STAFF PAPER

AN ECONOMIC ANALYSIS OF THE IFMPO

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Department of Agricultural Economics
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ABSTRACT

The Integrated Farm Management Program Option (IFMPO) of the 1990 farm bill is designed to increase crop management flexibility and promote the use of resource-conserving crops. Economic analysis of this program indicates that, although the current format provides flexibility, it provides little economic incentive to adopt resource-conserving crop rotations.

An Economic Analysis of the IFMPO

The Food, Agriculture, Conservation and Trade Act (FACTA) of 1990 continues many traditional U.S. agricultural policies but also adds flexible production options for commercial agricultural producers. The Act provides farmers with more choices for participation in crop programs. Many of FACTA's new provisions also attempt to meet the public's demand for policies dealing with water quality and pesticide use, organic food certification, and sustainable agriculture.

The Integrated Farm Management Program Option (IFMPO) provides significant flexibility for farmers participating in the federal commodity program and has the potential to reduce the negative impacts of farming practices on the environment and promote the use of environmentally beneficial crops. These are referred to under the IFMPO as resource-conserving crops (RCCs), which are defined as legumes, legume-grass mixtures, legume-small grain mixtures, legume-grass-small grain mixtures, and alternative crops (19). A farmer utilizing one or more RCCs in a rotation may benefit from improved soil fertility and tilth, reduced soil erosion, broken pest cycles, reduced chemical dependency, and water conservation. Legumes and grasses used in rotations can increase soil organic matter or maintain organic matter at higher levels than row crops (18). The economic benefits of rotations have been the focus of some research (10, 11, 17). Legumes have the added advantages of needing little or no nitrogen input and providing nitrogen credits for subsequent crops. Despite these benefits, the use of rotations is not widespread. The National Research Council found that U.S. farm programs and policies historically have restricted the use of rotations through financial penalties (15). A primary policy barrier is the potential loss of program subsidies if base acreage constraints are not followed (20, 9,

1). Thus, in 1990, the 1985 Food Security Act underwent major revisions to create programs that allow for environmentally beneficial crop rotations (4). Although the IFMPO is the primary vehicle for flexibility and RCC use, the Flexible Acreage Requirements of FACTA also allow farmers the opportunity to alter cropping patterns.

Although FACTA increases the probability that the issues of flexibility and environmental and sustainable agriculture will be addressed in future farm bill legislation, the immediate benefits of this flexibility still remain uncertain. FACTA may or may not provide the necessary economic incentives to ensure successful acceptance of these program options. The objectives of this analysis are to: (a) estimate the returns to corn and wheat rotations in eastern Kansas under several possible strategies including commodity program participation, (b) determine if current economic incentives in the IFMPO can encourage the use of RCCs, and (c) determine if alternative economic incentives in the IFMPO and flex acreage requirements could encourage the use of RCCs.

Program Descriptions

Integrated Farm Management Program Option (IFMPO)

Under the IFMPO, producers are allowed to adopt resource-conserving crop rotations. A participant's historical program base acreage, payment yields, and resulting commodity program payments are protected, while non-program crops are grown on program acres enrolled in the IFMPO. Producers must file an integrated farm management plan with the Agricultural Stabilization and Conservation Service (ASCS) to enroll their farm in the program. The plan must be approved by the Soil Conservation Service (SCS). A producer then enters into a 3- to 5-year contract renewable upon mutual agreement with ASCS. During this contract period, the producer must devote a minimum average of 20

percent of all commodity program crop acreage bases to RCCs. The choices include legumes, legume-grass mixtures, legume-small grain mixtures, legume-grass-small grain mixtures, and alternative crops. Grasses are defined as perennial grasses normally used for haying and grazing. Small grains are defined so as not to include malting barley or wheat. However, wheat may be interplanted with other small grains and a legume, if not harvested for human consumption. Legumes include clover, alfalfa, or others grown for forage or green manure but do not include bean crops from which seeds are harvested.

RCC acreage enrolled in the IFMPO that is not designated as Acreage Reduction Program acres (ARP or set-aside acres) cannot be cut for hay or grazed during the principal 5-month growing season specified by the state ASCS committee, with one exception. If a small grain crop is interplated with a legume, the legume may be harvested or grazed after the small grain is harvested (19). Payment acres devoted to RCCs in the IFMPO may be harvested for seed all year (19). Program base acres, program yields, and resulting commodity program payments are not reduced as a result of planting an RCC as part of a crop rotation on payment acres.

The producer also must comply with the acreage set-aside requirements of the ARP that are in effect for the contracted crop acreage bases. All ARP acres may be included in the IFMPO and may count toward the required RCC acres under the IFMPO (19). In addition, 50 percent of the ARP acres planted to RCCs in the IFMPO may be cut for hay or grazed throughout the year. Small grains, other than barley, oats, and wheat, that are part of the RCC on ARP acreage may be harvested for grain. The other 50 percent may be cut for hay or grazed except during the principal 5-month growing season specified by

the state ASCS Committee. ARP acres planted to RCCs with the use of cost-sharing funds are not eligible for the IFMPO.

Flexible Acreage Requirements

Farm managers may also use the required "normal" flex acres and "optional" flex acres to add a RCC rotation to their cropping system. As with previous farm bills, participating farmers have to meet ARP guidelines. However, beginning in 1991, they must also remove an additional 15 percent of their base acreage from deficiency payment eligibility without altering their program base acreage. These acres are called the "normal" flex acres (sometimes referred to as "Triple Base Acres"). These flex acres are ineligible to receive deficiency payments. Farmers may also voluntarily remove up to an additional 10 percent of their base acres as "optional" flex acres. Deficiency payments are forfeited when a crop other than the program crop is planted on "optional" flex acres. On flex acres, farmers may grow and harvest any crop approved by the USDA without any specific program restrictions. These include legumes; minor oil seed crops, such as sunflower or canola; program crops; and soybeans. Fruits and vegetables cannot be produced on flex acres.

Alternative Production Strategies

Returns over variable costs for 12 crop production strategies, including two government commodity program crops, (corn and wheat) are examined. A brief description of the strategies follows.

(a) Corn or wheat production without participation in any government commodity program (NCP).

(b) Corn or wheat production in the commodity program with the respective program crop produced on required flex acres (CP).

(c) Corn or wheat production in the commodity program with required flex acres planted to soybeans (CP-BEANF).

(d) Corn or wheat production in the commodity program with required flex acres and 5 percent optional flex acres planted to alfalfa and rotated annually with the program crop. One cutting of alfalfa for hay is performed (FLEX-1CUT).

(e) Corn or wheat production in the commodity program with required flex acres and 5 percent optional flex acres planted to alfalfa and rotated annually with the program crop. Two cuttings of alfalfa are performed (FLEX-2CUT).

(f) Corn or wheat production in the commodity program with the respective program crop produced on required flex acres, and IFMPO acres planted to alfalfa and rotated annually with the program crop. All of the required ARP acreage is allocated to IFMPO; half of this is harvested twice and the other half is not harvested. All IFMPO acres that are not ARP acres are not harvested (IFM).

(g) A strategy similar to IFM with the exception that all IFMPO acres not in ARP are harvested once annually (IFM-1CUT).

(h) A strategy similar to IFM with the exception that all IFMPO acres not in ARP are harvested twice annually (IFM-2CUT).

(i) A strategy similar to IFM with the exception that some IFMPO acres not in ARP are now harvested for seed to replant the IFMPO acres the following year (IFM-SEED).

(j) A strategy similar to IFM with the exception that all IFMPO acres not in ARP are grazed for three and one-half months annually if a rental fee is paid to do so (IFM-GRAZE).

(k) A strategy similar to IFM with the exception that all IFMPO acres not in ARP are harvested twice annually if a rental fee is paid to do so (IFM-HAY).

In each of the preceding strategies, with the exception of NCP, CP, and CP-BEANF, 20 percent of the program base acres are allocated to an RCC rotation using a legume (alfalfa) on either flex or IFMPO acreage. Several IFMPO strategies (IFM-1CUT, IFM-2CUT, IFM-SEED, IFM-GRAZE, and IFM-HAY) are included, which are not ASCS approved but

have been proposed by sustainable agricultural lobbyists and other groups. These options are examined to determine if they would make the IFMPO a more economically attractive program.

One strategy (IFM-SEED) examines the possibility of harvesting seed from legumes or grasses in an amount large enough to re-seed the IFM acres in the following year. In this case, alfalfa seed is harvested from non-ARP acres in IFMPO. In the IFM-SEED strategy, alfalfa seed is not purchased. Seed is harvested with a small grain combine, and the seed is not cleaned. The seed is used only as an input for the following alfalfa crop on the farm. The final two IFMPO strategies evaluate the potential of harvesting (IFM-HAY) and grazing (IFM-GRAZE) IFMPO acres, with the exception that half of the ARP acres in IFMPO remain unharvested. Each of these two alternatives is subject to the payment of a fee to the federal government.

Procedures and Data

Returns over variable costs per base acre are calculated for each of the previously described alternatives for both corn and wheat. Equations (1) - (8) in the Technical Appendix describe how these net returns are estimated.

The analysis initially assumes that alfalfa is introduced as the RCC in rotation with either wheat or corn allowable under the flex acreage provisions (FLEX-1CUT, FLEX-2CUT) or the IFMPO (IFM). Alfalfa is a legume commonly used in eastern Kansas for a nitrogen source and cash crop. The rotation of alfalfa, as used in these strategies, is different from the typical practice of establishing alfalfa for harvest over a 4-year period. Instead, alfalfa is planted annually and incorporated into the soil as green manure.

Crop Budgets

Table 1 provides a summary of the costs used in the analysis, based on Kansas State University Farm Management Guides (5, 6, 7, 8). A program yield of 85 bushels per acre for corn and 35 bushels per acre for wheat are based on 10-year average yields (1981-1990) from Kansas Farm Management Association farms in eastern Kansas. Crop prices for wheat and corn are the difference between the commodity program target price and USDA's estimated (projected) deficiency payment for 1992. Both crops require a 5 percent ARP and a 15 percent normal flex acreage reduction. When soybeans are examined as an alternative to a RCCs on flex acres,a yield of 25 bu./acre is used.

Annual seeding and establishment costs are included in the variable costs of the alfalfa budgets. The analysis also assumes that the farm manager has an equipment complement that is appropriate for all field operations, including establishment, harvest, and annual soil incorporation of the legume. If this is not the case, the cost of using such a rotation will be greater. In the strategies where harvest is allowed on IFMPO acres, the alfalfa is allowed to regrow before plow down. The exact time of plow down is not specifically addressed. This will depend upon several conditions including conservation compliance restrictions. Any field time or compliance constraints may reduce the potential for obtaining a nitrogen credit or increase costs.

Nitrogen Contribution

The alfalfa budget includes a 100 lbs. per acre nitrogen (N) credit valued at $.12 per pound of N for the subsequent corn crop (Table 1). The N credit does not represent the pounds of N contributed by alfalfa, but the equivalent N value to the subsequent corn crop.

The nitrogen benefits from growing a forage or grain legume before a non-legume are influenced by how the legume is managed for the return of N to the soil (11). The amount of N biologically fixed by the legume may be substantially higher, if the number of cuttings of hay is limited and regrowth is not removed prior to plow down, as opposed to leaving only the roots and stubble for incorporation. One study reports that corn yields in the first year after an alfalfa rotation with one harvest of the alfalfa were approximately equal to those of corn following corn that received 100 lbs. of N per acre (12). Corn yields in a rotation in which the alfalfa was harvested three times were equivalent to corn following corn that received 50 lbs. of N per acre. Another report indicates that some studies found higher levels of N fixation (11). However, the N credit should be based on the contribution to yield of the following crop. In Kansas, corn yields during the first year after alfalfa have been reported to be as great as those of corn receiving 90 lbs. of N per acre (3). The 100 lbs. per acre credit also falls in the middle of the expected range for N fixation in Kansas (14). Nitrogen fixation and carryover are sensitive to weather, soil conditions, and time of plow down. Therefore, the N credit will be different in various production regions. A credit of 50 lbs. of N per acre is allowed in a wheat crop following a legume because only 50 lbs. of N is recommended (8). A credit of 25 lbs. per acre of N is used when soybeans are rotated with corn on flex acres (14).

Grazing and Haying Fees

The IFM-GRAZE and IFM-HAY strategies evaluate the possibility of grazing and harvesting IFMPO acres, if a fee is paid for the privilege. In the IFM-GRAZE strategy, grazing is allowed if the farm manager pays a rental rate equivalent to the USDA's fee for

grazing national grasslands, which is $3.42 per head per month in 1992 (2). For purposes of this study, this rental fee is converted to per acre units by the following method.

The production level of alfalfa is 2.5 tons per year, which is equivalent to 6.25 animal unit months (AUM). Given a 3.5-month grazing season and an average animal weight of 650 pounds (.65 average animal unit (AU)), the stocking rate is 2.7 head per acre per month [(6.25 AUM/3.5 months) x (1/.65AU)]. The stocking rate is then multiplied by the rental fee to arrive at a monthly rental fee of $9.23 or an annual fee of $32.32 (16).

The gross return for the IFM-GRAZE includes an estimated benefit from grazing IFMPO in addition to the value of N generated for the subsequent crop (Table 1). Because a rental fee for grazing alfalfa is unavailable, this return is estimated to be the opportunity cost of leasing alternative grazing land with equivalent AUM production. For Kansas, the average season (150 days) lease rate for pasture is $61.30 per head (13). The lease rate is divided by the average of 3.125 AUMs available from grass to determine an average grazing value of $19.62 per AUM (16). Therefore, annual benefit from an acre of alfalfa producing 6.25 AUM is estimated to be $122.63 per acre. With the 100 lb./acre N credit, the total value is $134.63/acre (Table 1). This estimated benefit, based entirely on feed value, may be somewhat higher than the practical value. Cattle cannot be grazed as freely on alfalfa as grass because of the potential for foundering.

In order to harvest alfalfa for hay in the IFM-HAY strategy, another rental fee is required. No comparable fee is already established; therefore, the maximum fee the farmer would be willing to pay is estimated. This payment is the additional cost that would drive returns to $0.00 on the IFMPO acres in the IFM-2CUT strategy.

Results

The net returns per program base acre for corn and wheat are presented in Tables 2 and 3, respectively. Which option is best depends upon the goals of the farm manager. Two possible goals are examined in this study: (a) profit maximization and (b) the establishment of an RCC under IFMPO or another program option with the highest net returns.

Corn Rotations

If the manager's main objective is profit maximization, given current program constraints, the strategy for corn with the highest net return is participation in the basic commodity program with alfalfa produced and harvested twice on normal flex acres and optional flex acres (FLEX-2CUT) (Table 2). A comparison of alternative strategies for normal flex acreage alone indicates that corn has the highest return with the exception of alfalfa that is harvested twice. The return from alfalfa harvested twice on either normal or optional flex acres is $72.70 per acre (Table 1). The return from corn on normal flex acres is $46.29 per acre, and the return from corn that would be given up to plant another crop on optional flex acres is $46.29 per acre plus deficiency payments of $40.80 per acre, for a total of $87.09 per acre (Table 1). Under these conditions, optional flex acres should not be planted to alfalfa and should be left in corn to maximize profits. If alfalfa could be sold for only $50/ton rather than $65/ton, the strategy with the highest return would be the basic commodity program with soybeans produced on normal flex acres (CP-BEANF). The margin between CP and CP-BEANF is small. The reduced cost of not requiring a corn rootworm insecticide on rotated acres makes it a more profitable strategy than continuous

corn. Again, corn is a better alternative to soybeans on optional flex acres when the price of alfalfa is $50/ton.

If a farmer's main objective is establishing a resource-conserving crop rotation under current program constraints, the use of flex acreage in a rotation with corn may be superior to enrollment in the IFMPO. When the optional corn flex acreage of 5 percent is planted to alfalfa in addition to the required 15 percent, for a total of 20 percent, a return of $81.44 per base acre (FLEX-2CUT) is obtained (Table 2). Alternatively, returns from the current IFM strategy, which does not allow harvesting of the legume with the exception of 50% of the ARP acreage, is $65.89 per base acre (Table 2).

If the current IFMPO constraints are changed to allow one (IFM-1CUT) or two (IFM-2CUT) harvests on all IFMPO acres, the returns would be considerably improved. When only one cutting of alfalfa can be made on flex acres (FLEX-1CUT), to ensure a 100 lbs. per acre N credit, the return is $69.50 per base acre for corn (Table 2). A similar IFMPO strategy (IFM-1CUT) has a greater return of $74.85 per base acre to the farm manager. The return is greater because deficiency payments are made on IFMPO acres that are not ARP acres, and 50 percent of the ARP acres in the IFMPO are also harvested. The calculations for the IFM, IFM-1CUT, and IFM-2CUT options include two harvests of 50 percent of the RCC acres on the ARP acres enrolled in the IFMPO. The return per base acre with one cutting of alfalfa (IFM-1CUT) is close to the return from the government commodity program alone (CP). If two cuttings are allowed (IFM-2CUT), the return of $83.81 per base acre is greater than the return from producing alfalfa in the FLEX options.

The harvesting of alfalfa seed to the extent necessary to re-seed all IFMPO acres in the following year (300 lbs./acre x .54 acres) in the IFMPO (IFM-SEED) has a negative net return of -$3.58 per IFMPO acre (Table 2). The return per base acre of $69.33 is somewhat higher than the return of $65.89 per base acre from the current IFMPO strategy, which includes no harvesting of seed. Harvesting of seed reduces the cost of using the IFM strategy. Positive benefits may be derived from harvesting seed from resource-conserving crops other than alfalfa or selling excess alfalfa seed. Alfalfa seed is relatively inexpensive ($2.00 per pound); the harvesting of a more expensive and less available legume or grass seeds may make this option more economical.

Those IFMPO strategies that allow haying or grazing on all RCC acres that are also payment acres have relatively high returns. The option allowing grazing on these acres for a minimum rental payment (IFM-GRAZE) has a return of $79.43 per base acre. This return is only slightly less than the return in FLEX-2CUT and greater than the CP return. The analysis indicates that in the IFM-HAY strategy a farmer would be willing to pay up to $72.70 per acre of alfalfa for the ability to make two hay cuttings. This fee is equivalent to the net return under the 2-CUT alfalfa budget (Table 1). At this maximum fee, the returns per base acre of $72.90 are slightly less than the returns under the CP strategy (Table 2).

In this study, a N credit is added to the value of corn following alfalfa. Other benefits may be derived from using an RCC in rotation with corn, such as soil fertility and weed and pest control. Adequate data for analysis is not available on these other benefits of rotations in eastern Kansas. However, an economic comparison can be made between the CP and IFM strategies to estimate the additional benefits needed from the RCC

rotation to make the returns from the IFM strategy and the CP strategy equivalent. If the additional yield derived from these unaccounted impacts of crop rotations is sold at the market price and deficiency payments as well as program yields are fixed at current levels, the additional corn yield needed from those acres planted to corn after alfalfa to make the two strategies equivalent is 21.4 bushels per acre.

Wheat Rotations

The strategy for wheat with the highest net return of $57.71 per base acre is participation in the basic commodity program with alfalfa produced and harvested twice on normal flex acres (FLEX-2CUT) (Table 3). A comparison of alternative strategies for normal flex acreage alone indicates that alfalfa has the highest return. The return from alfalfa harvested twice on either normal or optional flex acres is $66.70 per acre (Table 1). The return from wheat on normal flex acres is $37.74 per acre (Table 1), and the return from wheat that would be given up to plant another crop on optional flex acres is $37.74 per acre plus deficiency payments of $22.75 per acre, for a total of $60.49 per acre. Therefore, optional flex acres planted to alfalfa rather than wheat will increase profits.

If alfalfa could be sold for only $50/ton rather than $65/ton, the strategy with the highest return would be the basic commodity program with soybean produced on normal flex acres (CP-BEANF) (Table 3). However, soybeans are subject to more price and yield risk and hence more variable income than wheat. The return from soybeans on normal or optional flex acres is $41.60. Therefore, soybeans should not be planted on optional flex acres because the return from wheat, including deficiency payments on optional flex acres, is $60.49/acre.

As for corn, flex acreage is superior to IFMPO in establishing a resource-conserving crop rotation under current program constraints. When the optional wheat flex acreage of 5 percent is planted to alfalfa in addition to the required 15 percent, a return of $57.71 per base acre (FLEX-2CUT) is obtained (Table 3). The return of $40.83 per base acre from the current IFM strategy, which does not allow harvesting of the legume except for 50% of the RCC acreage on ARP acres, is less than the return from the CP strategy and both FLEX options (Table 3). When only one cutting of alfalfa is made on flex acres (FLEX-1CUT), the return is $45.77 per base acre for wheat (Table 3). A similar IFMPO strategy (IFM-1CUT) has a greater return, $49.79 per base acre. If two cuttings are allowed (IFM-2CUT), the return of $58.75 per base acre is greater than the return from producing alfalfa in the FLEX-2CUT option.

The harvesting of alfalfa seed from .54 acres in the IFMPO (IFM-SEED) has a negative net return of $-4.48 per IFMPO acre (Table 3). The return per base acre is slightly greater than that of the current IFM strategy, where no harvesting of hay or seed is allowed. As discussed previously, if excess seed is sold, the return per base acres would rise. However, an increase in marketed alfalfa seed would likely reduce local alfalfa seed prices and, therefore, the incentive to allocate acreage to this option.

The option allowing grazing on all RCC acres which are not included in ARP acres for a minimum rental payment (IFM-GRAZE) has a return of $54.37 per base acre. The analysis indicates that under the IFM-HAY strategy for wheat, a farmer would be willing to pay up to $66.70 per acre of alfalfa based on a break-even rate on IFMPO acres. This payment is lower than that required in a corn rotation, because the N benefits from alfalfa included in the crop budget (Table 1) are less for wheat. Only 50 lbs. of N per acre is used

by the following wheat crop. With this maximum fee, the return of $48.74 per base acre is greater than the return of the IFM strategy.

The rotation of an RCC with wheat also may produce benefits in addition to N credits. If prices and deficiency payments are constant, an additional 17.9 bushels of wheat per acre from those acres planted to wheat after alfalfa are needed in the IFM strategy to produce returns equivalent to those of the CP strategy.

ARP Requirements

Current allowances for haying or grazing provide some incentive for enrolling in the IFMPO. However, the smaller the ARP requirement, the smaller the incentive becomes. Under a 20% ARP, the IFM scenario becomes economically attractive, given constant relative prices, but under the current ARP of 5% and a 0% ARP, it is not (Table 4).

Summary and Conclusions

Under the current program regulations of FACTA, the Flexible Acreage Requirement option presents a more economical opportunity to use a legume in a resource-conserving crop rotation with program crops than the IFMPO, assuming there are no available non-program acres. However, the greatest returns under both corn and wheat are generated by producing alfalfa on flex acres. If alfalfa prices fall because of increased alfalfa production, the greatest returns will be generated by producing soybeans on required flex acres. This economic analysis shows that soybeans, a crop with high erosion potential and relatively low soil nitrogen production compared to other legumes, could be more readily used on flex acres if alfalfa prices fall relative to soybean prices. The IFMPO, on the other

hand, is designed for the specific purpose of using RCC by excluding the use of some crops, including soybeans.

Another advantage of the Flex Acreage requirement is that a farmer who decides to use optional flex acres may do so on an annual basis for any or all of the crop bases. Annual decisions allow farmers to adapt to changing market conditions and institutional constraints. The impact of the decline in the ARP requirement for wheat over the last 3 years reinforces this point. This flexibility may be appropriate for many farm managers, but the multi-year contract required by the IFMPO may be more appropriate to generate lasting environmental benefits. In addition, some farm managers also may view the multi-year contract as risk reducing.

As it is currently designed, the IFMPO does not appear to be an economically desirable program in which to participate. The small amount of acreage enrolled in the program to date reinforces this point (10,117 base acres in Kansas and 55,766 nationally in 1991; 1,429 additional base acres in Kansas in 1992). One important change to improve participation would be to allow more haying or grazing of IFMPO acres. Current allowances for haying or grazing part of the ARP acreage included in IFMPO are economically attractive. However, as ARP requirements decline, this incentive becomes smaller. This analysis demonstrates that, even with a fee requirement, haying and grazing allowances improve the returns under this program. A caveat to this conclusion is that the rental fees charged by the USDA for grazing federal lands historically have been set far below the rental value of surrounding private pastures. Therefore, the estimated cost of the IFMPO grazing option may be low, whereas the opportunity cost or benefit is relatively high. Private landowners may object to this strategy, much as they have objected to the

federal grazing policies. In addition, haying and grazing strategies may be attractive only as long as local hay prices are not adversely affected. Some restrictions concerning harvest management strategies may be appropriate to balance the need for returns from the crop versus those for improving soil characteristics and weed control and reducing environmental externalities. IFMPO enrollment is also discouraged by current production costs and market conditions, which provide little economic incentive for farmers with a relatively inexpensive commercial N source to use an RCC rotation.

The use of an RCC in a rotation has many potential benefits. This study specifically accounts for the N credit realized by a crop following a legume. Soil fertility, reduced soil erosion, and broken pest cycles are equally valuable benefits; however, few data are available on these impacts. An estimate can be made as to what additional yields derived from these benefits would be needed to make the current IFMPO economically comparable to participation in the commodity program. In a corn rotation, the unaccounted benefits of rotation would need to improve yields by 25 percent, assuming additional yields are sold at the market price, for returns to be comparable to those from the current commodity program. In a wheat rotation, an additional 51 percent yield is needed to equate returns from the IFMPO and the current commodity program.

With the present lack of data concerning some of the relationships between legumes, improved soil characteristics, and reduced soil erosion costs, farm managers have little choice but to examine net returns, which are easily quantifiable from the limited information available. Without substantial changes in government programs to alter the current incentives or research concerning economic aspects of RCC rotations to demonstrate their economic potential, such rotations will not be used by the majority of commercial farmers

producing program crops. Further economic research into potential incentives and policy alternatives for RCC rotations, coinciding with agronomic studies, should be a high priority.

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Technical Appendix

Returns over variable costs per base acre are estimated for each scenario in this report using the following set of equations.

(1) $NR = RFR + OFR + IFMR + AIFMR + PCR + DPR - ARPC,$

where: *NR* = return over variable costs per base acre,
RFR = required flex acre return,
OFR = optional flex acre return,
IFMR = integrated farm management acre return,
AIFMR = integrated farm management program return per ARP acre,
PCR = program crop acre return,
DPR = deficiency payment per acre return, and
ARPC = set-aside cost per acre.

(2) $RFR = RF \times (GRRF - VCRF),$

where: *RF* = percent of base acres in required flex acres,
GRRF = gross return on required flex acres, and
VCRF = variable cost on required flex acres.

(3) $OFR = OF \times (GROF - VCOF),$

where: *OF* = percent of base acres in optional flex acres,
GROF = gross return from on optional flex acres, and
VCOF = variable cost from on optional flex acres.

(4) $IFMR = IFM \times (GRIFM - VCIFM),$

where: *IFM* = percent of base acres in IFMPO,
GRIFM = gross return on IFMPO acres not on ARP (set-aside) acres, and
VCIFM = variable cost of the crop on IFMPO acres not on ARP acres.

(5) $AIFMR = [(ARP \times ARPH) \times (GRARPH - VCARPH)] + [(ARP \times ARPNH) \times (GRARPNH - VCARPNH)],$

where: *ARP* = percentage of base acres in the ARP,
ARPH = percentage of base acres in ARP included as IFMPO acres and harvested.

GRARPH = gross return of the crop on ARP acres included in the IFMPO and harvested,

VCARPH = variable cost of the crop on ARP acres included in the IFMPO and harvested,

ARPNH = percentage of the base acres on ARP acres included in IFMPO acres and not harvested,

GRARPNH = gross return of the crop on ARP acres included in the IFMPO and not harvested in any strategy, and

VCARPNH = variable cost of the crop on ARP acres included in the IFMPO and not harvested in any strategy.

(6) $PCR = [1 - RF - OF - IFM - ARP] \times GRPCR,$

where: *GRPCR* = gross return from the crop on program acres.

(7) $DPR = [1 - RF - OF - IFM - ARP] \times DP,$

where: *DP* = deficiency payment per acre for the crop on program acres.

(8) $ARPC = ARP \times CARP,$

where: *CARP* = the cost of planting a cover crop on ARP acres not in the IFMPO.

Table 1. Cost, yield, and return estimates for crop rotation analysis.

	CROPS								
	CORN	WHEAT	SOYBEAN	IFM ALFALFA	1-CUT ALFALFA	2-CUT ALFALFA	IFM-ALFALFA SEED	IFM-ALFALFA GRAZE	IFM-ALFALFA HAY
VARIABLE COST									
$/planted acre	$146.66	$ 79.51	$ 98.90	$ 58.76	$ 80.26	$101.80	$ 75.53	$ 91.08	$ 174.50* $ 168.50*
SET-ASIDE COST									
$/set-aside acre	$ 20.00	$ 20.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00
YIELD									
Bu./acre	85	35	25						
Tons/acre					1.25	2.5			2.5
Lbs./acre							300		
Lbs. N/acre			25	100†	100†	100†	100†	100†	100†
AUM/acre								6.25	
PRICE									
$/bu.	$ 2.27	$ 3.35	$ 5.50						
$/ton					$ 65.00 ($ 50.00)	$ 65.00 ($ 50.00)	$ 2.00		$ 65.00 ($ 50.00)
$/lb.									
$/lb. of N			$ 0.12	$ 0.12	$ 0.12	$ 0.12	$ 0.12	$ 0.12	$ 0.12
$/AUM								$ 19.62	
GROSS RETURNS									
$/planted acre	$192.95	$117.25	$140.50	$ 12.00	$ 93.25	$174.50	$612.00	$134.63	$149.50
DEFICIENCY PAY.									
$/bu.	$ .48	$ .65	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00
$/payment acre	$ 40.80	$ 22.75	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00

* Includes a fee to the farmer to allow grazing on IFMPO acres. This fee is set at the value causing zero returns to IFMPO acres. Fees are $72.70 per acre in the corn rotation for a total variable cost of $174.50 and $66.70 per acre in the continuous wheat rotation for a total variable cost of $168.50.

† When alfalfa is rotated with wheat, the nitrogen credit is limited to 50 lbs./acre or $6.00/acre.

able 2. Net returns ($/base acre) from corn production strategies with government programs.

	Strategies*										
osts and Net Returns†	NCP	CP	CP-BEANF	FLEX-1CUT	FLEX-2CUT	IFM	IFM-1CUT	IFM-2CUT	IFM-SEED	IFM-GRAZE	IFM-HAY
Base in ARP	0.0%	5.0%	5.0%	5.0%	5.0%	0.0%	0.0%	0.0%	0.00%	0.00%	0.00%
a. ARP Cost (ARPC)	$0.00	$ 1.00	$1.00	$ 1.00	$ 1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Base in Normal Flex	0.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%
b. Flex Return (RFR)	$0.00	$ 6.94	$ 6.24	$ 1.95	$10.91	$ 6.94	$ 6.94	$ 6.94	$ 6.94	$ 6.94	$ 6.94
Base in Optional Flex	0.0%	0.0%	0.0%	5.0%	5.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
c. Optional Flex Return (OFR)	$0.00	$ 0.00	$0.00	$ 0.65	$ 3.64	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Base in IFMPO	0.0%	0.0%	0.0%	0.0%	0.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%
d. IFMPO Return (IFMR)	$0.00	$0.00	$0.00	$0.00	$0.00	($ 7.01)	$1.95	$10.91	($ 3.58)	$6.53	$0.00
Base in ARP-IFMPO	0.0%	0.0%	0.0%	0.0%	0.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Harv. ARP-IFMPO Return	$0.00	$0.00	$0.00	$0.00	$0.00	$1.82	$1.82	$1.82	$1.82	$1.82	$1.82
Nonh. ARP-IFMPO Return	$0.00	$0.00	$0.00	$0.00	$0.00	($1.17)	($1.17)	($1.17)	($1.17)	($1.17)	($1.17)
e. TOTAL (AIFMR)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.65	$0.65	$0.65	$0.65	$0.65	$0.65
Base in Prog. Crop	100.0%	80.00%	80.00%	75.00%	75.00%	65.00%	65.00%	65.00%	65.00%	65.00%	65.00%
f. Prog. Crop Return (PCR)	$46.29	$37.03	$38.97	$37.30	$37.30	$32.67	$32.67	$32.67	$32.67	$32.67	$32.67
Base that are Def. Pay. Acres	0.0%	80.00%	80.00%	75.00%	75.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%
g. Def. Payments (DPR)	$0.00	$32.64	$32.64	$30.60	$30.60	$32.64	$32.64	$32.64	$32.64	32.64	$32.64
Return Over Variable Cost (NR)‡ ($/base acre)	$46.29	$75.62	$ 76.85	$69.50	$ 81.44	$65.89	$ 74.85	$ 83.81	$ 69.33	$ 79.43	$ 72.90
Results with Alfalfa = $50/ton Returns Over Variable Cost ($/base acre)	$46.29	$75.62	$76.85	$65.75	$73.94	$64.95	$71.10	$77.24	$68.39	$78.49	$71.96

* NCP - No Commodity program.
CP - Commodity program with program crop (corn) on required flex acreage.
FLEX-1CUT - Required flex acreage and optional flex acreage planted to alfalfa with 1 cutting and rotated with the program crop.
FLEX-2CUT - Required flex acreage and optional flex acreage planted to alfalfa with 2 cuttings and rotated with the program crop.
IFM - IFMPO program acreage planted to alfalfa for rotation with the program crop and required flex acres planted to the program crop. Two cuttings of alfalfa allowed on 50% of the ARP in IFMPO. No harvest allowed on other IFMPO acres.
IFM-1CUT - Same as IFM - except 1 cutting of alfalfa allowed on IFMPO acres not in ARP.
IFM-2CUT - Same as IFM - except 2 cuttings of alfalfa allowed on IFMPO acres not in ARP.
CP-BEANF - Commodity program with soybeans planted on required flex acres.
IFM-SEED - Same as IFM - except harvest seed on 2.7% of the IFMPO acres not in ARP.
IMF-GRAZE - Payment made to graze IFMPO acres for 3.5 months, with the exception of the ARP in the IFMPO.
IFM-HAY - Payment made for 2 cuttings of IFMPO acres, with the exception of the ARP in the IFMPO.

† All costs and returns are $/base acre. See text and equations (1) - (8) for detailed explanation of how costs and returns are calculated.

‡ Return Over Variable Cost = b. + c. + d. + e. + f. + g. - a.

Table 3. Net returns ($/base acre) from wheat production strategies with government programs.

	Strategies*										
Costs and Net Returns†	NCP	CP	CP-BEANF	FLEX-1CUT	FLEX-2CUT	IFM	IFM-1CUT	IFM-2CUT	IFM-SEED	IFM-GRAZE	IFM-HAY
% Base in ARP	0.0%	5.0%	5.0%	5.0%	5.0%	0.0%	0.0%	0.0%	0.00	0.0%	0.0%
a. ARP Cost (ARPC)	$0.00	$ 1.00	$1.00	$ 1.00	$ 1.00	$ 0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Base in Normal Flex	0.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%
b. Normal Flex Return (RFR)	$0.00	$ 5.66	$ 6.24	$1.05	$10.01	$ 5.66	$5.66	$5.66	$5.66	$5.66	$5.66
% Base in Optional Flex	0.0%	0.0%	0.0%	5.0%	5.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
c. Optional Flex Return (OFR)	$0.00	$ 0.00	$0.00	$0.35	$ 3.34	$ 0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Base in IFMPO	0.0%	0.0%	0.0%	0.0%	0.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%
d. IFMPO Return (IFMR)	$0.00	$ 0.00	$0.00	$ 0.00	$ 0.00	($ 7.91)	($1.05)	$10.01	($ 4.48)	$5.63	$0.00
% Base in ARP-IFMPO	0.0%	0.0%	0.0%	0.0%	0.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Harv. ARP-IFMPO Return	$0.00	$0.00	$0.00	$0.00	$0.00	$1.67	$1.67	$1.67	$1.67	$1.62	$1.62
Nonh. ARP-IFMPO Return	$0.00	$0.00	$0.00	$0.00	$0.00	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)
e. TOTAL (AIFMR)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.35	$0.35	$0.35	$0.35	$0.35	$0.35
% Base in Prog. Crop	100.0%	80.0%	80.0%	75.0%	75.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%
f. Prog. Crop Return (PCR)	$37.74	$30.19	$30.19	$28.30	$28.30	$24.53	$24.53	$24.53	$24.53	$24.53	$24.53
% Base that are Def. Pay. Acres	0.0%	80.0%	80.0%	75.0%	75.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%
g. Def. Payments (DPR)	$0.00	$18.20	$18.20	$17.06	$17.06	$18.20	$18.20	$18.20	$18.20	$18.20	$18.20
Return Over Variable Cost(NR)‡ ($/base acre)	$37.74	$53.05	$53.63	$45.77	$57.71	$40.83	$49.79	$58.75	$44.27	$54.37	$48.74
Results with Alfalfa = $50/ton Return over Variable Cost ($/base acre)	$37.74	$53.05	$53.63	$42.02	$50.21	$39.89	$46.04	$52.18	$43.33	$53.43	$47.80

* NCP - No Commodity program
CP - Commodity program with program crop (wheat) on required flex acreage.
FLEX-1CUT - Required flex acreage and optional flex acreage planted to alfalfa with 1 cutting and rotated with the program crop.
FLEX-2CUT - Required flex acreage and optional flex acreage planted to alfalfa with 2 cuttings and rotated with the program crop.
IFM - IFMPO program acreage planted to alfalfa for rotation with the program crop and required flex acres planted to the program crop. Two cuttings of alfalfa allowed on 50% of the ARP in IFMPO. No harvest allowed on other IFMPO acres.
IFM-1CUT - Same as IFM - except 1 cutting of alfalfa allowed on IFMPO acres not in ARP.
IFM-2CUT - Same as IFM - except 2 cuttings of alfalfa allowed on IFMPO acres not in ARP.
CP-BEANF - Commodity program with soybeans planted on required flex acres.
IFM-SEED - Same as IFM - except harvest seed on 2.7% of the IFMPO acres not in ARP.
IMF-GRAZE - Payment made to graze IFMPO acres for 3.5 months, with the exception of the ARP in the IFMPO.
IFM-HAY - Payment made for 2 cuttings of IFMPO acres, with the exception of the ARP in the IFMPO.

† All costs and returns are $/base acre. See text for detailed explanation of how costs and returns are calculated.

‡ Return Over Variable Cost = b. + c. + d. + e. + f. + g. - a.

Table 4. Net returns ($/base acre) from corn and wheat production strategies with government programs under various ARP (Acreage Reduction Program) requirements.

	Strategies*					
Corn Net Returns	NCP	CP	CP-BEANF	FLEX-1CUT	FLEX-2CUT	IFM
20% ARP†	46.29	59.55	60.78	53.43	65.37	68.73
10% ARP‡	46.29	70.26	71.49	64.14	76.08	66.83
0% ARP§	46.29	80.97	82.20	74.85	86.79	64.94
Wheat Net Returns						
20% ARP†	37.74	40.98	41.56	33.69	45.63	46.37
10% ARP‡	37.74	49.03	49.61	41.74	53.68	42.68
0% ARP§	37.74	57.08	57.66	49.79	61.73	38.98

* NCP - No Commodity program.
CP - Commodity program with program crop on required flex acreage.
FLEX-1CUT - Required flex acreage (15%) and optional flex acreage (5%) planted to alfalfa with 1 cutting and rotated with the program crop.
FLEX-2CUT - Required flex acreage (15%) and optional flex acreage (5%) planted to alfalfa with 2 cuttings and rotated with the program crop.
IFM - IFMPO program acreage planted to alfalfa for rotation with the program crop and required flex acres planted to the program crop. Two cuttings of alfalfa allowed on 50% of the ARP in IFMPO. No harvest allowed on other IFMPO acres.

† Assumes 100% of IFM acres are on ARP.
‡ Assumes 50% of IFM acres are on ARP and 50% on payment acres.
§ Assumes 0% of IFM acres are on ARP and 100% on payment acres.

STAFF PAPER

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