STAFF PAPER

MATHEMATICAL FORMULAS FOR CALCULATING NET RETURNS FROM PARTICIPATION IN GOVERNMENT FARM PROGRAMS FOR MAJOR CROPS IN KANSAS: COMMODITY PROGRAM, CROP INSURANCE, CONSERVATION RESERVE AND DISASTER AID

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Department of Agricultural Economics
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Mathematical Formulas for Calculating Net Returns from Participation in Government Farm Programs for Major Crops in Kansas: Commodity Program, Crop Insurance, Conservation Reserve, and Disaster Aid

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INTRODUCTION

The purpose of this report is to provide mathematical descriptions of several government programs and combinations of these programs that affect estimates of net returns for crop enterprises. These descriptions serve as useful tools for estimating the returns for different program participation scenarios. The descriptions can also be used as a reference for classroom and extension education.

In this report, 12 government program scenarios are described mathematically:

1.) No Commodity Program

2.) No Commodity Program with Crop Insurance

3.) No Commodity Program with Conservation Reserve Program

4.) No Commodity Program with Crop Insurance and Conservation Reserve Program

5.) No Commodity Program with Disaster Aid

6.) No Commodity Program with Crop Insurance and Disaster Aid

7.) Commodity Program

8.) Commodity Program with Crop Insurance

9.) Commodity Program with Conservation Reserve Program

10.) Commodity Program with Crop Insurance and Conservation Reserve Program

11.) Commodity Program with Disaster Aid

12.) Commodity Program with Crop Insurance and Disaster Aid

The equations contained in this report can be used to calculate net returns for a single crop enterprise or enterprise combinations that may or may not be enrolled or eligible for government programs. The equations allow net returns to be calculated on a cash or total cost basis; total costs include opportunity

costs that are required to estimate net returns to management, labor and management; or land, labor, and management.

Equations (1)-(6) describe net returns when the farm enterprises under consideration are not enrolled in the government commodity program. Equations (7)-(12) characterize net returns when one or more of the farm enterprises is enrolled in the government commodity program. Although commodity programs, crop insurance, and conservation reserve programs exist each year, disaster aid programs are only intermittently available. Equations (5), (6), (11), and (12) include adjustments for a disaster aid program, such as the one available in 1988.

Prices and parameter values that pertain to the 1988 and 1989 government farm program can be found in Tables 1 and 2. Some information is location-specific (such as crop insurance premium rates) and must be provided by the user.

NON-PARTICIPATION IN THE COMMODITY PROGRAM

The following six equations are used to estimate net returns when the farm operator does not participate in the government commodity program. Equations for estimating net returns for non-participation along with the use of crop insurance, participation in the conservation reserve program, and a disaster assistance program like that available in 1988 are also presented.

No Commodity Program

Equation (1) describes the estimation of net returns when no enterprises are enrolled in any government program. Net returns are a function of commodity prices, yields, grazing value, and cost of production estimates. There is no price protection, yield protection, or income supplement in this case.

$$(1)\quad \sum_{i=1}^{4} NR_i = \sum_{i=1}^{4} \{[(P_i * Y_i) - VC_i - FC_i + GV_i] * PA_i\}$$

Where:

$i = 1,\ldots,4$ (1 = wheat, 2 = corn, 3 = grain sorghum, and 4 = soybeans),

NR_i = net returns, crop i ($),

P_i = market price, crop i ($/bu.),

Y_i = average yield on planted acreage (bu./acre),

VC_i = variable costs of production ($/acre),

FC_i = fixed costs ($/acre),

GV_i = grazing value ($/acre), and

PA_i = planted acres, crop i.

No Commodity Program with Crop Insurance

Equation (2) describes the option of purchasing crop insurance. The crop insurance premium is deducted from gross income along with other production costs, because it is a cost of production. If the crop insurance indemnity payment is nonnegative, it is added to the returns.

Traditionally, insurable yields are determined for areas identified by the FCIC as having similar soil types, production practices, yields, and crop loss histories. Crop yield guarantees are based on the Actual Production History (APH) for each producer. Under the APH method, yield guarantees are based on actual farm yields when there are three or more years of verifiable records. If the manager has 10 or more years of records, the guarantee is based on the latest 10-year average yield. Once the insurance yield is established, a yield guarantee level and an indemnity price election are selected by the farm manager. The yield guarantee levels are currently 50%, 65%, and 75% of APH yield. Yield

guarantee levels function as a 50%, 35%, or 25% deductible. If a yield occurs that is less than the yield guarantee, then an indemnity payment is paid to the farm operator. The indemnity payment is calculated as the difference between the yield guarantee and harvested yield multiplied by the indemnity price.

Premium rates are based on historical yields and the production and loss history for the county in which the farm is located. The premium charged depends on the amount of coverage purchased (yield guarantee level and indemnity price election) and the APH yield level. The cost of crop insurance per acre is calculated by multiplying the yield guarantee level by the indemnity price election and by the premium rate supplied by the FCIC (Barnaby).

The purpose of crop insurance is to provide protection from production risk. It is not intended to provide protection from price risk. The indemnity price election is used to value the crop that is lost and does not reflect the value lost if market prices are substantially above the price election selected. In addition, crop insurance does not provide protection against low prices when the actual yield is above the yield guarantee selected. Only when a producer suffers a loss in excess of the yield guarantee and market prices are below the indemnity price selected does the producer have some degree of price protection.

$$(2) \quad \sum_{i=1}^{4} NR_i = \sum_{i=1}^{4} \{[(P_i * Y_i) - VC_i - CI_i - FC_i + GV_i + \max\{0, IP_i * [(IY_i * LC_i) - Y_i]\}] * PA_i\}$$

CI_i = crop insurance premium ($/acre),

where: $CI_i = IP_i * LC_i * PR_i$,

IP_i = commodity indemnity price election ($/bu.) (3 price elections available: low, medium, high),

IY_i = insurance yield (bu./acre) (10 year average yield based on actual production history for insurance or assigned with the assistance of the FCIC),

LC_i = level of coverage (3 levels available):

1) 75% of IY_i
2) 65% of IY_i
3) 50% of IY_i, and

PR_i = premium rate (set by FCIC).

No Commodity Program with Conservation Reserve Program

The Conservation Reserve Program (CRP) is part of the conservation provision of the Food Security Act (Farm Bill) of 1985. The CRP is a voluntary program encouraging farmers to establish permanent grass, wildlife cover, or trees on highly erodible cropland through 10-year contracts with the U.S. Department of Agriculture (USDA). Although the CRP program is not targeted to provide protection from yield or price variability, it can have that effect because a guaranteed rental payment is received for not growing crops on the land in the CRP. Equation (3) illustrates the impact of CRP payments on net returns. Planted acres are reduced in return for a rental payment.

Annual payments are made over the course of 10 years for CRP acreage based on bids submitted and approved by the USDA. These payments fix a portion of the operator's gross income at a specific level. The maximum rental payments a participant receives under CRP are $50,000 in a given year. However, CRP rental payments are not included in the maximum payment limitations of other USDA programs. CRP acres cannot be used for grazing under normal circumstances, although they may be approved for grazing in emergency situations, as defined

by the USDA.

$$(3)\quad \sum_{i=1}^{4} NR_i = \sum_{i=1}^{4} \{[[(P_i * Y_i) - VC_i - FC_i + GV_i] * PA_i] - [(MC_i + FC_i) * CRA_i]\} + \min\{\sum_{i=1}^{4} (CRRP_i * CRA_i), \$50,000\}$$

Where:

MC_i = maintenance cost on conservation reserve acres ($/acre),

CRA_i = conservation reserve acreage, (acres) and

$CRRP_i$ = conservation reserve rental payment ($/acre).

No Commodity Program with Crop Insurance and Conservation Reserve Program

Either crop insurance or the conservation reserve program may be used by farm operators not participating in government commodity programs. Equation (4) describes how net returns can be estimated when both programs are selected. Neither the provisions for crop insurance nor the CRP provisions change, if both programs are selected.

$$(4)\quad \sum_{i=1}^{4} NR_i = \sum_{i=1}^{4} \{[[(P_i * Y_i) - VC_i - CI_i - FC_i + GV_i + \max\{0, IP_i * [(IY_i * LC_i) - Y_i]\}] * PA_i] - [(MC_i + FC_i) * CRA_i]\} + \min\{\sum_{i=1}^{4} (CRRP_i * CRA_i), \$50,000\}$$

No Commodity Program with Disaster Payments

Although the stated goal of the Federal Crop Insurance Act of 1980 was to replace federal disaster payment programs administered by the Agricultural Stabilization and Conservation Service (ASCS), disaster aid was available for

major crops suffering substantial yield losses in 1988 (Lipton and Pollack).

Under the 1988 disaster aid plan, farms not participating in the government program and growing program crops received disaster aid based on the following procedures (Williams and Barnaby):

> 1) If the produced yield is less than 65% of the average yield (county average yield) and greater than 25% of the average yield, the producer receives 65% of the loan rate for the yield loss below 65% of the average yield (essentially the difference between 65% of average yield and the actual produced yield).
>
> 2) If the produced yield is less than 25% of the normal average yield, then the producer receives 90% of the loan rate times the difference between 25% of average yield and the actual production and 65% of the loan rate times the additional yield lost (the amount of yield between 65% of average yield and 25% of average yield).

Farm operators having yield losses in excess of 65% of program yield (produced yield is less than 35% of program yield) must purchase crop insurance for the 1989 crop year. Farm operators are allowed to purchase crop insurance at the lowest yield guarantee level and indemnity price election. This results in the lowest premium possible. Equations (5.1)-(5.3) describe how these payments can be included in estimates of net returns.

(5.1) If $.35\ CAY_i \leq Y_i < .65\ CAY_i$

$$\sum_{i=1}^{4} NR_i = \sum_{i=1}^{4} \{[(P_i * Y_i) - VC_i - FC_i + GV_i] * PA_i + \min \{ \sum_{i=1}^{4} (DISP_i * PA_i), \$100{,}000\}$$

where:

$$DISP_i = .65\ CL_i * [.65\ CAY_i - Y_i]$$

(5.2) If $.25\ CAY_i \leq Y_i < .35\ CAY_i$

$$\sum_{i=1}^{4} NR_i = \sum_{i=1}^{4} \{[(P_i * Y_i) - VC_i - FC_i - CI_i * (1+r)^{-1} + GV_i] * PA_i + \min\{ \sum_{i=1}^{4} (DISP_i * PA_i), 100{,}000\}$$

where:

$$DISP_i = .65\ CL_i * [.65\ CAY_i - Y_i]$$

(5.3) If $Y_i < .25\ CAY_i$

$$\sum_{i=1}^{4} NR_i = \sum_{i=1}^{4} \{[(P_i * Y_i) - VC_i - FC_i - CI_i * (1+r)^{-1} + GV_i] * PA_i + \min\{\sum_{i=1}^{4} (DISP_i * PA_i), \$100,000\}$$

where:

$$DISP_i = (.65\ CL_i * .40\ CAY_i) + .90\ CL_i * [.25\ CAY_i - Y_i]$$

Where:

$DISP_i$ = disaster payments ($/acre),

CAY_i = county average yield (bu/acre), and

CL_i = basic county loan

r = discount rate.

For producers producing nonprogram crops (e.g. soybeans), disaster aid is calculated in similar fashion, with the exception that a 5-year olympic average price for the crop is used instead of the loan rate.[1]

No Commodity Program with Crop Insurance and Disaster Payments

Producers with crop insurance could also receive disaster aid under the 1988 disaster aid program. However, total disaster aid plus any indemnity payment from crop insurance cannot exceed 100% of expected income. For program crops, the expected income is the target price multiplied by the program yield. For soybeans, a 5-year olympic average price is used. Equation (6) demonstrates

[1]For nonprogram crops, the Secretary of Agriculture may use either state, area, or county average yields as reported by the Agricultural Statistical Reporting Service. If the farm operator is not participating in the government program, then the county loan rate is used instead of the target price. An olympic average is the average of the price observations with the highest and lowest observation dropped from the calculation.

how net returns can be estimated when the farm operator purchases crop insurance and receives disaster aid under a program like that of 1988.

$$(6)\quad \sum_{i=1}^{4} NR_i = \sum_{i=1}^{4} [((P_i * Y_i) - VC_i + FC_i - CI_i - GV_i)] \min\{ \sum_{i=1}^{4} (TP_i * CAY_i * PA_i) \sum_{i=1}^{4} [\max\{ 0, IP_i * [(IY_i * LC_i) - Y_i]\} * PA_i] + \min\{ \sum_{i=1}^{4} (DISP_i * PA_i), 100{,}000\}\}$$

If i=4 (soybeans), TP_i equals a 5-year olympic average of annual market price. Refer to equations (5.1)-(5.3) for the calculation of $DISP_i$.

COMMODITY PROGRAM PARTICIPATION

The following six equations are used for estimating net returns when the farm operator participates in government commodity programs. Equations for estimating net returns for participating in these programs with the purchase of crop insurance, participation in the conservation reserve programs, and a disaster aid program like that of 1988 are also described.

Commodity Program Only

When farm managers decide to participate in the commodity programs, they elect to forego potential income (income from set aside acres) in return for minimum price protection (the target price) on an established farm average yield (program yield). When a farm participates in the government commodity program, the farm receives a deficiency payment per bushel of program yield, based on the difference between the target price and the market price or the announced loan rate. This is in addition to the income received from the sale of the crop that is produced. If the market price is above the loan rate, the market price is

deducted from the target price to determine the deficiency payment. The deficiency payment per bushel is multiplied by the farm's program yield to determine the deficiency payment per acre. Commodity program payments are limited to $50,000 per operator plus the difference between the formula loan rate and effective loan rate multiplied by program yield and number of planted acres, which is subject to a $200,000 limit.

The farm operator may elect to participate in two optional programs in addition to the basic commodity program, if they are available. An optional paid land diversion program and a 0/92 option are available for some crops. Optional paid land diversion is a voluntary program in which farm operators elect to remove an additional amount of their base acreage from production in return for a guaranteed payment. The payment is equal to a mandated value per bushel multiplied by the program yield, which is then multiplied by the additional number of acres diverted under the optional program. Participation in the optional paid land diversion may increase or decrease the net return per acre, depending on the expectations of market price and yield. This always reduces the variability of net returns.

Feedgrain and wheat producers may also participate in the 0/92 option. Under this option, a farm may plant anywhere between 0 and 92% of permitted acreage (after set-aside) and receive deficiency payments on 92% of the permitted acreage. The deficiency payment on the actual percent of acres that is not planted of the 92% is guaranteed at a minimum level that is equal to the USDA projected deficiency payment (Smith et al.).

The 0/92 option, optional paid land diversion, and the conservation reserve program have similar effects. A known minimum payment is guaranteed for not producing crops on the land setaside under these programs. The average net

return increases or decreases, depending on fixed costs, the level of the minimum guaranteed payments, market prices, and yield expectations. The potential net return variability is reduced. Equations (7.1) and (7.2) describe the impact of the government program on potential net returns.

(7.1) If $\sum_{i=1}^{4} PAY_i \leq 50{,}000$ then:

$$\sum_{i=1}^{4} NR_i = \sum_{i=1}^{4} \{[(\max(P_i, EL_i) * Y_i) - VC_i - FC_i + GV_i] * PA_i - [(MC_i + FC_i - OSGV_i) * (ARP_i + CUA_i + OPD_i)] + PAY_i\}$$

(7.2) If $\sum_{i=1}^{4} PAY_i > \$50{,}000$ then:

$$\sum_{i=1}^{4} NR_i = \sum_{i=1}^{4} \{[(\max(P_i, EL_i) * Y_i) - VC_i - FC_i + GV_i] * PA_i - [(MC_i + FC_i - OSGV_i) * (ARP_i + CUA_i + OPD_i)]\} + \$50{,}000 + \min\{\sum_{i=1}^{4} [FL_i - EL_i) * PY_i * PA_i], \$200{,}000\}$$

Where:

i = 1,...,4 (1 = wheat, 2 = corn, 3 = grain sorghum, and 4 = soybeans),

NR_i = net returns, crop i ($),

P_i = market price, crop i ($/bu.),

EL_i = effective national average loan rate ($/bu.),

Y_i = average yield on planted acreage (bu./acre),

CP_i = cost of production ($/acre),

FC_i = fixed costs ($/acre),

GV_i = grazing value ($/acre),

PA_i = planted acres, crop i,

where: $PA_i = BA_i - ARP_i - CUA_i - OPD_i$,

BA_i = base acres, crop i,

ARP_i = acreage reduction program acres,

where: $ARP_i = ARR_i * BA_i$,

ARR_i = acreage reduction requirement (% of BA_i),

CUA_i = conservation use acreage (0/92 program) (between 0 and 92% of BA_i - ARR_i - OPD_i),

OPD_i = optional paid diversion (acres),

MC_i = maintenance cost for diverted acres ($/acre),

$OSGV_i$ = off-season grazing value ($/acre),

PAY_i = government payments ($),

where:

$$PAY_i = \{[DP_i * PA_i] + [.92 * (BA_i - ARP_i - OPD_i) - PA_i] * \max\{ DP_i, PRCUA_i\} + [OPD_i * OPDR_i]\} * PY_i$$

DP_i = deficiency payments ($/bu.),

where: $DP_i = TP_i - \max\{ EP_i, EL_i\}$

TP_i = target price ($/bu.),

EP_i = expected national average price ($/bu.),

PY_i = program yield (bu./acre),

$PRCUA_i$ = guaranteed payment rate on conservation use acres (CUA) ($/bu.), and

FL_i = formula loan rate ($/bu.).

Commodity Program with Crop Insurance

Government programs help reduce income variability, but do not provide income replacement for yield losses. Equations (8.1) and (8.2) describe how net returns can be estimated, while accounting for crop insurance costs and returns when the farm operator participates in the government commodity program. The same payment limits specified in equations (7.1) and (7.2) are used for these equations.

(8.1) If $\sum_{i=1}^{4} PAY_i \leq 50{,}000$ then:

$$\sum_{i=1}^{4} NR_i = \sum_{i=1}^{4} \{[(\max\{ P_i, EL_i\} * Y_i) - VC_i - CI_i - FC_i + GV_i + \max\{ 0, IP_i * [(IY_i * LC_i) - IY_i]\}] * PA_i - [(MC_i + FC_i - OSGV_i) * (ARR_i + CUA_i + OPD_i)] + PAY_i\}$$

(8.2) If $\sum_{i=1}^{4} PAY_i > \$50{,}000$ then:

$$\sum_{i=1}^{4} NR_i = \sum_{i=1}^{4} \{[(\max\{ P_i, EL_i\} * Y_i) - VC_i - CI_i - FC_i + GV_i + \max\{ 0, IP_i * [(IY_i * LC_i) - IY_i]\}] * PA_i - [(MC_i + FC_i - OSGV_i) * (ARP_i + CUA_i + OPD_i)]\} + \$50{,}000 + \min\{ \sum_{i=1}^{4} [(FL_i - EL_i) * PY_i * PA_i], \$200{,}000\}$$

Where:

CI_i = crop insurance premium ($/acre),

where: $CI_i = IP_i * LC_i * PR_i$,

IP_i = commodity indemnity price election ($/bu.) (3 price elections available: low, medium, high),

IY_i = insurance yield (bu./acre) (10 year average yield based on actual production history for insurance unit),

LC_i = level of coverage (3 levels available):

1) 75% of IY_i
2) 65% of IY_i
3) 50% of IY_i, and

PR_i = premium rate (supplied by FCIC).

Commodity Program with Conservation Reserve Program

The government commodity program including optional programs can be used in conjunction with the conservation reserve program. The relationships that affect net returns are described by equations (9.1) and (9.2).

(9.1) If $\sum_{i=1}^{4} PAY_i \leq \$50,000$ then:

$$\sum_{i=1}^{4} NR_i = \sum_{i=1}^{4} \{[(\max\{ P_i, EL_i\} * Y_i) - VC_i - FC_i + GV_i] * * PA_i - [(MC_i + FC_i - OSGV_i) * (ARP_i + CUA_i + OPD_i + CRA_i)] + PAY_i\} + \min\{ \sum_{i=1}^{4} (CRRP_i * CRA_i), \$50,000\}$$

(9.2) If $\sum_{i=1}^{4} PAY_i > 50,000$ then:

$$\sum_{i=1}^{4} NR_i = \sum_{i=1}^{4} \{[(\max\{ P_i, EL_i\} * Y_i) - VC_i - FC_i + GV_i] * PA_i - [(MC_i + FC_i - OSGV_i) * (ARP_i + CUA_i + OPD_i + CRA_i)]\} + \$50,000 + \min\{ \sum_{i=1}^{4} (CRRP_i * CRA_i), \$50,000\} + \min\{\sum_{i=1}^{4} [(FL_i - EL_i) * PY_i * PA_i], \$200,000\}$$

Where:

CRA_i = conservation reserve acreage and

$CRRP_i$ = conservation reserve rental payment ($/acre).

Commodity Program with Crop Insurance and Conservation Reserve Program

Crop insurance can be purchased by producers participating in the government commodity program and the conservation reserve program. Equations (10.1) and (10.2) describe how to estimate net returns when the farm participates in all of the programs.

(10.1) If $\sum_{i=1}^{4} PAY_i \leq \$50,000$ then:

$$\sum_{i=1}^{4} NR_i = \sum_{i=1}^{4} \{[(\max\{ P_i, EL_i\} * Y_i) - VC_i - CI_i - FC_i + GV_i + \max\{ 0, IP_i * [(IY_i * LC_i) - IY_i]\}] * PA_i - [(MC_i + FC_i - OSGV_i) * (ARP_i + CUA_i + OPD_i + CRA_i)] + PAY_i\} + \min\{ \sum_{i=1}^{4} (CRRP_i * CRA_i), \$50,000\}$$

(10.2) If $\sum_{i=1}^{4} PAY_i > \$50,000$ then:

$$\sum_{i=1}^{4} NR_i = \sum_{i=1}^{4} \{[(\max\{ P_i, EL_i\} * Y_i) - VC_i - CI_i - FC_i + GV_i + \max\{ 0, IP_i * [(IY_i * LC_i) - IY_i]\}] * PA_i - [(MC_i + FC_i - OSGV_i) * (ARP_i + CUA_i + OPD_i + CRA_i)]\} + \$50,000 + \min\{\sum_{i=1}^{4} (CRRP_i * CRA_i), \$50,000\} + \min\{ \sum_{i=1}^{4} [(FL_i - EL_i) * PY_i * PA_i], \$200,000\}$$

Commodity Program with Disaster Payments:

Although disaster aid cannot be considered as part of an annual risk management plan, farmers who participated in government commodity programs were also eligible to receive disaster aid for their 1988 crops. The disaster aid program is described on pages 6-8 for those farm operators not participating in the commodity programs. The following procedures are used to estimate the deficiency and disaster aid payments for a program crop when the farm operator participates in the commodity program. Equations (11.1), (11.2), and (11.3) describe the estimation procedures when government commodity payments are less than $50,000 per operation.

A farm must have actual production of less than 65% of the farm program yield to qualify for disaster aid. There is one exception, however, under the 1988 disaster aid program. The advance sign-up deficiency payment (ADP_i) is guaranteed, although it is not under the normal commodity program. Equations (11.1,A) and (11.1,C) describe how the payments are estimated, as long as harvested yield is greater than 65% of program yield (PY_i). There is no disaster aid if the actual produced yield is greater than program yield, with the exception that the minimum deficiency payment is guaranteed at the advanced deficiency payment rate (11.1,A) or if the deficiency payment is greater than the advanced deficiency payment and actual produced yield is greater than 65% of program yield (11.1,B). If harvested yield is less than program yield and greater than or equal to 65% of program yield and the actual deficiency payment is less than the advance deficiency payment, disaster aid is calculated as described by equation (11.1,C). Payments are equal to the difference between program yield and harvested yield multiplied by the difference between the advanced deficiency payment rate and the actual deficiency payment rate.

If the farm produces a yield less than 65% of program yield and greater than 35% of program, the payments are as follows:

1) If the actual deficiency payment is less than the advance sign-up deficiency payment, the difference between 65% of program yield and harvested yield is reimbursed at 65% of target price less the advance sign-up guarantee plus 35% of program yield (the difference between program yield and 65% of program yield) multiplied by the advance sign-up deficiency payment.

2) If the actual deficiency payment is greater than the advance sign-up deficiency payment, total payments are equal to the difference between harvested yield and 65% of program yield reimbursed at 65% of the target price less the advance sign-up payment. In addition, 35% of program yield plus harvested yield is multiplied by the actual deficiency payment rate.

The difference from the previous estimate is that the 35% of program yield is reimbursed at the actual deficiency payment rate rather than at the advance sign-up rate (which is guaranteed, if the actual payment is less). Equation (11.1,D) describes these procedures. Disaster aid is subject to a $100,000 payment limitation, which is net of the actual deficiency payment.

(11.1) If $\sum_{i=1}^{4} PAY_i \leq \$50,000$ and if $.35\ PY_i \leq Y_i$:

$$\sum_{i=1}^{4} NR_i = \sum_{i=1}^{4} \{[(\max\{P_i, EL_i\} * Y_i) - VC_i - FC_i + GV_i] * PA_i$$

$$- [(MC_i + FC_i - OSGV_i) * (ARP_i + CUA_i + OPD_i] +$$

$$PAY_i\} + \min\{\sum_{i=1}^{4} [(DISP_i * P_i), \$100,000\}$$

where:

$$PAY_i = \{[DP_i * PA_i] + [.92 * (BA_i - ARP_i - OPD_i) - PA_i]$$

$$* \max\{DP_i, PRCUA_i\} + [OPD_i * OPDR_i]\} * PY_i$$

$$DP_i = TP_i - \max\{EP_i, EL_i\} \text{ and}$$

A) If $Y_i \geq PY_i$, $DP_i = \max\{DP_i, ADP_i\}$ and

$DISP_i = 0.0$

B) If $PY_i > Y_i \geq .65\ PY_i$ and $DP_i \geq ADP_i$,

$$DISP_i = (DP_i * PY_i) - (DP_i * PY_i)$$

C) If $PY_i > Y_i \geq .65\ PY_i$ and $DP_i < ADP_i$,

$$DISP_i = (PY_i - Y_i) * (ADP_i - DP_i)$$

D) If $.65\ PY_i > Y_i \geq .35\ PY_i$

$$DISP_i = (DP_i * Y_i) + (.65\ TP_i - ADP_i) * (.65\ PY_i - Y_i) + (\max\{DP_i, ADP_i\} * .35\ PY_i) - (DP_i * PY_i)$$

Where:

ADP_i = advanced deficiency payment ($/bu.).

If disaster payments were received when harvested yield in 1988 was less than 35% of program yield, the purchase of crop insurance was required for the 1989 crop year. Equation (11.2) describes how government payments along with the required purchase of crop insurance affect net returns.

(11.2) If $\sum_{i=1}^{4} PAY_i \leq \$50,000$ and if $.25\ PY_i \leq Y_i < .35\ PY_i$:

$$\sum_{i=1}^{4} NR_i = \sum_{i=1}^{4} \{[(\max\{P_i, EL_i\} * Y_i) - VC_i - FC_i - CI_i * (1+r)^{-1} + GV_i] * PA_i - [(MC_i + FC_i - OSGV_i) * (APP_i + CUA_i + OPD_i] + PAY_i\} + \min\{\sum_{i=1}^{4} [(DISP_i * PA_i), \$100,000\}$$

where:

$$PAY_i = \{[DP_i * PA_i] + [.92 * (BA_i - ARP_i - OPD_i) - PA_i] * \max\{DP_i, PRCUA_i\} + [OPD_i * OPDR_i]\} * PY_i$$

$$DP_i = TP_i - \max\{EP_i, EL_i\} \text{ and}$$

$$DISP_i = (DP_i * Y_i) + (.65\ TP_i - ADP_i) * (.65\ PY_i - Y_i) + (\max\{DP_i, ADP_i\} * .35\ PY_i) - (DP_i * PY_i)$$

If harvested yield is less than 25% of program yield, an additional payment component needs to be estimated:

1) If the actual deficiency payment is less than the advance sign-up, deficiency payment harvested yield between 25 and 65% of program yield is reimbursed at 65% of the target price less the advance sign-up deficiency payment. The difference between harvested yield and 25% of program yield is reimbursed at 90% of the target price less the advance sign-up deficiency payment. In addition, 35% of program yield (the difference between program yield and 65% of program yield) is reimbursed at the advance sign-up payment. Harvested yield is multiplied by the actual deficiency payment.

2) If the actual deficiency payment is greater than the advance sign-up deficiency payment, payments are the same as in 1), with the exception that 35% of program yield is multiplied by the actual deficiency payment rather than by the advance sign-up payment.

Again, the amount of disaster aid that is subject to the $100,000 disaster payment limit is net of the actual deficiency payment. Equation (11.3) describes how net returns can be estimated under these conditions.

(11.3) If $\sum_{i=1}^{4} PAY_i \leq \$50,000$ and if $Y_i \leq .25\ PY_i$:

$$\sum_{i=1}^{4} NR_i = \sum_{i=1}^{4} \{[(\max\{P_i, EL_i\}\ Y_i) - VC_i - FC_i - CI_i\ (1+r)_{-1} + GV_i] * PA_i - [CMC_i + FC_i - OSGV_i) * (APP_i + CUA_i + OPD_i] + PAY_i\} + \min\{\sum_{i=1}^{4} [(DISP_i * PA_i), \$100,000)$$

where:

$$PAY_i = \{[DP_i * PA_i] + [.92 * (BA_i - ARP_i - OPD_i) - PA_i] * \max\{DP_i, PRCUA_i\} + [OPD_i * OPDR_i]\} * PY_i$$

$$DP = TP_i - \max\{EP_i, EL_i\} \text{ and}$$

$$DISP_i = (DP_i * Y_i) + ((.65\ TP_i - ADP_i) * .40\ PY_i) + (.90\ TP_i - ADP_i) * (.25\ PY_i - Y_i) + (\max\{DP_i, ADP_i\} * .35\ PY_i) - (DP_i * PY_i)$$

Government commodity program payments are limited to $50,000 per operator plus a $200,000 limit on the difference between the formula loan rate and effective loan rate multiplied by program yield and planted acres. The following section describes how the payments and net returns are estimated, if the government commodity program payments exceed $50,000.

(11.4), (11.5), (11.6) If $\sum_{i=1}^{4} PAY_i > \$50,000$ then PAY_i = is replaced in equations (11.1), (11.2), and (11.3) by:

$$\$50,000 + \min \{ \sum_{i=1}^{4} [FL_i - EL_i) * PY_i * (BA_i - ARP_i - CUA_i - OPD_i)], \$200,000\}$$

Commodity Program with Crop Insurance and Disaster Payments

The following equations describe how net returns may be estimated, when the farm operator participates in the commodity program, purchases crop insurance, and receives disaster payments under a disaster aid program similar to that of 1988. Fewer equations describe these estimates because the farm operator is already purchasing crop insurance for the present year. Total disaster aid per acre plus any indemnity payment from crop insurance cannot exceed target price multiplied by program yield. For soybeans, a 5-year olympic average price is used.

(12.1) If $\sum_{i=1}^{4} PAY_i \leq \$50,000$ then:

$$\sum_{i=1}^{4} NR_i = \sum_{i=1}^{4} \{[(\max\{P_i, EL_i\} * Y_i) - VC_i - FC_i + GV_i] * PA_i - [(MC_i + FC_i - OSGV_i) * (ARP_i + CUA_i + OPD_i] + PAY_i + \min\{ \sum_{i=1}^{4} (TP_i * PY_i * PA_i), \max\{ 0, (IP_i - IC_i) * [(IY_i * LC_i) - Y_i]\}\] * PA_i + \min\{ \sum_{i=1}^{4} (DISP_i * PA_i), \$100,000\}\}$$

where:

$$PAY_i = \{[DP_i * PA_i] + [.92 * (BA_i - ARP_i - OPD_i) - PA_i] * \max\{DP_i, PRCUA_i\} + [OPD_i * OPDR_i]\} * PY_i$$

$DP_i = TP_i - \max\{EP_i, EL_i\}$ and

A) If $Y_i \geq PY_i$ $DP_i = \max\{DP_i, ADP_i\}$:

$DISP_i = 0.0$

B) If $PY_i > Y_i \geq .65\ PY_i$ and $DP_i \geq ADP_i$:

$DISP_i = (DP_i * PY_i) - (DP_i * PY_i)$

C) If $PY_i > Y_i \geq .65\ PY_i$ and $DP_i < ADP_i$:

$DISP_i = (PY_i - Y_i) * (ADP_i - DP_i)$

D) If $.65\ PY_i > Y_i \geq .25\ PY_i$:

$$DISP_i = (DP_i * Y_i) + ((.65\ TP_i - ADP_i) * .40\ PY_i) + (.90\ TP_i - ADP_i) * (.25\ PY_i - Y_i) + (\max\{DP_i, ADP_i\} * .35\ PY_i) - (DP_i * PY_i)$$

E) If $Y_i \leq .25\ PY_i$:

$$DISP_i = (DP_i * Y_i) + ((.65\ TP_i - ADP_i) * .40\ PY_i + (.90\ TP_i - ADP_i) * (.25\ PY_i - Y_i) + (\max\{DP_i, ADP_i\} * .35\ PY_i) - (DP_i * PY_i)$$

The following equation describes how the payments and net returns are estimated, if the government commodity program payments exceed $50,000:

(12.2) If $\sum_{i=1}^{4} PAY_i > \$50,000$ then PAY_i is replaced in equation (12.1) by:

$$\$50,000 + \min\{\sum_{i=1}^{4}[(FL_i - EL_i) * PY_i * (BA_i - ARP_i - CUA_i - OPD_i)], \$200,000\}.$$

Combinations that involve participation in the CRP are also possible. These can be calculated by adding the payments from the CRP to the relevant equation and reducing the planted acres and adding maintenance costs as described in equation (9.1).

SUMMARY

The equations developed and described in this report are to facilitate research, extension, and classroom education programs that require the use of net return estimates for alternative government program scenarios.

Equations (1)-(6) describe net returns when the farm enterprises under consideration are not enrolled in the government commodity program. Equations (7)-(12) characterize net returns when one or more of the farm enterprises is enrolled in the government commodity program. Although commodity programs, crop insurance, and conservation reserve programs exist each year, disaster aid programs are only intermittently available. Equations (5), (6), (11), and (12) include adjustments for a disaster aid program such as the one available in 1988.

Although government programs that supplement farm incomes are intermittently revised, this report can serve as a framework for comparison of future programs as well.

Table 1. 1988 Government Commodity Program Provisions

Government Program Provision	Crop			
	Wheat	Corn	Grain Sorghum	Soybeans
Acreage Reduction Requirement (ARR)	27.5%	20.0%	20.0%	n/a
Optional Paid Diversion (OPD)	none	10.0%	10.0%	n/a
0/92 Option (CUA)	yes	yes	yes	n/a
Target Price (TP)	$4.23/bu.	$2.93/bu.	$2.78/bu.	n/a
Effective Loan Rate (EL)	$2.21/bu.	$1.77/bu.	$1.68/bu.	$4.77/bu.
Payment Rate Conservation Use Acres (PRCUA)	$1.53/bu.	$1.10/bu.	$1.08/bu.	n/a
Optional Paid Diversion Rate (OPDR)	n/a	$1.75/bu.	$1.65/bu.	n/a
Formula Loan Rate (FL)	$2.76/bu.	$2.21/bu.	$2.10/bu.	n/a
Advance Deficiency Payment (ADP)	$0.612/bu.	$0.44/bu.	$0.432/bu.	n/a

n/a - not applicable to this crop.

Table 2. 1989 Government Commodity Program Provisions.

Government Program Provision	Crop			
	Wheat	Corn	Grain Sorghum	Soybeans
Acreage Reduction Requirement (ARR)	10%	10%	10%	n/a
Optional Paid Diversion (OPD)	n/a	n/a	n/a	n/a
0/92 Option (CUA)	yes	yes	no	n/a
Target Price (TP)	$4.10/bu.	$2.84/bu.	$2.70/bu.	n/a
Effective Loan Rate (EL)	$2.06/bu.	$1.65/bu.	$1.57/bu.	To be announced
Payment Rate Conservation Use Acres (PRCUA)	$1.25/bu.	$2.225/bu.	$2.25/bu.	n/a
Optional Paid Diversion Rate (OPDR)	n/a	n/a	n/a	n/a
Formula Loan Rate (FL)	$2.57/bu.	$2.06/bu.	$1.96/bu.	n/a
Advance Deficiency Payment (ADP)	$.20/bu.	$.356/bu.	$.36/bu.	n/a

n/a - not applicable to this crop.

REFERENCES

Barnaby, G.A. Multiple Peril Crop Insurance: What Is It? Should You Buy It? Cooperative Extension Service. Manhattan, KS: Kansas State University, 1987.

Lipton, K.L. and S.L. Pollack. The Disaster Assistance Act of 1988: A Description of the Provisions. Staff Report No. AGES880909. Washington, DC: USDA, ERS, ATAD, September 1988.

Smith, E.G., L.A. Lippke, R.D. Knutson, and C.G. Anderson. "1988 Farm Program Participation Guidelines." Texas Agricultural Extension Service. Food and Fiber Economics. 17-1 (February 1988).

Williams, J.R. and G.A. Barnaby. "Government Programs That Compete with Multiple Peril Crop Insurance." Paper presented at Risk Management Strategies Using Multiple Peril Crop Insurance: A National Inservice Training Workshop for Extension Farm Management Personnel. Kansas City, MO, November 2-4, 1988.