{cu} \right) \ , \ 0 \right\} - CRCP_{cu} \right) \times PA_{cu} \right] \tag{7}$$

where:

c	=	crop c, insured with CRC,
u	=	insurance unit u,
$NRCRC_c$	=	net returns from insurance for crops with CRC,
RG_{cu}	=	revenue guarantee ($ per acre)
	=	$APH_{cu} \times \max\{BP_c, IP_c\} \times CL_c,$ (8)
IP_c	=	indemnity price
	=	$\max\{\min(HP_c, BP_c + LL_c), \max(BP_c - LL_c, 0)\}$ (9)
APH_{cu}	=	actual production history (units per acre),
BP_c	=	95% or 100% of base market price from futures ($ per unit),
HP_c	=	95% or 100% of harvest time market price from futures ($ per unit),
LL_c	=	liability limit ($/bu.),
CL_c	=	revenue coverage level ranges from 50% to 85% in 5% increments in most counties (USDA RMA, 2003),
GR_{cu}	=	gross revenue per acre
	=	$IP_c \times HY_{cu},$ (10)
HY_{cu}	=	harvested yield (units per planted acre),
$CRCP_{cu}$	=	CRC insurance premium ($ per acre)
	=	$BPP_c \times CL_c \times APH_{cu} \times PR_{cu},$ (11)
BPP_c	=	base price for premium is 95 or 100% of BP_b,
PR_{cu}	=	premium rate (set by RMA),
PA_{cu}	=	planted acres per insurance unit.

Scenario 2.b.ii Revenue Assurance with a Harvest Price Option (RA-HPO)

RA-HPO and CRC are very similar insurance products. RA-HPO can be used for a whole farm insurance unit in addition to the basic, optional, and enterprise units. RA-HPO does not have limits on the harvest time market price increase or decrease. Some settlement prices used to determine the harvest price for RA-HPO are determined differently than CRC. Harvest time market prices for RA for corn are the CBOT November average settlement prices of the December corn contract. Soybeans are the October average of the CBOT November contract and wheat in Kansas is the July 1 to July 14 average of the KCBOT July contract. Similar to CRC, appropriate price measurements periods based on appropriate futures markets are used to set base and harvest prices for RA insured crops in other states. RA-HPO for grain sorghum is not available in Kansas. Base prices for corn are the February average settlement prices of the December CBOT contract, and soybeans are the February average settlement prices of the November CBOT futures contract. Wheat is the August 15 to September 14 average price for "the new crop" July KCBOT hard red winter wheat contract. Like the harvest time market price, base prices for grain sorghum are not available. RA can be used to insure basic, optional, enterprise, and whole farm (combines corn and soybean acres into a single unit) insurance units. Premiums may differ between CRC and RA-HPO.

Net revenue for RA-HPO is calculated in the following equation:

$$\sum_{c=1}^{n} \mathrm{NRRAHP}_c = \sum_{c=1}^{n} \sum_{u=1}^{m} \left[\left(\max\left\{ \left(\mathrm{RG}_{cu} - \mathrm{GR}_{cu} \right) \ , \ 0 \right\} - \mathrm{RAHPP}_{cu} \right) \times \mathrm{PA}_{cu} \right] \tag{12}$$

where:

c	=	crops, insured with RA-HPO,
u	=	insurance unit u,
$NRRAHP_c$	=	net returns from insurance for crops with RA-HPO,
RG_{cu}	=	revenue guarantee ($ per acre)
	=	$APH_{cu} \times \max\{BP_c, HP_c\} \times CL_c$, (13)
APH_{cu}	=	actual production history (units per acre),
BP_c	=	base market price from futures ($ per unit),
HP_c	=	harvest time market price from futures ($ per unit),
CL_c	=	revenue coverage level ranges from 65% to 85% in 5% increments (Edwards, 2003c) in most counties,
GR_{cu}	=	gross revenue per acre
	=	$HP_c \times HY_{cu}$, (14)
HY_{cu}	=	harvested yield (units per planted acre),
$RAHPP_{cu}$	=	RA-HPO insurance premium ($ per acre)
	=	$BP_c \times CL_c \times APH_{cu} \times PR_{cu}$, (15)
PR_{cu}	=	premium rate (approved by RMA),
PA_{cu}	=	planted acres per insurance unit.

Scenario 2.c.i Income Protection (IP)

IP is revenue insurance protecting against low prices, low yields, or a combination of low prices and low yields. IP makes indemnity payments when gross revenue falls below a revenue guarantee.

Revenue guarantee

The revenue guarantee equals the APH yield multiplied by a base market price and by the coverage level. The coverage level is selected by the producer and ranges from 50 to 75% in 5% increments of expected gross revenue. Unlike CRC or RA-HPO, IP does not have the option of increasing the base revenue guarantee if harvest time prices are higher than the base market price.

Like CRC, base market prices for corn are calculated using average December CBOT futures contracts during the month of February. For soybeans, the value is the February average of the November contract and for wheat the value is the average settlement price for August 15 to September 14 on the July CBOT soft red winter wheat contract. IP is not available for grain sorghum in Kansas. Base market prices are released prior to the deadline for purchasing crop insurance. These prices reflect estimates of futures prices at harvest-time. IP offers only the enterprise insurance unit.

Gross revenue

Gross revenue is used to calculate indemnity payments. Gross revenue equals actual yield times the harvest time market price. The harvest time market price is based on CBOT futures contracts. The harvest price for corn is the November average for December the CBOT contract. For soybeans, the October average for the November CBOT futures contract is used. For Kansas wheat, the harvest price is the June average closing prices for July Chicago soft red winter wheat futures contract. In most cases, gross revenue does not equal the revenue a farmer receives for the crop, because they may sell the crop for a different price or use contracting, hedging, or option methods which affect the final price. Prices used to calculate revenue under IP are also based on

CBOT futures contracts. Usually, cash prices at harvest time are below futures prices. A producer is also free to store grain for later sale.

Net revenue for IP is calculated in the following equation:

$$\sum_{c=1}^{n} NRIP_c = \sum_{c=1}^{n}\left[\left(\max\left\{\left(RG_c - GR_c\right)\ ,\ 0\right\} - IPP_c\right)\times PA_c\right] \tag{16}$$

where:

c	=	crop c, insured with IP,
$NRIP_c$	=	net returns from crops with IP,
RG_c	=	revenue guarantee ($ per acre)
	=	$APH_c \times BP_c, \times CL_c,$ (17)
APH_c	=	actual production history (units per acre),
BP_c	=	base price ($ per unit),
CL_c	=	common revenue coverage level range from 50% to 75% in 5% increments (Edwards, 2003c), although 85% is offered in some regions,
GR_c	=	gross revenue per acre
	=	$HP_c \times HY_c,$ (18)
HP_c	=	harvest market price ($ per unit),
HY_c	=	harvested yield (units per planted acre),
IPP_c	=	insurance premium ($ per acre)
	=	$BP_c \times CL_c \times APH_c \times PR_c,$ (19)
PR_c	=	premium rate (set by RMA),
PA_c	=	planted acres.

Scenario 2.c.ii Revenue Assurance with a Base Price Option (RA-BPO)

RA-BPO and IP are very similar insurance products. However, unlike IP, which only allows enterprise units, RA-BPO allows basic, optional, enterprise, and whole-farm (combines corn and soybean acres into a single unit) insurance units. RA-BPO has 80 and 85% revenue coverage levels, where IP revenue coverage only ranges up to a 75% coverage level in Kansas. Premiums may differ between the two products.

The base market price for corn is the February average of the CBOT December futures contract under RA-BPO. For soybeans, the February average of the CBOT November contract is used. Wheat in Kansas is the August 15 to September 14 average price of July KCBOT hard red winter wheat futures contract. For grain sorghum, RA-BPO is not available.

The RA-BPO harvest time market price for corn is the November average of the CBOT December futures contract. The soybean value is the October average of the November CBOT contract. Wheat is the July 1 to July 14 average of the July KCBOT hard red winter wheat contract.

Net revenue for RA-BPO is calculated in the following equation:

$$\sum_{c=1}^{n} \mathrm{NRRABP}_c = \sum_{c=1}^{n} \sum_{u=1}^{m} \left[\left(\max\left\{ \left(\mathrm{RG}_{cu} - \mathrm{GR}_{cu} \right), 0 \right\} - \mathrm{RABPP}_{cu} \right) \times \mathrm{PA}_{cu} \right] \tag{20}$$

where:

c	=	crop c, insured with RA-BPO,
u	=	insurance unit u,
NRRABP_c	=	net returns from crops with RA-BPO,

RG_{cu} = revenue guarantee ($ per acre)

$$= APH_{cu} \times BP_c, \times CL_c, \quad (21)$$

APH_{cu} = actual production history (units per acre),

BP_c = base price ($ per unit),

CL_c = revenue coverage level 65% to 85% (Edwards, 2003c),

GR_{cu} = gross revenue per acre

$$= HP_c \times HY_{cu}, \quad (22)$$

HP_c = harvest market price ($ per unit),

HY_{cu} = harvested yield (units per planted acre),

$RABPP_{cu}$ = insurance premium per acre

$$= BP_c \times CL_c \times APH_{cu} \times PR_{cu}, \quad (23)$$

PR_{cu} = premium rate (set by insurance company and approved by RMA),

PA_{cu} = planted acres per insurance unit.

Scenario 2.d.i Group Risk Plan (GRP)

This policy uses a county index as the basis for determining a loss. When the actual county yield for the insured crop, as determined by the National Agricultural Statistics Service (NASS), falls below the trigger yield, an indemnity is paid. Payments are not based on the individual producer's loss records, rather for the entire county. Indemnity payment equals the percent yield shortfall times a protection level. Producers have two choices under GRP: 1) Yield election, and 2) Protection level.

Trigger yield

Under GRP, the trigger yield equals the expected county yield times a producer-chosen coverage level (also called yield election). Expected county yields are based on the county's historical average. Yield election levels ranges from 70 to 90% in 5% increments of expected county yield.

Actual County Yield

The actual county yield is calculated by NASS. NASS releases county yields by March in the year after the crop is harvested.

Dollars of Protection

Under GRP, the level of protection is chosen by the farm manager. The dollars of protection is calculated by selecting the revenue coverage percent and multiplying it by the maximum dollar of protection available for the crop and practice. The liability coverage levels range from 60 to 90% of the maximum dollars of protection. The maximum protection level is calculated by multiplying the expected county yield by the MPCI price and 150%.

Net revenue for GRP is calculated in the following equation:

$$\sum_{c=1}^{n} NRGRP_c = \sum_{c=1}^{n} \left\{ \left[\left(\left\{ \max\left[TY_c - ACY_c, 0 \right] / TY_c \right\} \times PL_c \right) - GRPP_c \right] \times PA_c \right\} \tag{24}$$

where:

c	=	crop c, insured with GRP,
$NRGRP_c$	=	net returns from insurance for crops with GRP,

TY_c = trigger yield (units per acre)

= $ECY_c \times YE_c$, (25)

ECY_c = expected county yield (units per acre),

YE_c = yield election or coverage level ranges from 70% to 90% in 5% increments (Edwards, 2003c),

ACY_c = actual county yield or payment yield determined by NASS (units per acre),

PL_c = dollars of protection per acre

= $CL_c \times$ maximum dollars of protection per acre from actuarial documents

= maximum dollars of protection per acre = $ECY_c \times PMPCI_c \times 1.5$, (26)

$PMPCI_c$ = MPCI price ($ per unit),

CL_c = coverage level ranges from 60% to 100% (USDA RMA, 2003),

$GRPP_c$ = insurance premium per acre,

PA_c = planted acres per county.

The calculation, $\max(TY_c - ACY_c, 0) / TY_c$, in equation 24 is the percent that the actual county yield is below the trigger yield.

Scenario 2.d.ii Group Risk Income Protection (GRIP)

Like GRP, GRIP is a "low" cost group insurance program designed to help protect the manager from losses. Under GRIP, producers can receive indemnity payments when the actual county revenue falls below the trigger revenue. The indemnity payment equals the percent revenue shortfall times a protection level. Producers have two choices under GRIP: 1) Coverage level, and 2) Protection level.

Trigger revenue

GRIP's trigger revenue equals the expected county yield, times an expected market price, times a farm manager-chosen coverage level. Like GRP, expected county yields are based on historical yields for each county as determined by NASS. The expected market price is based on the average futures prices for the last five trading days prior to March 1. For corn and soybeans the market is the CBOT. The farm manager can choose a coverage level in a range between 70 and 90% of the trigger revenue in 5% increments.

Actual county revenue

Actual county revenue is used in calculating indemnity payments. Actual county revenue equals actual county yield multiplied by the harvest time market price. The actual county yield is calculated by NASS. NASS releases county yields by March in the year after the crop is harvested. The harvest time market price is based on CBOT futures contracts for a particular month during harvest (i.e., corn is the average of the December futures contract price during November).

Dollars of Protection

Like GRP, the dollars of protection or liability insured under GRIP is chosen by the farm manager. The dollars of protection is calculated by selecting the revenue coverage percent and multiplying it by the maximum dollar of protection available for the crop and practice. The revenue coverage levels range from 60 to 90% of the maximum dollars of protection. The protection level is calculated by multiplying the expected market price from futures, by the expected county yield and by 150%.

Net revenue for GRIP is calculated in the following equation:

$$\sum_{c=1}^{n} NRGRIP_c = \sum_{c=1}^{n} \left\{ \left[\left(\left\{ \max\left[TR_c - ACR_c, 0 \right] / TR_c \right\} \times PL_c \right) - GRIPP_c \right] \times PA_c \right\} \quad (27)$$

where:

c	=	crop c, insured with GRIP,
$NRGRIP_c$	=	net returns from crops with GRIP,
TR_c	=	trigger revenue
	=	$ECY_c \times EP_c \times TRE_c$, (28)
ECY_c	=	expected county yield per acre,
EP_c	=	expected market price ($/bu.),
TRE_c	=	trigger revenue election ranges from 70% to 90% in 5% increments (USDA RMA, 2003),
ACR_c	=	actual county revenue ($ per acre)
	=	$ACY_c \times HP_c$, (29)
ACY_c	=	actual county yield or payment yield per acre determined by NASS,
HP_c	=	harvest market price ($/bu.),
PL_c	=	dollars of protection per acre
	=	$CL_c \times$ maximum dollars of protection per acre from actuarial documents
	=	maximum dollars of protection per acre = $ECY_c \times BP_c \times 1.5$, (30)
BP_c	=	base price from futures ($ per unit),
CL_c	=	coverage level ranges from 60% to 100% (USDA RMA, 2003),
$GRIPP_c$	=	insurance premium per acre,

PA_c = planted acres per county.

The calculation, $\max(TR_c - ACR_c, 0)/TR_c$ in equation 27, is the percent that the actual county revenue is below the trigger revenue.

Scenario 2.e Catastrophic Coverage (CAT)

CAT is minimum coverage yield insurance and pays indemnities when actual yield is below a yield guarantee. CAT pays 55% of the established market price (set by RMA in January for spring planted crops) of the commodity on crop losses in excess of 50% of the APH (also called yield guarantee). The premium on CAT coverage is 100% subsidized by the RMA, however, producers must pay an administrative fee for each crop insured in each county. CAT coverage is not available for all crops. Basic insurance units are used for CAT. If loss is in excess of 50% of the APH, then an indemnity payment will be made. Farm managers may elect to take their CAT coverage under IP or GRP in some locations instead of the more common CAT coverage based on APH.

Net revenue for CAT is calculated in the following equation:

$$\sum_{c=1}^{n} NRCAT_c = \sum_{c=1}^{n} \sum_{u=1}^{m} \left\{ \left[\left[\max\left(\left\{ YG_{cu} - HY_{cu} \right\}, 0 \right) \times INDP_c \right] \times PA_{cu} \right] - P_c \right\} \tag{31}$$

where:

c = crop c, insured with CAT,

u = insurance unit u,

$NRCAT_c$ = net returns from insurance for crops with CAT,

YG_{cu} = yield guarantee (units per acre)

$$= \quad APH_{cu} \times YE_c, \tag{32}$$

APH_{cu} = actual production history (units per acre),

YE_c = yield election (50%),

HY_{cu} = harvested yield (units per planted acre),

$INDP_c$ = indemnity price (55% of RMA price, $/unit),

PA_{cu} = planted acres per insurance unit,

P_c = administrative fee.

Scenario 3. No Commodity Program with the Conservation Reserve Program

The 2002 Farm Bill continues to include provisions that retire environmentally sensitive land from crop production. The 2002 Act emphasizes programs that support conservation on land in production, including livestock operations. This provision, called the Comprehensive Conservation Enhancement Program (CCEP), is a revision of the previous conservation provision of the Federal Agriculture Improvement and Reform Act (1996 Farm Bill), which established the Conservation Reserve Program (CRP).

The CRP is a voluntary program encouraging producers to establish permanent grass, wildlife cover, or trees on highly erodible cropland through 10 to 15 year contracts with the USDA. Although the CRP is not targeted to provide protection from yield or price variability, it can have that effect because a guaranteed rental payment is received in return for not growing crops on the land enrolled in CRP. Planted acres are reduced for participants in the CRP. Acreage enrolled in the previous CRP is considered enrolled in the CCEP.

The Commodity Credit Corporation (CCC) makes annual payments based on the agriculture rental value of the land. The rates are based on the relative productivity of

soils within each county and the cash-rent equivalent. The maximum CRP rental rate for each offer is calculated in advance of enrollment. Producers may offer land for enrollment into the CRP at that rate or may offer a lower rental rate to increase the likelihood that their offer will be accepted. The maximum CRP payment a producer can receive is $50,000 per year. Producers must also have less than 2.5 million adjusted gross income (AGI) or have at least 75 percent of their AGI from agriculture in order to be eligible for payments. However, these payments are not included in the maximum payment limitations of other programs sponsored by the USDA.

The following equations can be used to calculate net returns to producers enrolled in the CRP but not enrolled in a commodity program.

$$TNR = \sum_{c=1}^{n} NR_c + \sum_{N=1}^{n} NRCRP_N \tag{33}$$

where:

TNR	=	total net returns,
NR_c	=	net returns from crops not enrolled in a government commodity program (see equation 2),
$NRCRP_N$	=	net returns from non-crop acres enrolled in CRP.

$$\sum_{N=1}^{n} \mathrm{NRCRP_N} = \min\left\{\sum_{N=1}^{n}\left(\mathrm{CRPPR_N} \times \mathrm{CRPA_N}\right),\ 50{,}000\right\} - \sum_{N=1}^{n}\left[\left(\mathrm{MC_N} + \mathrm{EC_N} + \mathrm{FC_N}\right) \times \mathrm{CRPA_N}\right] \tag{34}$$

where:

N	=	number of CRP parcels with different rental rates,
$CRPPR_N$	=	CRP payment rate,

$CRPA_N$ = conservation reserve acreage (acres),

MC_N = maintenance cost on non-crop acres (CRP acres) ($/acres),

EC_N = annualized establishment costs of (CRP acres) ($/acre),

FC_N = fixed costs of non-crop acres (CRP acres) ($/acre).

Scenario 4. No Commodity Program with Crop Insurance and the Conservation Reserve Program

Crop insurance and the CRP can be used by producers not participating in the government commodity programs. Equation 35 describes how net returns can be estimated when both programs are selected. Neither provisions for crop insurance nor the CRP change, if both are selected.

$$TNR = \sum_{c=1}^{n} NR_c + \sum_{c=1}^{n} NRCI_c + \sum_{N=1}^{n} NRCRP_N \tag{35}$$

where:

TNR = total net returns,

NR_c = net returns from crops not enrolled in a government commodity program, (see equation 2),

$NRCI_c$ = net returns from any of the previously described crop insurance programs (see equations 4, 7, 12, 16, 20, 24, 27, 31),

$$= NRMPCI_c + NRCRC_c + NRRAHP_c + NRIP_c + NRRABP_c + NRGRP_c + NRGRIP_c + NRCAT_c, \tag{36}$$

$NRCRP_N$ = net returns from non-crop acres (see equation 34).

COMMODITY PROGRAM PARTICIPATION

The following four scenarios are used for estimating net returns when the producer participates in government commodity programs. Equations for estimating

returns for participation in these programs with the purchase of crop insurance and/or participation in CRP is also described.

The Commodity Program Provisions of the 2002 Farm Bill

If producers decide to participate in the government commodity program, they are eligible for four types of payments: a direct payment (formerly known as the Agricultural Market Transition Act (AMTA) payment), a counter-cyclical payment, and a loan deficiency payment (LDP) or a marketing loan. Producers are not eligible for both the marketing loan and the LDP on the same grain. But, if a producer takes a marketing loan and then repays it at a posted county price (PCP) below the loan rate, they effectively realize a marketing loan gain (MLG) equivalent to the LDP.

The marketing loan program allows a manager to receive a loan for commodities at a crop-specific county level loan rate per unit of production by using the commodity as collateral. The marketing loan program is described in greater detail following the discussion of commodity program payments.

In addition to specific payment limits for each type of payment, there is a $2.5 million adjusted gross income (AGI) limitation that producers must meet or have at least 75 percent of their AGI from agriculture in order to be eligible for commodity program payments.

Direct Payments: These are fixed payments that are based on a producer's historical production acreage and yield. Direct payments are calculated by multiplying 85% of the base acreage, by the direct program yield, and the direct payment rate. The direct payment rate ($/bu.) for each crop is reported in Table 2. Each manager is limited

to $40,000 for direct payments. Payment limits are based on a single entity. Under some conditions, managers may qualify for one entity plus a 50% share in two other entities.

Counter-cyclical Payments: This provision provides additional payments when market prices fall below a certain level, known as a target price or trigger price. Like direct payments, counter-cyclical payments are based on a producer's historical production acreage and yield. Counter-cyclical payments are calculated by multiplying 85% of the base acreage, by the counter-cyclical program yield, and the counter-cyclical payment rate. The counter-cyclical payment rate ($/bu.) is calculated by subtracting the higher of the weighted national average market price ($/bu.) as reported by NASS or the national loan rate ($/bu.) and the direct payment rate from the target price ($/bu.). The following equation illustrates this calculation. Refer to Figures 1 and 2 for additional information.

$$CCPR = \max\{[TP - \max\{MP, LR\} - DPR], 0\} \tag{37}$$

where:

CCPR = counter-cyclical payment rate,

TP = target price ($/bu.),

DPR = direct payment rate ($/bu.),

MP = market price ($/bu.),

LR = marketing loan rate ($/bu.).

The target price for counter-cyclical payments for each crop is given in Table 2. If the sum of the direct payment rate and the higher of the market price or loan rate are greater than or equal to the target price, no counter-cyclical payment will be received. Thus, if the market price exceeds the trigger price or the target price minus the direct payment

rate, there is no counter-cyclical payment. Each manager is limited to $65,000 in counter-cyclical payments.

Loan Deficiency Payments: The difference between the posted county price (PCP) and the marketing loan rate is referred to as the loan deficiency payment rate ($/bu.). The LDP is calculated by multiplying the loan deficiency payment rate, harvest yield, and the planted acres assuming an LDP is taken on all harvested grain. Because the LDP is equal to the loan rate minus the PCP, it is equivalent to the amount that could alternatively be obtained if the manager placed the crop under loan and repaid the loan at the PCP, realizing the difference as a marketing loan gain (MLG). Each manager is limited to $75,000 in LDPs and MLGs.

Producers who elect to use acres planted to wheat for livestock grazing are eligible to receive graze out payments in lieu of an LDP. Graze out payments are calculated by multiplying the LDP rate, by the number of acres grazed, and the direct payment wheat yield.

Marketing Loan Gains: A gain may be received if the producer places the grain under loan and later repays the loan at the PCP to reclaim the grain for sale. If the producer repays the loan at a rate that is lower than the marketing loan rate (i.e., PCP is less than the marketing loan rate), the producer realizes the difference as a marketing loan gain. The marketing loan gain ($/bu.) is calculated by multiplying the marketing loan rate minus the lower value of the PCP rate, by the harvested yield per acre, and the number of planted acres assuming all harvested grain is marketed this way. Although the maximum amount of LDPs and MLGs a manager can receive is $75,000, marketing loans can be repaid with generic certificates. The use of generic certificates provides an

equivalent result to the repayment of a loan at the PCP, but any gain realized through the use of generic certificates is not subject to payment limits, thus there is no effective limit on the marketing loan program.

If the producer chooses to collect an LDP, they cannot put those bushels under loan with the CCC, and likewise, if they choose to take a marketing loan they are not eligible for the LDP on those bushels. In order to receive either the marketing loan or the LDP, the producer must produce a crop. Both direct and counter-cyclical payments can be collected regardless of actual production and even if the crop is not planted.

Marketing Loan Program Options: Crops that are eligible under the 2002 Farm Bill for marketing loans are: wheat, feed grains, soybeans, cotton, honey, peanuts, chickpeas, lentils, dry beans, wool, and mohair. With a marketing loan, producers place their crops under loan with the Commodity Credit Corporation (CCC) at the county loan rate. The total dollars received from a marketing loan or LDP are a function of the amount of crop produced. Once the farm manager has the crop in hand there are several scenarios which could occur with the marketing loan program.

1. The manager may take the LDP any day after crop harvest and before giving up beneficial interest in the commodity. The LDP rate will be the difference between the loan rate and PCP when it is below the loan rate (equation 43). Under this scenario, the effective price of the grain could be higher than the sum of the LDP rate and posted county price (PCP). This could happen if the market price at which the commodity is actually sold rises above the PCP at which the LDP was calculated (Figure 1, Scenario E).

2. The manager can take out a marketing loan and receive the loan rate. Once a loan is taken the manager's repayment obligation for the loan is limited to the loan rate plus interest or the value of the commodity under loan (the PCP). Several things could occur once the manager receives the loan. These are described below.

   a. The loan can be repaid before maturity at the lower of the loan rate plus interest or at the current PCP. To repay the loan at loan rate plus interest the local price would have increased to the point that the PCP exceeded the loan rate plus interest. The PCP can be locked in once for a 60-day period and the loan repaid anytime in that 60 days at the previously locked in PCP. The manager may choose to do this if the PCP is expected to rise, causing the expected marketing loan gain to fall. However, if the loan is not repaid in the 60 days, the previously locked in PCP expires and the loan can be repaid at the current PCP. This could be done if the manager's forecast of a higher PCP does not occur. If the PCP at which the loan is repaid is below the loan rate, all interest changes are waived and the difference between the loan rate and the PCP is realized as a marketing loan gain (equation 45). If the PCP at which the loan rate is repaid is above the loan rate but below the loan rate plus interest, the difference between the PCP and the loan rate reflects the amount of interest paid while the remaining interest is waived.

   b. The loan can be repaid before maturity with generic certificates. Generic certificates can be purchased by the manager from CCC on a dollar-for-dollar basis and used to repay the loan at the current PCP. Repaying a

loan at the current PCP with generic certificates provides the same result as repaying a loan at the current PCP with cash as in case 2.a, but the difference between the loan rate and the PCP, while equivalent to MLG, is not subject to payment limits under scenario 2.a (equation 47).

c. The loan can be held to maturity and the grain forfeited to the CCC without an interest charge. This would be done if the PCP is less than the loan rate plus interest at maturity and the manager did not want to exercise option 2.a or 2.b before maturity. The availability of 2.a and 2.b makes this option unnecessary and unlikely.

The manager may be able to receive an effective price higher than the sum of the PCP and MLG or equivalent rate if the commodity is sold at a market price higher than the PCP used to calculate the MLG or equivalent (Figure 1, Scenario E).

Figure 1 provides an illustration of revenue ($/bu.) using corn as an example for various market price scenarios.

Base Acre and Program Yield Decisions**:** Under the 2002 Farm Bill, a producer could choose to update their base acres for direct and counter-cyclical payments and program yields for counter-cyclical payments. Program yields associated with direct payments could not be updated and thus remained unchanged from the previous program yields, which have been fixed since 1985. The exception was oilseeds. Because previous program yields did not exist, direct payment yields for oilseeds were based on the average yields for the 1998-2001 crop years, but adjusted for 1981-1985 yield levels. Producers had to update base acres if they wanted to update their counter-cyclical program yields. However, base acres could be updated without updating the counter-

cyclical program yields. If a producer decided to update their base acres, then they had to decide whether to use partially updated or direct program (old) yields. If a producer decided to use the partially updated counter-cyclical program yields, then the producer had to decide which method to use to update counter-cyclical program yields. Under the new Farm Bill, if base acres were updated (as previously mentioned), then counter-cyclical program yields could be partially-updated based on weighted average (new) yields (weighted by acreage) on the farm for the 1998 -2001 crop seasons excluding any year that planted acreage was zero. Under the partial update options, counter-cyclical program yields could equal 70 percent of this difference between old and new yields or 93.5 percent of new yields. Refer to Figure 2 for a diagram of the general procedure. For additional detail refer to Lubben, 2002a and 2002b. The methods for updating counter-cyclical program yields are listed in the following equations.

$$\text{CCPY} = \text{DPY} + 0.70 \times (\text{Weighted Avg. Yield 1998 through 2001} - \text{DPY}) \quad (38)$$

$$\text{CCPY} = \text{Weighted Avg. Yield 1998 through 2001} \times 0.935 \quad (39)$$

or

$$\text{CCPY} = \text{DPY} \quad (40)$$

where:

CCPY = counter-cyclical program yield,

DPY = direct payment yield.

Unlike some previous farm programs, soybean base acres and program yields could now be added to the updated (new) or current (old) program base for the government program. Figure 2 illustrates this procedure.

To establish an oilseed acreage base for each oilseed, when the manager retained the old base acres for other non-oilseed commodities, the producer could count the average of the total planted and prevented planted acreage for the 1998-2001 crop years for each oilseed. All years were included in the average, including years of zero acreage. However the new oilseed base was limited to the four-year average of the amount of acres by which total acreage of all covered commodities exceeded the existing program acreage base in each year from 1998-2001. Producers could add additional oilseed acres above this difference up to the average oilseed acres discussed above, but they had to reduce one or more of the other crop bases on a one-for-one basis for each acre of oilseeds added above the limit. Some farms had an established history of double cropping, where a producer had a crop of wheat and a second crop such as soybeans, sorghum, or sunflowers on the same acre in a given year. In these cases, the total acreage of covered commodities for the farm included both the primary and the secondary crop. Both crops were eligible for direct and counter-cyclical payments.

To establish an updated acreage base for all covered commodities a producer could count the average of the total planted and prevented planted acreage for the 1998-2001 crop years for all covered commodities. All years were included in the average, including years of zero acreage.

For soybeans and other oilseeds, direct program yields were needed that corresponded with the old government program yields for other commodities that are the basis for direct payments. They were determined by taking the weighted average (weighted by acres) of the farm yield from 1998 through 2001 and multiplying by an adjustment factor equal to the national average yield from 1981 through 1985 compared

to 1998 through 2001. For soybeans, this ratio was 0.78 (it varied by specific oilseed). Once the direct payment yields were established for oilseeds equivalent to other old yields, the rules for partially updating yields for counter-cyclical payments followed as with other commodities, using equations 38, 39, or 40.

Scenario 5. Commodity Program Only

The following equations can be used to estimate net returns for producers using the government commodity program. The following equation describes estimation of net returns under this scenario.

$$TNR = \sum_{c=1}^{n} NRCP_c \tag{41}$$

where:

TNR = total net returns,

$NRCP_c$ = net returns from crops enrolled in a government commodity program.

$$\begin{aligned}\sum_{c=1}^{n} NRCP_c = {} & \min\left\{\sum_{c=1}^{n}\left\{DPR_c \times DPY_c \times (BA_c \times 0.85)\right\}, 40{,}000\right\} + \\ & \min\left\{\sum_{c=1}^{n}\left\{CCPR_c \times CCPY_c \times (BA_c \times 0.85)\right\},\ 65{,}000\right\} + \\ & \sum_{c=1}^{n}\left\{MP_c \times HY_c \times PA_c \times (1 - F_c)\right\} + \sum_{c=1}^{n}(LR_c \times HY_c \times PA_c \times F_c) - \sum_{c=1}^{n}(LCC_c \times HY_c \times PA_c \times K_c) + \\ & \min\left\{\{\sum_{c=1}^{n}(LDPR_c \times HY_c \times PA_c \times L_c) + \sum_{c=1}^{n}(MLGR_c \times HY_c \times PA_c \times M_c)\}, 75{,}000\right\} + \\ & \sum_{c=1}^{n}(EMLGR_c \times HY_c \times PA_c \times G_c) + \\ & \sum_{c=1}^{n}\left\{\left(OSGV_c - VC_c - FC_c - OSMC_c\right) \times PA_c\right\}\end{aligned} \tag{42}$$

where:

c	=	crop c,
DPR_c	=	direct payment rate,
DPY_c	=	direct payment yield (1981-1985 Avg. yield per acre),
BA_c	=	base acres,
$CCPR_c$	=	counter-cyclical payment rate (equation 37),
$CCPY_c$	=	counter-cyclical payment yield (units per acre) (equations 38, 39 and 40),
MP_c	=	market price including any returns or losses from marketing strategies such as forward contracting, hedging, and options ($/bu.),
HY_c	=	harvested yield (units per acre),
PA_c	=	planted acres,
F_c	=	portion of crop marketed through forfeiture on a loan to government when $MP_c < PCP_c < LR_c$
		$0 \le F_c \le 1$ and $F_c + K_c + L_c + M_c + G_c \le 1$
LCC_c	=	$\min\{(LR_c \times R_c \times T_c), \max(PCP - LR, 0)\}$
LR_c	=	marketing loan rate ($/bu.),
R_c	=	interest rate on loan per time period,
T_c	=	number of time periods,
K_c	=	portion of crop marketed using loan when loan is paid back when the $PCP_c > LR_c$
		$0 \le K_c \le 1$ and $F_c + K_c + L_c + M_c + G_c \le 1$
$LDPR_c$	=	loan deficiency payment rate, ($/bu.)

$$\mathrm{LDPR_c} = \max(\mathrm{LR_c} - \mathrm{PCP_c}, 0)\,, \tag{43}$$

PCP_c = posted county price ($/bu.),

L_c = portion of crop marketed using LDP

$$0 \le L_c \le 1 \text{ and } 0 \le F_c + K_c + L_c + M_c + G_c \le 1, \tag{44}$$

$MLGR_c$ = marketing loan gain rate ($/bu.)

$$\text{MLGR}_c = \max(\text{LR}_c - \text{PCP}_c, 0), \tag{45}$$

M_c = portion of crop marketed using loan in which loan is paid back with cash when $PCP_c < LR_c$, resulting in marketing loan gain

$$0 \le M_c \le 1 \text{ and } 0 \le F_c + K_c + L_c + M_c + G_c \le 1, \tag{46}$$

$EMLGR_c$ = equivalent marketing loan gain rate ($/bu.), using generic certificates

$$= \max(LR_c - PCP_c, 0) \tag{47}$$

G_c = portion of crop marketed using loan in which loan is paid back with generic certificates when $PCP_c < LR_c$, resulting in equivalent marketing loan gain

$$0 \le G_c \le 1 \text{ and } 0 \le F_c + K_c + L_c + M_c + G_c \le 1 \tag{48}$$

VC_c = variable costs associated with producing the crop ($/acre),

FC_c = fixed costs ($/acre),

$OSMC_c$ = off season maintenance cost ($/acre),

$OSGV_c$ = off-season grazing value ($/acre).

The following section of equation 42 represents the direct payment

$$\min\left\{\sum_{c=1}^{n}\left\{\text{DPR}_c \times \text{DPY}_c \times (\text{BA}_c \times 0.85)\right\}, 40,000\right\}$$

The next section of equation 42 calculates the counter-cyclical payment.

$$\min\left\{\sum_{c=1}^{n}\left\{CCPR_c \times CCPY_c \times (BA_c \times 0.85)\right\},\ 65{,}000\right\}$$

The section below represents the revenue received from the market.

$$\sum_{c=1}^{n}\{MP_c \times HY_c \times PA_c \times (1 - F_c)\}$$

The following component represents the revenue received from default on the loan when $MP_c < PCP_c < LP_c$.

$$\sum_{c=1}^{n}(LR_c \times HY_c \times PA_c \times F_c)$$

The next line in this equation represents the cost of repaying the loan when the PCP rises above the loan.

$$\sum_{c=1}^{n}(LCC_c \times HY_c \times PA_c \times K_c)$$

The following calculation represents the revenue received from loan deficiency payments.

$$\sum_{c=1}^{n}(LDPR_c \times HY_c \times PA_c \times L_c)$$

The next section of equation 42 represents the revenue from marketing loan gains.

$$\sum_{c=1}^{n}(MLGR_c \times HY_c \times PA_c \times M_c)$$

The following portion of equation 42 represents the revenue received from using generic loan certificates to pay off the loan to receive a gain equivalent to a marketing loan gain.

$$\sum_{c=1}^{n}(EMLGR_c \times HY_c \times PA_c \times G_c)$$

The last section of equation 42 calculates any net revenue from off season grazing.

$$\sum_{c=1}^{n}\left\{\left(\mathrm{OSGV_c} - \mathrm{VC_c} - \mathrm{FC_c} - \mathrm{OSMC_c}\right)\times \mathrm{PA_c}\right\}$$

For modeling purposes it may be easiest to drop the fourth, sixth, and seventh terms from equation 42 and simply calculate an LDP for each crop, if the modeled PCP is below the loan rate.

Scenario 6. Commodity Program with Crop Insurance

Government programs help reduce income variability but do not provide income replacement for yield losses. The following equations describe how net returns can be estimated, while accounting for crop insurance when the farm operator also participates in the government commodity program. The same payment limits specified before apply to this scenario.

$$TNR = \sum_{c=1}^{n} NRCP_c + \sum_{c=1}^{n} NRCI_c \tag{49}$$

where:

TNR	=	total net returns,
NR_c	=	net returns from crops enrolled in a government commodity program (see equation 42),
$NRCI_c$	=	net returns from crop insurance (see equation 36).

Scenario 7. Commodity Program with the Conservation Reserve Program

The CRP can be used in conjunction with the government commodity program. The following equations describe the relationships that affect net returns when a producer participates in the CRP and the commodity program.

$$TNR = \sum_{c=1}^{n} NRCP_c + \sum_{N=1}^{n} NRCRP_N \tag{50}$$

where:

TNR	=	total net returns,
$NRCP_c$	=	net returns from crops enrolled in a government commodity program (see equation 42),
$NRCRP_N$	=	net returns from non-crop acres (see equation 34).

Scenario 8. Commodity Program with Crop Insurance and with the Conservation Reserve Program

Producers who participate in the government commodity program and the CRP have the option to purchase crop insurance. Different crops can be insured with different insurance products and unit designations. A manager that produces a crop in more than one county can insure the same crop using different insurance plans as long as one plan is applied to all units of the crop in a single county. The following equations describe how to estimate net returns when the farm operator simultaneously participates in the above mentioned programs.

$$TNR = \sum_{c=1}^{n} NRCP_c + \sum_{c=1}^{n} NRCI_c + \sum_{N=1}^{n} NRCRP_N \tag{51}$$

where:

TNR	=	total net returns,
$NRCP_c$	=	net returns from crops enrolled in a government commodity program (see equation 42),
$NRCI_c$	=	net returns from crop insurance (see equation 36),
$NRCRP_N$	=	net returns from non-crop acres (see equation 34).

Table 1. Base Price and Harvest Time Price Assignment Methods for Kansas Crops

Commodity	Insurance Product	Base Price	Location	Harvest Price
Corn	IP RA-BPO RA-HPO	February average daily settlement of December contract	CBOT	November average daily settlement of December contract
	CRC	February average daily settlement of December contract	CBOT	October average daily settlement of December contract
Soybeans	IP RA-BPO RA-HPO CRC	February average daily settlement of November contract	CBOT	October average daily settlement of November contract
Wheat	CRC	August 15 to September 14 average daily settlement of July contract of hard red winter wheat	KCBOT	June average daily settlement for July contract of hard red winter wheat
	RA-BPO RA-HPO	August 15 to September 14 average daily settlement of July contract of hard red winter wheat	KCBOT	July 1 to July 14 average settlement for July contract of hard red winter wheat
	IP	August 15 to September 14 average daily settlement of July contract of soft red winter wheat	CBOT	June average daily settlement for July contract of soft red winter wheat

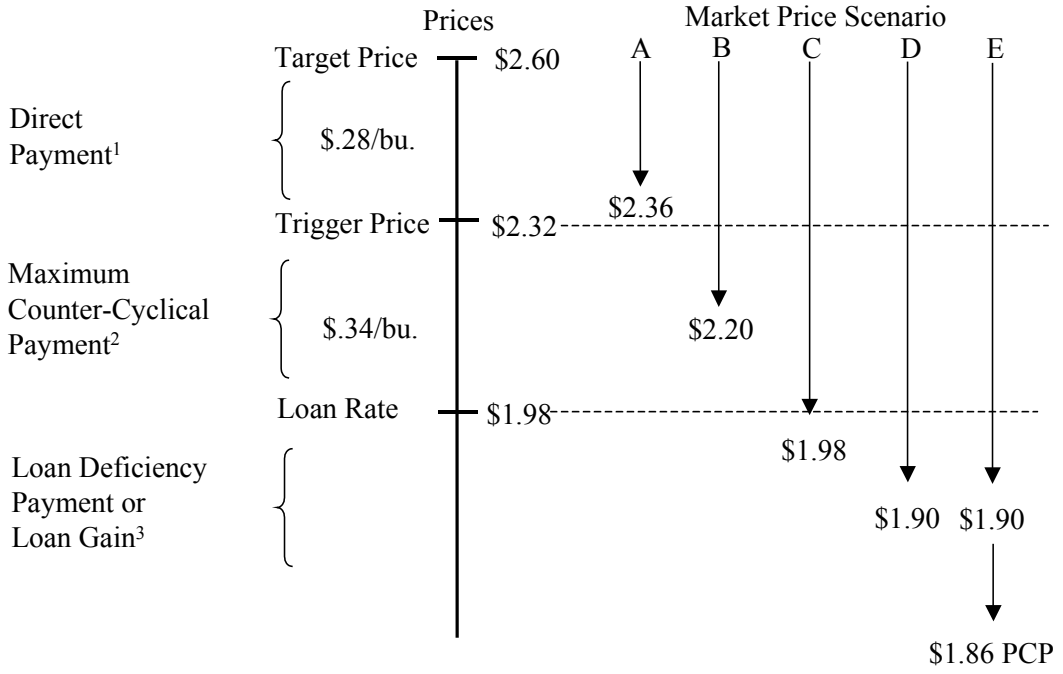
Table 1. Base Price and Harvest Time Price Assignment Methods for Kansas Crops (cont'd)

Commodity	Insurance Product	Base Price	Location	Harvest Price
Grain Sorghum	CRC	95% of February average daily settlement of December corn contract	CBOT	95% of October average daily settlement of December corn contract

Table 2. Loan Rates, Direct Payment Rates, and Target Prices ($/bu.)

	Loan Rate 2002-2003	**Loan Rate 2004-2007**	**Direct Payment Rate**	**Target Price 2002-2003**	**Target Price 2004-2007**
Corn	1.98	1.95	0.28	2.60	2.63
Sorghum	1.98	1.95	0.35	2.54	2.57
Soybeans	5.00	5.00	0.44	5.80	5.80
Wheat	2.80	2.75	0.52	3.86	3.92

Figure 1. Examples of corn revenue ($/bu.) at various market prices.



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[1] Total Direct Payments = $/bu. × Direct Payment Yield × Base Acres

[2] Total Counter-cyclical Payments = $/bu. × Counter-cyclical Payment Yield × Base Acres

[3] Total Loan Deficiency Payments = $/bu. × Produced Yield on Harvested acres × Harvested Acres

Refer to the next page for an explanation of the scenarios.

Figure 1: Examples of corn revenue at various market prices (cont'd)

For all scenarios assume the target price is $2.60/bu., the loan rate is $1.98/bu., and the direct payment is $.28/bu.

Scenario A

National average market price, local market price, and Posted County Price are $2.36
Revenue = $2.36/bu. × Produced Yield + $.28/bu. × Direct Payment Yield

Scenario B

National average price, local market price, and Posted County Price are $2.20
Revenue = $2.20/bu. × Produced Yield + $.28/bu. × Direct Payment Yield + $.12/bu. × Counter-cyclical Payment Yield.

Scenario C

National average price, local market price, and Posted County Price are $1.98 and equal to the loan rate. Revenue = $1.98/bu. × Produced Yield + $.28/bu. × Direct Payment Yield + $.34/bu. × Counter-cyclical Payment Yield. The $1.98 could also be received from the loan.

Scenario D

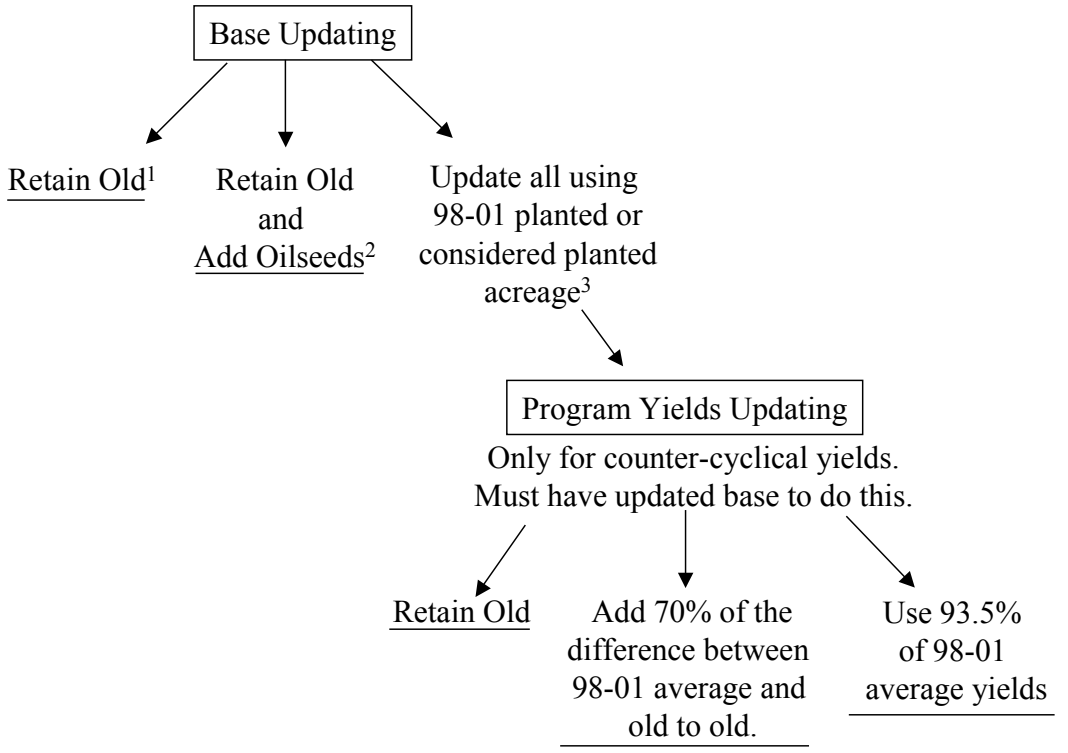
National average price is at or below loan rate while local market price and Posted County Price are $1.90 and are below the loan rate. Revenue = $1.90 × Produced Yield + $.28/bu. × Direct Payment Yield + $.34/bu. × Counter-cyclical Payment Yield + $.08//bu. from the LDP × Produced Yield. The alternative calculation would be $1.98/bu. from the Loan × Produced Yield + $.28/bu. × Direct Payment Yield + $.34/bu. × Counter-cyclical Payment Yield.

Scenario E

National average price is at or below loan rate while local market price is $1.90 and is above the Posted County Price of $1.86, but both are below the loan rate. Revenue = $1.90 × Produced Yield + $.28/bu. × Direct Payment Yield + $.34/bu. × Counter-cyclical Payment Yield + $.12//bu. from the LDP × Produced Yield. The alternative calculation would be $1.98/bu. from the Loan × Produced Yield + $.28/bu. × Direct Payment Yield + $.34/bu. × Counter-cyclical Payment Yield + $.04 Marketing Loan Gain × Produced Yield realized by repaying $1.98 loan at $1.86 PCP, then selling grain at $1.90.

Note: In all scenarios, the counter-cyclical payment is based on the national average price, market revenue is based on the local market price, and LDPs and MLGs are based on the Posted County Price. All of these prices can differ from one another.

Figure 2. Schematic of base and yield updating choices for 2003.



[1] Old may be called current before updating.

[2] To establish an oilseed acreage base for each oilseed, when the manager retained the old base acres for other non-oilseed commodities, a producer could count the average of the total planted and prevented planted acreage for the 1998-2001 crop years for each oilseed. All years were included in the average, including years of zero acreage. However the new oilseed base was limited to the four-year average of the amount of acres by which total acreage of all covered commodities exceeded the existing program acreage base in each year from 1998-2001. Producers could add additional oilseed acres above this difference up to the average oilseed acres calculated above, but they had to reduce one or more of the other crop bases on a one-for-one basis for each acre of oilseeds added above the limit. Some farms had an established history of double cropping, where a producer had a crop of wheat and a second crop such as soybeans, sorghum, or sunflowers on the same acre in a given year. In these cases, the total acreage of covered commodities for the farm included both the primary and the secondary crop. Both crops were eligible for direct and counter-cyclical payments.

[3] To establish an updated acreage base for all covered commodities, a producer could count the average of the total planted and prevented planted acreage for the 1998-2001 crop years for all covered commodities. All years were included in the average, including years of zero acreage.

References

Edwards, W. 2003a. "Group Risk Plan and Group Risk Income Protection." Available at: http://www.exnet.iastate.edu/Publications/FM1850.pdf. Accessed on March 14, 2003.

Edwards, W. 2003b. "Catastrophic Crop Insurance." Available at: http://www.exnet.iastate.edu/Publications/FM1852.pdf. Accessed on March 14, 2003.

Edwards, W. 2003c. "Managing Risk with Crop Insurance." Available at: http://www.exnet.iastate.edu/Publications/FM1854.pdf. Accessed on March 14, 2003.

Edwards, W. 2003d. "Actual Production History and Insurance Units for Multiple Crop Insurance." Available at: http://www.exnet.iastate.edu/Publications/FM1860.pdf. Accessed on March 14, 2003.

Hofstrand, D. and W. Edwards. 2003a. "Multiple Peril Crop Insurance." Available at: http://www.exnet.iastate.edu/Publications/FM1826.pdf. Accessed on March 14, 2003.

Hofstrand, D. and W. Edwards. 2003b. "Crop Revenue Insurance." Available at: http://www.exnet.iastate.edu/Publications/FM1853.pdf. Accessed on March 14, 2003.

Lubben, B.D. 2002a. "The New Farm Bill and Commodity Programs: As Simple at 1, 2, 3?" Available at http://www.agmanagerinfo/policy/default.asp Accessed on May 16, 2003.

Lubben, B.D. 2002b. "Policy Minute: Making Farm Bill Decisions with the K-State Spreadsheet." Available at: http://www.agmanager.info/policy/default.asp. Accessed on May 16, 2003.

U.S. Department of Agriculture Risk Management Agency. 2003. Available at: http://www.rma.usda.gov/policies. Accessed on various days during March and April, 2003.

Williams, J. R., and G. A. Barnaby. 1994. "Mathematical Formulas for Calculating Net returns from Participation in Government Commodity Programs Including Marketing Loans. Department of Agricultural Economics." Staff Paper No. 94-6. Kansas State University, Manhattan, KS. March.