POST-CRP LAND USE ALTERNATIVES FOR PUTNAM COUNTY, MISSOURI

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SUTHIJIT TRAIYONGWANICH

Dr. Gary Devino, Thesis Supervisor

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ABSTRACT

A mail survey was used to identify terms which would be required by landowners for extension of the Conservation Reserve Program as well as Post-CRP alternatives, problems and marketing service that are most likely to appear in Putnam County if there was no extensions of the program. A response rate of 60.5 percent was obtained from 185 participants. Respondents were interested in extending the CRP contracts. Both within area and out-of-area landowners preferred to take a higher rate if expected to return to crop production if the CRP program was not continued. Forty one percent would be used as pasture or hay land. Residence location was a significant determinant in respondents' decisions concerning expect land use of the CRP land. The dollars amount of resuming production on the CRP acres in each alternative land use under either conventional or alternative are shown in table.

Future Land Use	Product Sale	Direct Cost	Return Over D.C.
Crop Production			
Conventional	2,629,972	946,158	1,683,814
No-Till	2,831,102	827,867	2,003,235
Ridge-Till	2,831,102	707,232	2,123,870
Livestock Production			
Conventional	1,768,584	1,030,987	737,597
Alternative	2,681,487	1,401,443	1,280,044

LIST OF TABLES

LIST OF FIGURES

TABLE OF CONTENTS

CHAPTER I

INTRODUCTION

The Conservation Reserve Program (CRP) of the 1985 Food Security Act is a voluntary long-term cropland retirement program of The U.S. Department of Agriculture. Program goals are to reduce soil erosion on highly erodible or environmentally sensitive cropland and reduce excess supplied of the U.S. Agricultural products (Siegel, 1989). Highly erosive agricultural land is removed from production and placed in a permanent vegetative cover (grasses, shrubs, trees or any other acceptable vegetative cover which is not used for commercial purposes except under declared emergency conditions) for a ten-year time period. There were nine signup periods between 1986 and 1989. The 1990 Farm Bill[1] continued the CRP and made additional lands eligible, through the 12th signup period (Bjerke, 1991).

Landowners who signed up for the program received half of the expense of establishing permanent vegetative cover and an annual rental payments per acre in exchange for retiring cropland. Landowners agreed to implement a conservation plan approved by the local conservation district. They also agreed not to harvest, graze, or make

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[1] The 1990 law emphasized conservation of environmentally sensitive land. It added three programs: The Wetlands Reserve Program, Agricultural Water Quality Incentives Program, and the Environmental Easement Program.

other commercial use of the forage for the duration of the contract. Landowners could enroll entire farms or part of a farm. They could signup in more than one enrollment period.

In order to limit economic impacts on communities, each county was limited to enrolling no more than 25 percent of its cropland. Exceptions were made where it was determined that to do so would not hurt the local economy.

At the end of 1992 Missouri had about 1.7 millon acres in the CRP program through the 12th signup. Nationwide, over 36 million acres have been contracted (Osborn and Heimlich, 1993). Thus, Missouri holds nearly five percent of the total acres enrolled in the program.

Most of Missouri's enrollment took place in the first nine sign-ups (1,504,413 acres)[2]. More than 1 million acres are in Northern Missouri. There is some concentration in Western Missouri. The rest is dispersed around the state (ASCS, 1994). Figure 1 shows the distribution of the CRP enrollment by county in Missouri through nine signup periods. Several counties in Northern Missouri had enrollments which amounted to 20-25 percent of eligible land. Figure 2 presents the percent of county area enrolled in the CRP through the 9th signup.

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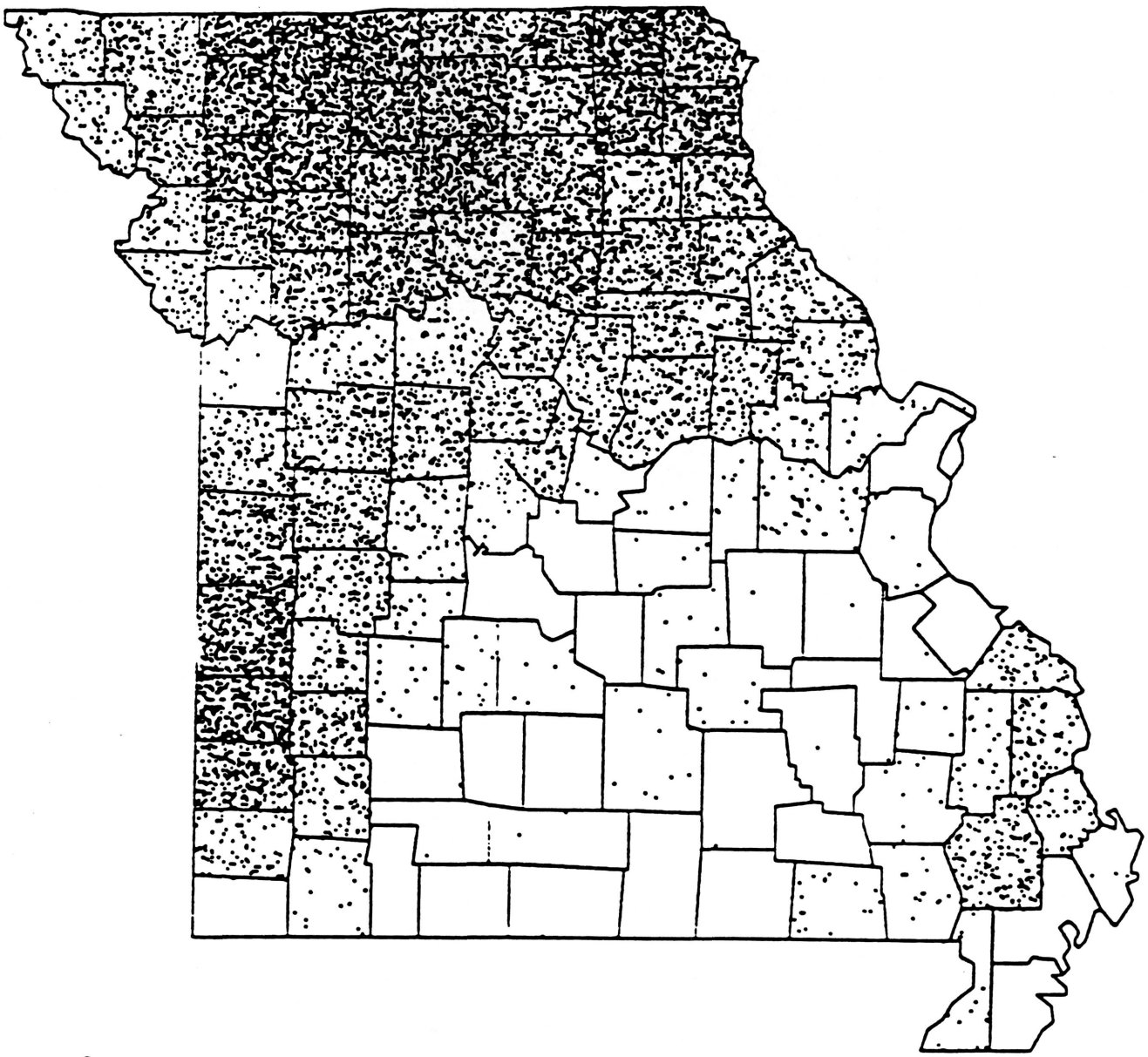
[2] This study covered only the first nine signup period.

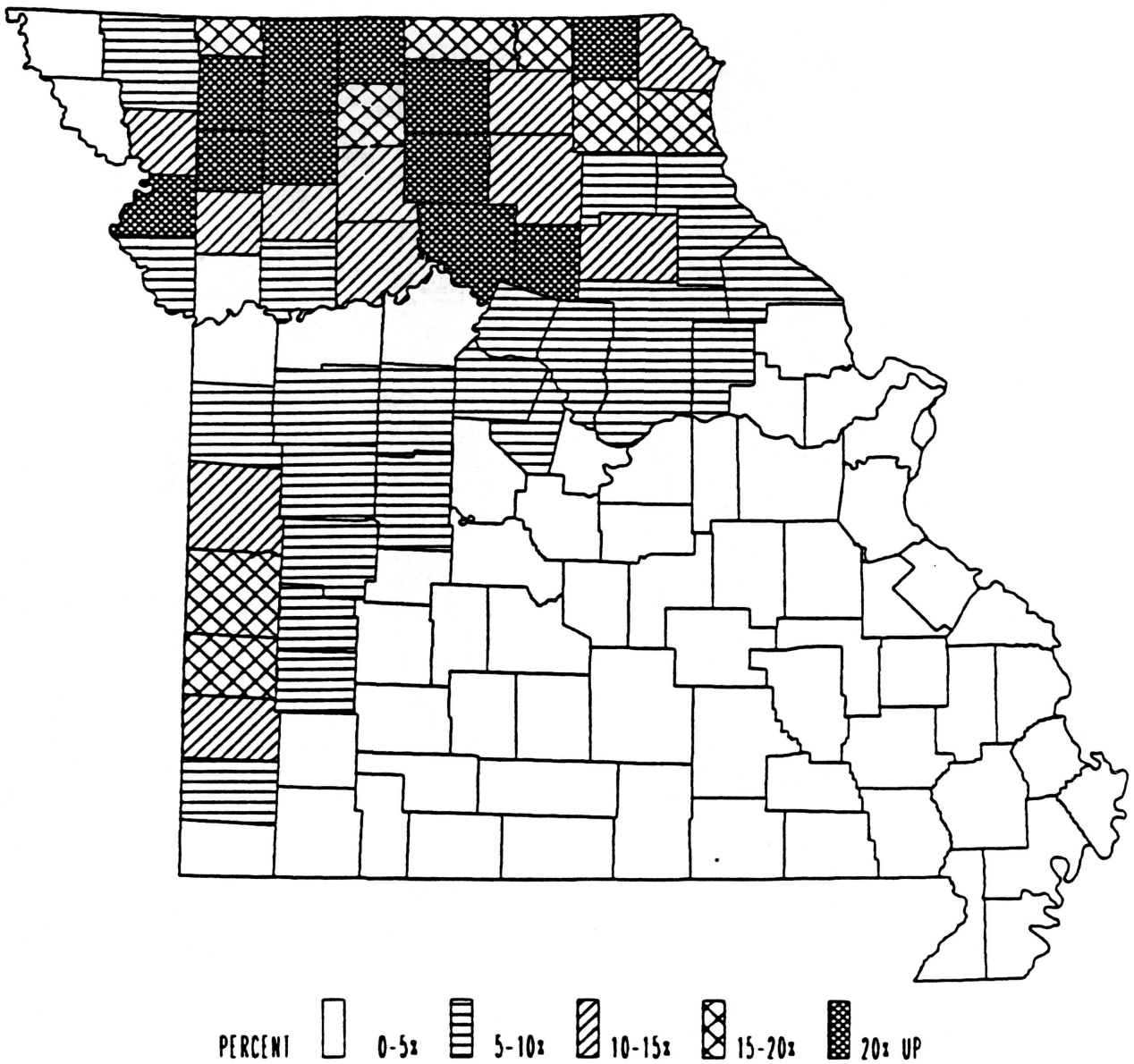
FIGURE 1. CRP ACREAGE BY COUNTY IN MISSOURI, SIGNUPS 1 THROUGH 9



⊙ Each Dot Represents 100 Acres

Source: Agricultural Stabilization and Conservation Service United States Department of Agricultures

FIGURE 2. PERCENTAGE OF MISSOURI CROPLAND IN CRP SIGNUPS 1 THROUGH 9TH.



Source : Agricultural Stabilization and Conservation Service United States Department of Agriculture

The CRP contracts will begin to expire in October 1995. They will expire in the same order as land was enrolled in the CRP. Table 1 presents the expiration date and the number of the CRP acres effected for each signup in Missouri.

TABLE 1 CRP EXPIRATION DATES AND ACRES IN MISSOURI

Sign-Up	Expiration Date	Acres
1&2	9-30-95	157,902
3&4	9-30-96	734,500
5&6	9-30-97	395,009
7&8	9-30-98	133,992
9	9-30-99	60,873
10	9-30-00	32,973
11	9-30-01	87,528
12	9-30-02	101,823

Source: Agricultural Stabilization and Conservation Service United States Department of Agriculture

At the termination of the contract period, owners will have several options for future land use. There could be an extension of the CRP program, a partial renewal of the program, or a discontinuation. If the program is not renewed, there are many possible alternatives for the landowner. The land could be left in permanent cover, used for pasture and/or hay for livestock, used for row crop farming, or for other alternative land use. Whatever alternative is taken will impact soil conservation,

recreation, agribusiness, and rural communities. If lands return to production, the environmental benefit that have been gained will be reduced. Returning the land to production would increase farm input requirements such as seed and fertilizer. This could benefit local communities.

The system of agricultural production which would be used by the CRP landowners after expiration of the CRP contracts is of interest. Row crop farming and livestock grazing system could utilize either a conventional agricultural production system or some alternative system that might achieve at least some of the conservation and environmental goals of the CRP program. A conventional system incorporates traditional farming practices with unrestricted use of inputs that could degrade the environment. The use of alternative systems which are considered in this thesis are called a "Sustainable" system. They are designed to meet resource conservation and environmental concerns while maintaining productivity, profitability and, usefulness to society indefinitely (Ikerd).[3] The goals of sustainable agriculture are defined in title XVI of the Food, Agriculture, Conservation and Trade Act of 1990. The titled stated:

> Sustainable agriculture is defined as integrated systems of plant and animals production practices, having site specific application, that will over the long-term: (A) satisfy human food and fiber needs; (B) enhance

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[3] John E. Ikerd, Extension Professor, Department of Agricultural Economics, University of Missouri, Columbia.

environmental quality and the natural resource base; (C) make efficient use on non-renewable and on-farm resources; (D) sustain economically viable farming operation; and (E) enhance the quality of life for farmers and society as a whole.

The different production practices used in conventional and sustainable systems of farming cause potential changes in factor inputs and product outputs. Information about the plans which landowners have for their land after the CRP expires, provides a basis for evaluation of economic impacts on agribusiness and communities in the post-CRP era.

Purposes and objectives

The primary purpose of this study has been to document expected land use in a typical North Missouri county after the CRP contracts expire. The objective of this study was to evaluate expected post-CRP use of land which is presently under the CRP contract in Putnam County, Missouri. Specific objectives were:

1) To identify terms under which landowners would extend their CRP contracts.

   a. For resident landowners
   b. For non resident landowners

2) To identify expected land use if there were no extensions of the CRP program.

   a. For resident landowners
   b. For non resident landowners

3) To identify expected requirements for farm inputs and marketing service if the CRP program was not continued.

a. using conventional production practices
b. using alternative production practices

More specification were :

3.1 to estimate the potential agricultural production under each alternative land use.

3.2 to provide preliminary estimates of farm inputs needed for production under the sustainable agricultural production and conventional agricultural production systems.

3.3 to document the potential problems facing landowners and their need for agricultural marketing services in each post-CRP alternative.

The null hypothesis to be tested under objectives 1 and 2 is that place of residence does not influence landowner's decisions. The probabilities of each post-CRP alternative are the same for the landowners who live within or near to Putnam County as for those who live out-of-the area.

Review of Literature

A considerable amount of literature is available to provide background for this study. The literature review took three directions. The first was a general review of the economic impacts of the CRP on various sectors of the economy. The second involved looking at the future land use at the state level. The final was the potential production and cost of conventional systems and alternative systems.

The Economics Impact of The CRP on Various Sectors

Research on CRP has been conducted by various states since the program began in 1985. Much of this research was done with Input/Output models. The research evaluated the impact of resource changes or the contributions of an industry to the local economy. This work falls into two categories, (a) economic effect of the CRP. (b) the adverse impact of the program to agribusiness.

Under the (b) heading, Devino et al.(1988) analyzed the impact of the CRP on agribusiness in Northern Missouri through the first five signup periods (782,720 acres). The study provided a look at the reduction in crop production and demand for farm supply sales due to removing acres from production. The model assumed half the CRP acreage reduction had been planted to corn and the other half to soybeans. The estimated production for corn was 89 bushel per acre and 34 bushel per acre for soybeans. Production of corn and soybean in Northern Missouri was estimated to be reduced by about 35 million bushels and 13 million bushels, respectively. When the previous assumption held, the potential reduction in farm supply sales could reach $166 million annually for Northern Missouri. The reduction of farm supply sale would be vary from county to county depended upon the crops removed from production and on the input requirements of those crops in individual counties.

Future Use of the Acres Presently in the CRP

Several studies have addressed concern about the future land use of land which has been enrolled in the CRP. Several universities as well as federal and state agencies have conducted surveys to determine future land use on both the national level and in individual states.

The Soil and Water Conservation Society conducted a 1990 survey about the future land use without the CRP. About 34 percent of respondents planned to return their CRP acres to crop production, 20 percent would remain in grass for livestock forage, and 13 percent would remain in grass for hay production. Their study determined the CRP alternatives within each of five U.S. regions including Missouri.

In 1990, Monson and Lenkner surveyed 2,199 CRP landowners in Missouri to determine their plans after their contracts expired. They also obtained information about conservation practices. Results indicated that nearly 50 percent of the CRP land will return to crop production when contracts expire and 30 percent will be used for pasture or hay. The study emphasized future land use intentions, conservation practices, and demographic characteristics.

Potential Costs and Returns of Conventional Agricultural Production and Alternative System

Ikerd, Monson and Van Dyne[4] employed the regional cropping system-land category approach to evaluate aggregate impacts of changes from conventional to more sustainable system of farming. The aggregate impacts were estimated and compared in term of farm level costs, returns, chemical use, and soil loss for conventional and alternative systems of production for corn, soybean, milo, small grains, cotton, peanuts, and tobacco for nine major crop-producing regions of the U.S. Production regions were defined in terms of Major Land Resource Areas (MLRAs). Defining characteristic included physical properties of the soil and drainage area and climate, rather than political boundaries. Indices of soil erodibility were used to develop four resource vulnerability categories of lands for each major agricultural land resource region. Predominant cropping systems or rotation in each region were identified to mach with soil erodibility characteristics for nine major land resource areas of the U.S.

Conventional and alternative cropping systems were developed for each basic crop rotation, for each of four vulnerability categories, and for each of nine major land

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[4] John E. Ikerd, Sandra J. Monson, and Donald L. Van Dyne, Financial Incentives Needed to Encourage Adoption of Sustainable Agriculture, Department of Agricultural Economics, University of Missouri-Columbia.

use regions of the U.S. The conventional scenario was developed to represent crop rotation in use during 1984-87 as reported in the 1987 National Resource Inventory (NRI) of the Soil Conservation Service. The other information on production systems including tillage practice, inputs and input levels, cash costs, and production levels came from crop budgets obtained from extension specialists in 13 states and from data on conservation and tillage practices reported in the NRI.

An alternative, low input or sustainable scenario was developed to represent farming systems that have different potential outcomes with respect to resource conservation and environmental quality. It was designed to maintain productivity and profitability and reduce apparent soil loss and water quality risk by moving to lower input alternative and other conservation practices. This scenario was developed to use different crop rotation patterns, tillage methods, pesticide and fertilizer input levels based on cropping system and soil erodibility of each area as identified in the NRI.

A computer-based farm planning procedure was used to assess potential difference between conventional and low input farming systems for each crop rotation and land categories in each region. The study indicated that cropping systems which incorporate reduced tillage, greater cropping diversity, and more efficient management of

commercial pesticides and fertilizers can improve resource conservation, reduce environmental risks, reduce costs of production, and increase short run profits in comparison to conventional systems of farming.

In another Missouri study, Moore[5] (1994) studied the potential economic consequences of a Management Intensive Grazing as opposed to more conventional continuously stocked grazing systems. He used research data from management intensive grazing trials at the University of Missouri Forage Systems Research Center (F.S.R.C.) for the years 1992-93 to examine the potential changes in costs and returns of three different grazing systems. Grazing enterprise budgets were used to present the potential differences in costs and returns generated per acre from a conventional grazing operation and a management-intensive grazing system excluding winter calving. Three different grazing systems were formulated for land: a less intensive 3 paddock system, a 12 paddock intensive system, and the highest intensive 24 paddock system. Costs were based on an 80 acre unit. The major cost categories were pasture cost and animal cost. Pasture cost consisted of fence, water, establishment, fertility, clipping. A financial analysis was conducted. The study found that intensive grazing has the potential to increase farm profitability despite its

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[5] Kevin C. Moore. 1994, Management Incentive Grazing : A Look at the Economics, University of Missouri-Columbia.

greater initial costs. The most intensive grazing system generated the greatest net income per acre ($127.87), followed by the 12 paddock grazing system ($109.51) and lastly the 3 paddock grazing system.

Methodology and Data Sources

Most of previous studies have dealt with macro analysis. This study was examined a local range of individuals opinions within a typical North Missouri county. The survey results presented in this thesis are based on land initially contracted in signup periods 1-9 (from 1986 through 1989). The major reasons for including only the first nine signups were : (1) there was a two-year gap between the ninth and tenth signups, and (2) the program changed slightly under the 1990 Farm Bill. Eighty-eight percent (1,504,413 acres) of Missouri's CRP acreage enrollment took place in the first nine signup (Osborn, et al. 1992).

The case study county was the source of data. Putnam County in North-Central Missouri was selected as the study area. It was selected because : 1) it was located in Northern Missouri where the percentage of land enrolled in the CRP was large (Distribution of the CRP was shown in Figure 1. 2) It had a substantial percentage of its CRP acres placed in the first nine signup periods. Eighty-eight percent of current CRP acres have been taken place in the

first nine signup and, 3) its agriculture was typical of much of northern Missouri.

To achieve the objectives stated previously, Putnam County CRP participants were surveyed by mail. Acreage from the expected post-CRP of land use were employed to estimate farm inputs needed and potential agricultural production. Each alternative land use were estimated under both conventional and alternative production practice. Crop production model would be based on Ikerd, et al study. Livestock production design would be based on Moore study.

CHAPTER II

AREA AND SURVEY

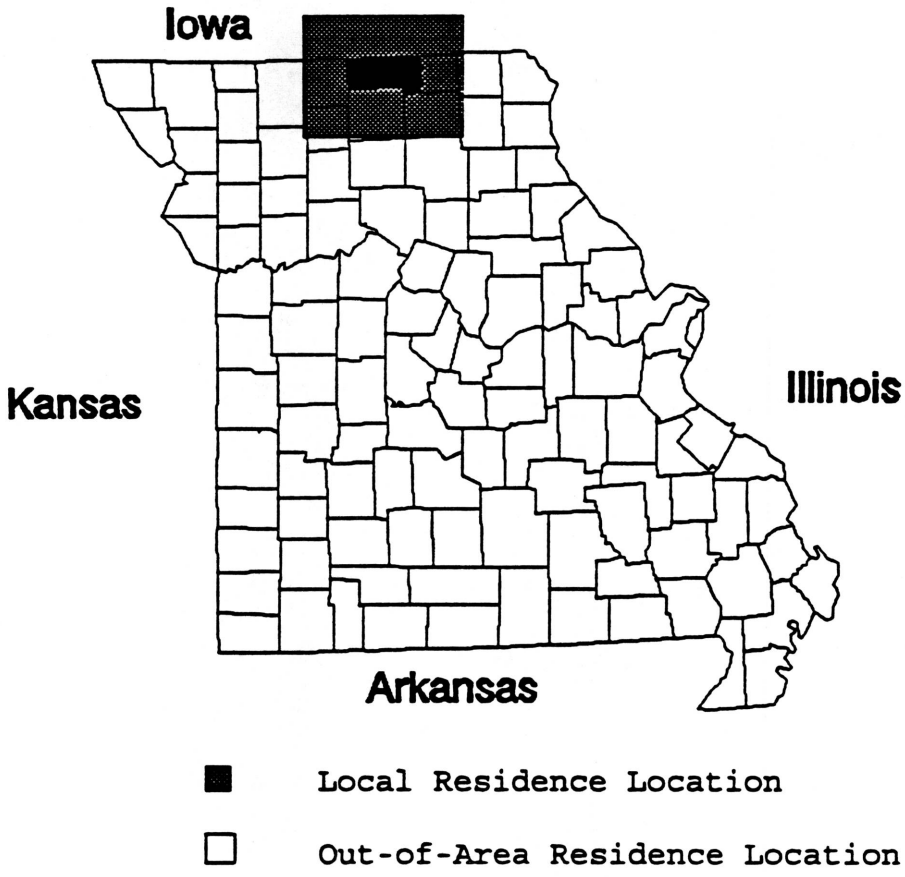
Characteristic of The Study Area

Putnam County is located in the north central part of Missouri on the Missouri/Iowa border. Figure 3 shows its location in respect to other counties in the state. The county's topography consists mostly of rolling hills. Much of the land is wooded. The county's cropland covers approximately 165,780 acres (ASCS). Agricultural production in the county is devoted primarily to hay, grain and livestock.

In 1992, the 27,200 acres of total row crop harvested acres in Putnam County consisted of soybeans (54 percent); corn (44.5 percent); and wheat (1.8 percent). Hay production was the principal crop with 53,500 acres harvested. Livestock production is heavily cattle oriented. There were about 52,100 head of cattle and 9,000 head of hogs and pigs in 1992. More than half of cattle were beef cows.

Much of the land is highly erodible. To date, 29,626 acres have been enrolled in the CRP, with 26,024 acres of cropland representing 249 contracts of cropland enrolled in the first nine signup. This represents 15.7 percent of the county's cropland acreage. Annual CRP rental payments average $64 per acre.

FIGURE 3 PUTNAM COUNTY CRP LANDOWNER LOCATION



Mail Survey

Data collection

The questionnaire was designed to provide information under two conditions. The first was about conditions for CRP renewal or extension. Landowners were asked to identify the dollars per acre per year which would be required for them to continue their present contracts. The second was about expected land use after CRP expires, if the CRP was not renewed. Landowners indicated the number of CRP acres that would be placed in each alternative land use if the CRP is not continued. This study does not attempt to identify factors that influence landowners' decisions about future land use. The questionnaire also was designed to get information concerning factors that restrict the use of CRP land for crop production and livestock grazing. Landowners were asked where they expected to purchase farm inputs and where they expected to market farm production. The final section contained questions which referred specifically to wildlife. The survey instrument is contained in appendix A.

The mail survey was conducted during the fall of 1993. There were 249 contracts for the first nine CRP sign-ups in Putnam County. These contracts represented all or part of 185 landowners' property[6].

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[6] Since a person could contract land more than once in the program, a respondent could have more than one contract. Therefore, the no. of firms were less than the no.of

To examine the effect of residence's distance on responses, the completed questionnaires were divided into 2 groups based on the location of the landowner's residence. The analysis was restricted to comparison of the area designated as local area and out-of-area. Local area was designated as Putnam County or within 15 miles of the county's borders. Because Putnam County is located on the state line, local area included portions of other Missouri counties and a portion of the State of Iowa. Out-of-area included landowners who live greater than 15 miles from Putnam County's borders. Out-of-area included some landowners who lived in Missouri but greater than 15 miles from Putnam's borders and others who lived out of state. Landowner location is shown in figure 3. Sixty-one owners were identified as having an out-of-area residence and one hundred-twenty four owners lived in the local area.

Data Processing

Data were translated to spreadsheet format for evaluation of post-CRP alternatives. Statistical analysis was utilized in testing for differences in response by in-area and out-of-area landowners. The interval data were arranged into nominal or ordinal categories. Champion (1981), Dowdy and Wearden (1991) presented "chi-square" statistical tests that can be used with categorical data, the nominal level of measurement. It was used to evaluate

the significance of difference between what is observed and what is expected according to chance. Chi-square analysis was used to test whether the responses were the same for landowners who live within the local area and those who do not. The study compared the differences between the frequencies observed in a sample against expected frequencies or hypothetical frequencies that might be found if the population did not differ (Freund, 1984). The results of the statistical analysis are shown in chapter III.

CHAPTER III

SAMPLE SURVEY ANALYSIS

Results of The Mail Survey

One hundred-eighty five questionnaires were mailed to owners of the CRP land which was located in Putnam County, Missouri. One hundred-seventeen responded. Seventy five responses were from the local area and forty two farms were from out-of-area owners. The questionnaires were edited and five were discarded because of insufficient information or because the owner plans to sell the land after the CRP contracts expire. The response rate was calculated as the number of participants who returned completed questionnaires divided by the number of questionnaires mailed. Of the 185 questionnaires mailed, 112 were returned as usable surveys (60.5 percent of total landowners, see table 2). Respondents' ownership totaled 62 percent (16,141/26,024) of the Putnam County CRP land. Survey responses were organized according to residence location of the people who responded. Table 2 summarizes the results of the mail survey. Responses between local area and out-of-area were also compared in the table.

TABLE 2 SUMMARY OF THE CRP SURVEY QUESTIONNAIRES SENT AND RECEIVED, PUTNAM COUNTY, MISSOURI.

Item	Local Area	Out-of-Area	Total
Surveys Sent	124	61	185
Surveys Returned	75	42	117
Usable Surveys	71	41	112
% Of Response	57.26	67.21	60.5

Agricultural Characteristics

Land Ownership and Farming Practices on All Land Owned

Nearly 37 percent of the respondents were out-of-area landowners. They owned 39 percent of the CRP acres which were owned by all respondents. Sixty-three percent of the respondents lived in the local area. They owned 61 percent of total acres owned by respondents (Table 3). Individual CRP contract ranged from 10 to more than 1,000 acres. Each respondent had an average of about 144 acres in the program.

Table 3 also indicates the frequency with which respondents placed land into particular land uses. According to the percent row under "other cropland" category, cropland acres which were owned by the out-of-area landowners (52.2 percent) were greater than cropland acres which were owned by local area landowners.

Table 4 indicates the frequency with which respondents reported land in each particular land use categories. The

majority of land of local landowners was in pasture/hay (52.1 percent). While the majority of land of out-of-area landowners was in the CRP cropland and other cropland.

TABLE 3 COMPARISON OF CURRENT LAND USE OF CRP RESPONDENTS BETWEEN LOCAL RESIDENCE AND OUT-OF-AREA, PUTNAM COUNTY, MISSOURI.

Farm Ownership	Local	Out-of-Area	Total Respondent
	----Percent----		--Acres--
CRP Respondents	63.4	36.6	112[a]
CRP Cropland[b]	60.8	39.2	16,141
Other Cropland	47.8	52.2	10,866
Pasture/Hay	69.0	31.0	28,298
Wood	44.8	55.2	5,159
Other[c]	44.7	55.3	1,388

[a] Indicated the number of CRP respondents
[b] According to official CRP acres
[c] In the category "other", many respondents reported lots, waste, ditches etc.

TABLE 4 CURRENT LAND USE OF ALL LAND OWNED BY CRP RESPONDENTS, PUTNAM COUNTY, MISSOURI.

Farm Ownership	Local Area	Out-of- Area
	----Percent----	
CRP Cropland[a]	26.2	25.9
Other Croplands	13.9	23.3
Pasture/Hay	52.1	36.0
Wood	6.1	11.7
Other[b]	1.7	3.1
Total (Acres)	37,479	24,373

[a] According to official CRP acres

Vegetative Cover On CRP Ground

CRP acres were planted to many kind of vegetative covers. Table 5 presents the percentage of each vegetative cover. The majority of vegetative cover on the CRP land in Putnam County was cool season grasses. The next choice was grass/legume mixture.

TABLE 5 CURRENT VEGETATIVE COVER PLANTED ON THE CRP ACRES OWNED BY THE CRP RESPONDENTS, PUTNAM COUNTY, MISSOURI.

Crop on CRP	Local Area	Out-Of-Area
	--------Percent-------	
Cool Season Grass	55.5	81.2
Warm Season Grass	1.8	5.2
Grass/Legume Mixture	41.5	12.5
Tree	0.3	1.1
Other	0.9	0
Total (Acres)	9659.7	6292.8

Current Land Use on The Non-CRP Land

Fifty-seven percent of respondents indicated that they have been farming other land during the time they have had land in the CRP program. Table 6 presents the non-CRP acres that the respondents were farming during the contract period. Out-of-area respondents reported higher number of row crop acres and fewer hay and pasture acres than owners who lived in-area.

TABLE 6 CURRENT LAND USE ON THE NON-CRP LAND OWNED BY CRP RESPONDENTS, PUTNAM COUNTY, MISSOURI.

Residence	Row Crop	Hay	Pasture
	----------Acres----------		
Local Area	3715	3,490	9,253
Out-of-Area	4550	1,049	3,017
Total	8,265	4,539	12,270

Farming Conservation Practices on The Non CRP Land

The landowners used a variety of conservation practices to operate 12,804 crop acres (8,265 acres in row crops and 4,539 acres in hay, see table 6) that were not in the CRP. The local landowners commonly used rotations that included grass/legume pasture. Out-of-area landowners commonly used no-till or ridge-till, as shown in table 7.

TABLE 7 CONSERVATION PRACTICES USED BY OWNERS OF THE CRP LAND IN PUTNAM COUNTY, MISSOURI ON THEIR NON-CRP LAND.

Conversation Practice	Local Area		Out-of-Area	
	No.of Owners	Acres	No. of Owners	Acres
No-Till or Ridge-Till	17	2,545	8	3,849
Terraced	0	0	4	454
Use Reduced Till or Conservation Tillage	4	132	2	155
Farming on The Contour W/O Terraces	1	100	2	54
Grass/Legume Rotations	11	2,709	6	559
Total	33	5,486[a]	22	5,071[a]

[a] Total no.of acres which used conservation practices are higher than the total no.of crop acres available in table 3 due to more than one conservation practice were used on the same acres.

Farm Input Usage

Landowners were asked if expected to change the quantity of their farm assets after the CRP relative to the amount which had before the CRP. Fifty-seven percent of the local respondents indicated that the number of livestock would be increased after contracts expire. Most out-of-area respondents reported no expected change for livestock, row crop machinery, and livestock machinery (Table 8). Many of these landowners hired custom farmers or tenants to farm their land, so they didn't need to own the equipment. The respondents indicated that the level of farm building and farm real estate would remained unchanged for both residence classes. Overall, holders of the CRP contracts were not expected to need additional assets except livestock. This implies that the CRP participants may have adequate machinery, building, and land to farm their CRP land once contracts expire.

TABLE 8 PROJECTED NEEDS FOR POST-CRP FARM ASSETS BY OWNERS OF PUTNAM COUNTY LAND ENROLLED IN THE CRP PROGRAM.

Changes in Farm Assets	Local Area				Out-of-Area			
	More	Same	Less	None	More	Same	Less	None
Implement Needed	----------	----------	----------	Percent	----------	----------	----------	----------
Livestock	57.4 (N=54)	20.4 (N=54)	12.9 (N=54)	9.3 (N=54)	15.1 (N=33)	27.3 (N=33)	9.1 (N=33)	48.5 (N=33)
Row Crop Machinery	4.0 (N=49)	67.4 (N=49)	18.4 (N=49)	10.2 (N=49)	11.4 (N=35)	34.3 (N=35)	8.6 (N=35)	45.7 (N=35)
Farm Buildings	10.6 (N=47)	74.5 (N=47)	4.3 (N=47)	10.6 (N=47)	14.3 (N=35)	48.6 (N=35)	8.5 (N=35)	28.6 (N=35)
Machinery for Livestock	12.2 (N=49)	69.4 (N=49)	8.2 (N=49)	10.2 (N=49)	3.1 (N=32)	34.4 (N=32)	9.4 (N=32)	53.1 (N=32)
Farm Real Estate (Land)	15.7 (N=51)	74.5 (N=51)	2.0 (N=51)	7.8 (N=51)	16.2 (N=37)	70.3 (N=37)	2.7 (N=37)	10.8 (N=37)

Post CRP Alternatives

Post-CRP alternatives were evaluated under two conditions. 1) Conditions to extend or continue the program. 2) The expected land use after the CRP expires, if there is no program extension.

1). Extension of CRP

The landowners were asked to identify the yearly payment (dollars per acre per year) which would be required to continue their present contracts. CRP participants are interested in extending their CRP contracts since seventy-one percent of the respondents responded to a question about a five year extension and nearly sixty-nine responded to a question about a 10 year extension. The dollars per acre per year required have been grouped into five different intervals of size 10, table 9.

For the five year extension, the responses ranged from $50 to $100 for the local residences and $50 to $120 for the out-of- area residences. Most responses were between $65-$74 for both groups. The average payment for the out-of-area residences was $67.04 which was little higher than the local residences required $66.05.

For a ten year extension, the out-of-area respondents indicated that they would require a higher range of payment from $50 to $130. Local residence would require from $45 to $100. The average required payment was $69.8 and $67.52 for local residences and out-of-area residences, respectively.

TABLE 9 PAYMENT REQUIREMENTS FOR LANDOWNERS TO CONTINUE IN THE CRP PROGRAM, PUTNAM COUNTY, MISSOURI.

Dollars Per Acre Per Year	5 Year Extension			10 Year Extension		
	Local (%)	Out-of-Area(%)	No.of Respondents	Local (%)	Out-of-Area(%)	No.of Respondents
45-54	13.5	7.4	9	8.3	6.9	6
55-64	30.8	29.6	24	27.0	31.0	22
65-74	32.7	40.8	28	31.3	44.8	28
75-84	19.2	18.5	15	16.7	7.0	10
85≥	3.8	3.7	3	16.7	10.3	11
Total Respondent	52	27	79	48	29	77
Maximum($)	100	120		100	130	
Minimum ($)	50	50		45	50	
Average ($)	66.05	67.04		69.8	67.52	

Potential Options

The first attitude question asked dealt with the option of reducing CRP rental rates and being allowed to hay or graze the CRP land (conventional pasture). CRP participants are interested in this option since seventy-five percent of the respondents are willing to trade lower CRP rental payment for the opportunity to have unrestricted haying and grazing on the CRP land.

More than 90 percent of both residence classes desired $50/Acre (Table 10). The acres that they would commit to this payment rate total 9,496 (36 percent of all Putnam County's CRP land). The percent participation was reduced to only 25 percent for both residence class when the payment rate decline to $30/acre. The acres designed for this rate were only 2,069 (8 percent of the Putnam County CRP land). The percent that responded to $10/acre was less than 10 for both groups and accounted for only 1 percent of CRP land.

TABLE 10 POST-CRP RENTAL PAYMENT REQUIRED WHEN LANDOWNERS WOULD BE ALLOWED TO HAY AND GRAZE ON THE CRP LAND (CONVENTIONAL PASTURES), PUTNAM COUNTY, MISSOURI

Annual Rental Payment	Local Area (N=56)		Out-of-Area (N=28)	
	%Respndnt[a]	CRP Acres	%Respndnt[a]	CRP Acres
$ 50/Acre	91.1	6,465	92.8	3,031
$ 30/Acre	25.0	1,667	25.0	402
$ 10/Acre	7.1	265	3.6	80

[a] Percent is greater than 100 percent since many respondents may prefer more than one rate.

A final "what if" question concerned intensive grazing programs. This program had the potential to increase beef production by 50 percent as compared to conventional pastures which implied greater income for farmers than the previous option (conventional pastures). The percentage of respondents in each level of annual payment is shown in table 11.

Only sixty-seven percent of the respondents indicated interest in this option. Compared to table 10, at the same payment rate, the percent of respondents who would leave land in CRP when there was intensive grazing program were lower than those with conventional grazing programs for every payment rate. All respondents were less willing to trade lower CRP rental payment for the opportunity of intensive haying and grazing. This was in spite of the potential for greater income from production. It implied that opportunity to earn more income by intensive grazing system was not enough to offset their perceived cost on inconvenience of intensive grazing. Thus, the influence of the intensive managed grazing option on respondents' decisions to enroll land in the CRP and require annual payment was opposite to what might have been expected.

TABLE 11 POST-CRP RENTAL PAYMENT REQUIRED WHEN INTENSIVE GRAZING WOULD BE ALLOWED, PUTNAM COUNTY, MISSOURI.

Annual Payment	Local Area (N=50)	Out-of-Area[a] (N=26)
	----------Percent----------	
$ 50/Acre	72	85
$ 30/Acre	24	19
$ 10/Acre	4	0

[a] Percent is greater than 100 percent since many respondents may have indicated more than one rate.

2). No CRP extension

Respondents were asked what they would do with their CRP land if there was no program extension. The three categories into which respondents would most likely place their CRP land were crop, pasture/hay, or crop and pasture/hay combination. The results are summarized in table 12. Hay and pasture was the first choice for the respondents who live in the Putnam County area. The next choices were crop production and pasture/crop combination, respectively. The majority choice for out-of-area residences was crop production. The next choice was hay or pasture and pasture/crop combination, respectively.

TABLE 12 EXPECTED LAND USE AFTER THE CRP CONTRACTS EXPIRES IF THERE IS NO PROGRAM CONTINUATION, PUTNAM COUNTY, MISSOURI

Expected Land Use	CRP Contract	
	Local Area	Out-of-Area
	---------No. of Respondents-------	
Crop	18	22
Pasture	35	9
Grass or Tree	1	2
Other*	1	2
Crop/Pasture	13	5
Crop/Grass	1	0
Crop/Pasture/Grass	1	0
Crop/Pasture/Other	0	1
Pasture/Grass/Other	1	0
Total	71	41

* In the category "other" many respondents reported rotate row crop to hay, lots&building.

If the CRP was not renewed, two major use categories into which respondents would most likely place their CRP land were crop production and livestock production. Respondents indicated that fifty-five percent of their CRP land would be used for crop production and forty-one percent would be used for livestock production (Table 13). The percentages of land used for livestock was considerably more than Monson and Lenkner (1990) study, where the state average was 30 percent for livestock. Nearly three percent of the respondents indicated they would keep their land in grass or trees without haying/grazing.

Responses between local residences and out-of-area residences were also compared. Out-of-area respondents would expect to place a larger percentage of their land into crop production (74.9 percent). Local respondents were more interested in converting enrolled land to livestock production (53.7 percent).

TABLE 13 EXPECTED LAND USE AFTER THE CRP CONTRACTS EXPIRE IF THERE IS NO PROGRAM CONTINUATION, PUTNAM COUNTY, MISSOURI.

Land Use After Contracts Expire	CRP Acres[a]			Respondent[b]		
	Local Area	Out-of-Area	Total Rspndent's Acres	Local (n=71)	Out-of (N=41)	Total Rspndent (N=112)
	----------Percent[a]----------			----------Percent[b]-------		
Maintain in Grass or Trees	2.9	2.5	2.8	5.6	4.9	5.3
Use land as Pasture/Hay	53.7	21.7	41.1	70.4	36.6	58.0
Resume Row Crop Production	42.1	74.9	55.0	46.5	68.3	54.5
Other[c]	1.3	0.9	1.1	2.8	7.3	4.5
Total[d] (Acres)	9842.0	6342.8	16184.8			

[a] Percent of total respondent's CRP acres

[b] Percent is greater than 100 percent since many respondents may have indicated more than one activity.

[c] Other category, many respondents reported hay-crop rotation, lots & building, fence.

[d] CRP acres enrolled by survey respondents were slightly greater than the official CRP acres in table 3.

Expected Post CRP Livestock Production

Fifty-eight percent of the respondents indicated they would place a part or all of their enrolled land in livestock production. This accounted for forty-one percent of land enrolled in the CRP.

Potential Problems

Respondents who reported that their land would be used for haying or grazing reported that they would expect a variety of problems.

The principal problem in returning land back to livestock production will be fencing and water supply. This was the case for all landowners. Local landowners also indicated the need for buildings for hay and buildings for livestock (Table 14).

Service Required

To place land back in livestock production, respondents indicated their need for hired services. The principal services which will be needed were for fence building and for developing water supplies, table 15. A high percentage of respondents indicated a need for these two services.

Expected Purchase Location

All classes of respondents indicated a strong preference for buying livestock inputs from local suppliers.

The expected purchase location for each livestock inputs is shown in table 16.

Expected Selling Location

All classes of respondents reported a high expectation of selling their livestock products to local buyers (Table 17).

TABLE 14 POTENTIAL PROBLEMS FACING LANDOWNERS IN RETURNING THE CRP LAND TO LIVESTOCK PRODUCTION, PUTNAM COUNTY, MISSOURI.

Potential Problems	Local Area[a]	Out-of-Area[a]	Total Respondent
	---Percent---		
Fences to build	74.4	80.0	75.9
Provide Water Source	47.7	53.3	48.3
Building for Hay	30.2	46.7	34.5
Building for Livestock	23.3	46.7	29.3
Wrong Kind of Vegetative Cover	2.3	6.7	3.4
Inadequate stand	16.3	0	12.1
Weed Problems	9.3 (N=43)	6.7 (N=15)	8.6 (N=58)

[a] Percent is greater than 100 percent since many respondents since more than one problem could be expected.

TABLE 15 SERVICES REQUIRED IN RETURNING THE CRP LAND TO LIVESTOCK PRODUCTION, PUTNAM COUNTY, MISSOURI.

Required Services	Local Area	Out-of-Area	Total Respondent
	--- Percent[a]--		
Need Fence Building	62.2	85.7	68.6
Developing water supply	48.6	64.3	52.9
Information on cattle sources	0	14.3	3.9
Other	5.4 (N=37)	7.1 (N=14)	5.8 (N=51)

[a] Percent is greater than 100 percent since many respondents may need more than one service.

TABLE 16 EXPECTED POST-CRP PURCHASE LOCATION FOR LIVESTOCK SUPPLIES, PUTNAM COUNTY, MISSOURI.

Inputs	Residence Area	
	Local Area	Out-of-Area
	---Percent of Respondents[a]--	
Feed		
Local Supplier	94.8	100.0
Out of County	7.7	0
	(N=39)	(N=14)
Animal Health Product		
Local Supplier	90.0	92.8
Out of County	12.5	14.2
	(N=40)	(N=14)
Livestock equipment		
Local Supplier	88.9	91.7
Out of County	13.9	8.3
	(N=36)	(N=12)
Other[b]		
Local Supplier	80.0	0
Out of County	60.0	0
	(N=5)	(N=14)

[a] Percent is greater than 100 percent since some respondents indicated to buy inputs from both suppliers.

[b] Other category, many respondents reported capital for fertilizer, pasture and hay ground.

TABLE 17 HOW LIVESTOCK PRODUCED ON POST-CRP LAND WILL BE MARKETED, PUTNAM COUNTY, MISSOURI.

Item	Local Area N=40	Out-of-Area N=14
	--------Percent------	
Local Buyers	72.5[a]	64.3
Out of County Buyers	35.0	35.7
Other	2.5	0

[a] Percent is greater than 100 percent since some respondents prefer to sell to both markets.

Expected Post-CRP Crop Production

Almost fifty-five percent of the respondents indicated a part or all of their CRP acres would be used in crop production. It also accounted for fifty-five percent of land enrolled in the CRP. Only two are considering selling their land at the end of the contract.

Landowners who planned to resume crop production were asked about the permanence of this decision. For out-of-area landowners nearly seventy-four percent of those planning to row crop plan for this to be a permanent land use (Table 18). Only fifty percent of in-area landowners plan to row crop permanently. Planning to row crop for a limited time as part of the process of establishing a different type of pasture/hay cover was a major reason for both residence classes.

Although many respondents stated that their land would be returned to crop production, 74 percent of the out-of-area landowner planned to hire a custom farmer or tenant to farm their land. Seventy-nine percent of in-area landowners were more interested in farming their land by themselves.

TABLE 18 EXPECTED TIME PERIOD FOR ROW CROPPING POST-CRP LAND, PUTNAM COUNTY, MISSOURI

Items	Local Area	Out-of-Area
	------Percent-------	
Period to Row Crop	(N=26)	(N=23)
Permanent	50.0	73.9
Limited Time	50.0	21.7
for establishing pasture/hay	30.7	17.4
not for establishing pasture/hay	19.3	4.3
Undecided	0	4.4

Conservation Practice

Respondents indicated that the possibility of re-enrolling in another farm program was affected by conservation compliance decision. A conservation compliance plan will be required if they expect to participate in government farm programs. Landowners would use a variety of conservation practices. The most commonly used method would be no-tillage or ridge-till for both residence classes (Table 19).

TABLE 19 CONSERVATION PRACTICES WHICH CRP LANDOWNERS EXPECT TO USE TO MEET CONSERVATION COMPLIANCE REQUIREMENTS, PUTNAM COUNTY, MISSOURI.

Practice	Local Area		Out-of-Area	
	% of CRP Acres	% of Owners	% of CRP Acres	% of Owners
Terraces	0	0	3.1	9.1
Contour W/O Terraces	1.1	3.4	4.3	13.6
Conservat'n Tillage or Residual Management	10.4	20.7	20.7	22.7
No-Till or Ridge-Till	54.2	69	49.7	45.5
Grass/Legume Rotation	34.3	34.5	20.4	31.8
Other	0	0	1.8	9.1
Total Respondents	4992.6	29	3047.1	22

Note : Percent is greater than 100 percent because of multiple practice usage.

Farm Equipment Required

The percent of respondents who would expect to purchase equipment to farm the CRP land after current contracts expire was relatively low for both residence classes (Table 20). Respondents would be able to continue farming their CRP land with limited farm equipment investments if a follow up CRP program was unavailable.

TABLE 20 EXPECTED EQUIPMENT PURCHASES REQUIRED TO OPERATE ROW CROP PRODUCTION AFTER THE CRP CONTRACTS EXPIRE, PUTNAM COUNTY, MISSOURI.

Implement Need	Local Area (N=28)	Out-of-Area (N=22)
	---Percent of Respondents[a]--	
Tractors	10.7	13.6
Planting Equipment	28.6	9.1
Tillage Equipment	7.1	9.1
Combine(s)	7.1	9.1
Other	0	0

[a] Percent is less than 100 percent since many respondents may have no implement needs.

Potential Problems

Respondents indicated a variety of problems would be faced if they resume crop production. The major potential problem was the need for minimum tillage equipment as shown in table 21.

TABLE 21 POTENTIAL PROBLEMS FACING LANDOWNERS IN RETURNING THE CRP LAND TO CROP PRODUCTION, PUTNAM COUNTY, MISSOURI.

Potential Problems	Local Area	Out-of-Area
	---Percent of Respondents[a]-	
Wrong Kind of Cover Crop	0	15.8
Weed Problem	21.4	5.3
Need for Terraces	3.6	15.8
Need for Minimum Tillage Equipment	35.7 (N=28)	21.1 (N=19)

[a] Percent is less than 100 percent since many respondent did not identify problems.

Services Required to Resume Crop Production

Services needed to resume crop production were similar for both residence classes. Education service on production practices (no-till, weed control) was the farm service most owners would require to resume production on the CRP acres (Table 22).

TABLE 22 SERVICES REQUIRED TO RETURN THE CRP LAND TO CROP PRODUCTION AFTER CRP EXPIRES, PUTNAM COUNTY, MISSOURI.

Required Services	Local Area	Out-of-Area
	------Percent of Respondents[a]--	
Land Moving	16.7	13.3
Education Service	66.7	73.3
Other[b]	0 (N=12)	20.0 (N=15)

[a] Percent is greater than 100 percent since many respondents may need more than one service.

[b] Other category, some respondents were reported plow under, up to renter.

Expected Purchase Location

Local respondents tended to purchase inputs from local supplier. All classes of respondent greatly preferred to buy crop inputs from local suppliers. This response was consistent across all type of inputs (Table 23).

TABLE 23 EXPECTED PURCHASE LOCATION FOR CROP INPUTS REQUIRED FOR POST-CRP PRODUCTION, PUTNAM COUNTY, MISSOURI.

Inputs	Local	Out-of-Area
	--------Percent of respondents[a]------	
Consultant	(N=17)	(N=14)
Local Supplier	100	100
Out of County	5.9	0
Fertilizer	(N=33)	(N=24)
Local Supplier	100	95.8
Out of County	3.0	8.3
Spreading Service	(N=33)	(N=20)
Local Supplier	100	100
Out of County	3.0	10
Seed	(N=33)	(N=24)
Local Supplier	100	91.7
Out of County	6.1	12.5
Chemicals	(N=33)	(N=23)
Local Supplier	100	95.7
Out of County	3.0	8.7
Application Service	(N=30)	(N=22)
Local Supplier	100	95.5
Out of County	3.33	9.1

[a] Percent is greater than 100 percent since some respondents indicated they would purchase inputs from both suppliers.

Expected Need for Marketing Service

CRP landowners expect to utilize local marketing services. A high percentage of respondents indicated they expect to obtain all marketing services from local supplier, table 24.

TABLE 24 LOCATION OF SUPPLIERS OF MARKETING SERVICES REQUIRED FOR POST-CRP CROP PRODUCTION, PUTNAM COUNTY, MISSOURI.

Item	Local Area	Out-of-Area
	--------Percent[a]-------	
Buyers	(N=22)	(N=18)
Local Suppliers	100	94.4
Out-of-Area	4.6	22.2
Haulers	(N=21)	(N=16)
Local Suppliers	100	100
Out-of-Area	4.8	6.3
Storage	(N=17)	(N=8)
Local Suppliers	100	100
Out-of-Area	0	0
Other	(N=2)	(N=1)
Local Suppliers	100	100
Out-of-Area	0	0

[a] Percent is greater than 100 percent since some respondents indicated to require services from both suppliers.

Statistic Analysis

Respondents' decision could be associated with the location of their residence relative to the location of their land. Survey results were analyzed to determine landowner's decision under two conditions, CRP Extension and No CRP Extension. These data were analyzed to determine if the in-area and out-of-area landowners viewed continuation of the CRP and future alternative land use in the same way. Statistical analysis was conducted to determine if respondents' answers differed significantly between these two residence classes.

The null hypothesis was that the two groups were identical with respect to selected questions. The following questions were selected because they were central to the study's objectives:

Question 8. Required yearly payment for CRP renewal or extension.

Question 9. Future alternatives for the CRP land after CRP expires.

Data from the survey were collected at the nominal and interval level of measurement. The data at the interval level of measurement involved arranging the data in intervals of some specified size and treating as nominal or ordinal data. The study tested the frequencies, using Chi-square, because the data were grouped in nominal or ordinal categories.

A chi-square test was performed to test the significance between different groups and their responses under each condition. It compared the frequencies which were actually observed with expected frequencies. If there was no differences between them, the null hypothesis was accepted. A confidence level of 95 percent was used for the chi-square test to determine significant differences.

1). CRP Extension

Table 25 presents the association between different groups and dollars required to continue the CRP. Dollar per acre per year required has been dichotomized according to

$64 or less and greater than $64. The $64 was used as the breaking point because it was the current annual rental payment for the CRP acres. Chi-square was used to detect the significant differences on required payment between these two landowner groups. The computer outcome is shown in Appendix B.

TABLE 25 EFFECT OF LOCATION OF LANDOWNERS ON PAYMENT REQUIRED FOR CRP CONTINUATION, PUTNAM COUNTY, MISSOURI.

Dollar/Acre/Year Required	Local area	Out-of-Area
	-----Percent---	
5 Year Extension:		
64 or Less Than 64	44	37
Greater Than 64	56	63
	(N=52)	(N=27)
10 Year Extension:		
64 or Less Than 64	35	38
Greater Than 64	65	62
	(N=48)	(N=29)

All classes of respondents would like to receive rental payment higher than $64 per acre per year for both a 5 year and a 10 year extension of the CRP.

Non-significant differences were indicated between the residence classes concerning rental payment required. The calculated chi-square value was 0.378 for a five year extension and 0.049 for a ten year extension (See Appendix B-I and B-II). The critical value used was 3.841 at the 95 percent level of significance. Since the χ^2_{cal} for both cases was less than the critical value, the null hypothesis was

accepted. The dollars per acre per year required were not different between these landowner groups under either a 5 year extension and a 10 year extension.

2). No CRP Extension

The chi-square test was used to identify differences between the residence classes on expected future land use of land presently in the CRP program.

TABLE 26 INTENDED LAND USE AFTER THE CRP CONTRACTS EXPIRES IF THERE IS NO PROGRAM CONTINUATION, PUTNAM COUNTY, MISSOURI.

Expected Land Use[a]	CRP Contract (Percentage)	
	Local Area	Out-of-Area
Crop[b]		
50% or More	38	61
Less Than 50%	62	39
	(N=71)	(N=41)
Pasture[b]		
50% or More	59	32
Less Than 50%	41	68
	(N=71)	(N=41)
Grass or Tree		
50% or More	4	7
Less Than 50%	96	93
	(N=71)	(N=41)
Other[c]		
50% or More	1	2
Less Than 50%	99	98
	(N=71)	(N=41)

[a] Denotes the percent of CRP land that would be placed in that particular land use

[b] Denotes significant differences were detected between the classes of residence, using Chi-square at the 95 percent level of significance.

[c] In the category "other" many respondents reported hay-crop rotation, lots, building.

Residence location had a significant impact on respondents' decisions about post-CRP activities. Out-of-area residences expected to place a larger percentage of their land in crop production or maintain it in grass or trees and other activity than did in-area residences. Local residences indicated a greater percentage of the CRP land would be utilized for pasture or hay for livestock than did outside residences.

Significant differences were indicated among residence location classes concerning the percent of land use for crop production and livestock operation. The calculated χ^2_{cal} value were higher than the critical value, 3.841, at 95 percent level of significance. (See Appendix B table I,II). This difference may be related to the difference in time required for crop production and livestock operation. Livestock production requires more time and intensive care than crop production. Landowners who live outside Putnam County may have less time to spend on their Putnam county farms than in-area landowners have. No significant differences were indicated for expected land use for grass or tree and other activity. The calculated χ^2_{cal} value were lower than 3.841. (See Appendix B table III-VI)

After all data reported here was summarized, a model was developed to estimate yields and costs on the CRP acres under each alternative land use. Both conventional and alternative production systems were evaluated.

CHAPTER IV

DESCRIPTION OF THE MODELS AND RESULTS

The purpose of this chapter is to explain in some detail the models used in the estimation of costs and returns for the production systems evaluated. This will include sources of data and other information, methodology behind their construction, and pertinent underlying assumptions. The results from each model will be presented.

To satisfy the final objective, an analysis was undertaken to determine changes that could be expected in total yields and in production costs for crops and livestock, if the CRP program is not extended.

The Cropping System

For row crops, the estimation of crop production and costs were built upon the number of acres obtained from the questionnaires. Monson and Lenkner's study[7] indicated that yields and production costs from the CRP land were similar to other cropland. Based on the assumption that (1) the CRP land will be used in the same manner as Putnam County land which is now in production, and (2) yields from the CRP land

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[7] Michael Monson and Robert Lenkner, "A Sample of CRP Contract Holders on Future Land Use", Department of Agricultural Economics, University of Missouri-Columbia, HEWP 1991-6.

are virtually the same as other croplands, the percent of each crop and yield from the CRP acres was estimated from the non-CRP cropland data. Average harvested acres and crop yields were developed by using data from Missouri Farm Fact[8], published by the Missouri Department of Agriculture.

Missouri Farm Facts provided the number of harvested acres and yield per acre from 1990-1992 for corn, soybeans, and wheat for Putnam County. A three years period was included to modify the influences of weather variability and existing government program. Data for these three years were used to specify the average harvested area and average yield per acre of each crop. The average harvested acres of each crop were used to specify the percent (ratio) of each crop. The row crop acres obtained from the questionnaires were divided into soybean, corn, and wheat based on this average ratio. The calculated percent of each crop (ratio) multiplied by the CRP acres which were expected to revert to row crop production, provided crop acres for each of the crops grown in Putnam County. Table 27 summarizes the cropland devoted to major row crops in Putnam County for the three year period 1990-1992. Soybeans were the dominant crop in the county. The table also presents the estimation of the CRP acres which would be returned to each crop.

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[8] Missouri Agricultural Statistics Service, 1992 and 1993 Missouri Farm Facts.

TABLE 27 ACRES OF CROPLAND DEVOTED TO ROW CROPS (1990-1992) AND ESTIMATION OF THE CRP ACRES WHICH WOULD BE UTILIZED FOR EACH CROP, PUTNAM COUNTY, MISSOURI

Crops	1990	1991	1992	Average		Est.CRP[a]
	---------Acres-------			Acres[b]	Percent	Acres
Soybean	12,500	13,600	12,100	12,734	50.8	7,271
Corn	9,300	10,400	14,600	11,433	45.6	6,529
Wheat	1,300	900	500	900	3.6	514

Source: 1992 and 1993 Missouri Farm Facts

[a] Total CRP acres which would return to row crop production was 14,313.

[b] Total current crop grown in Putnam County from 1990-1992 was 25,067 acres.

Missouri Farm Facts was also used to develop yield estimates. Three years of crop yield per acre for Putnam County are presented in table 28. The average yield per acre also was estimated.

TABLE 28 YIELD PER ACRE OF EACH CROP FROM THREE YEARS RECORD (1990-1992) IN PUTNAM COUNTY, MISSOURI.

Year	Soybean (Bu/acre)	Corn (Bu/acre)	Wheat (Bu/acre)
1990	25.50	89.10	37.70
1991	27.90	98.30	31.10
1992	40.00	118.40	39.40
Avg. Yield/Acre	31.13	101.93	36.07

Source: 1992 and 1993 Missouri Farm Facts

Next, crop production and costs of production under conventional and alternative systems were constructed using a computer-based farm planning model. Procedures developed by Ikerd, et al. were used.

Model for The Cropping System

The CRP acres that are expected to be returned to row crop production could utilize either a conventional system or an alternative agricultural production system.

Conventional farming systems can be viewed as systems which attempt to optimize production and profits. Conventional systems are assumed to have the typical cropping patterns, tillage practices, chemical, fertilizer, and pesticide application rates for the area.

Alternative (Sustainable or low-input) systems can be viewed as cropping systems which attempt to reduce environmental risks, such as soil erosion and water pollution from agricultural chemicals while maintaining productivity and profitability. Crop rotations, legumes, tillage practices, and cover crops which help maintain soil fertility, control weeds, and prevent soil erosion are emphasized.

Analysis of Putnam County Region With Conventional and Alternative Model

In order to develop estimates of relative costs and

yields of crop production response to conventional and sustainable alternative systems, information about Putnam County fertility and crop production characteristics was needed to develop the analysis. Since 1) Missouri was classified as Central Feed Grains and Livestock Region or **M region**, 2) the calculated average crop yields per acre of Putnam County (as shown in table 28) was close to average yields in the third land vulnerability class as defined by the Ikerd, et al model, and 3) land class three includes highly erodible soil frequently planted to row crops, production levels in the third land quality group under M region were selected. Farming practices under conventional scenarios and sustainable scenarios are defined below.

Description of Row Crop Production Alternatives

Farming practices under conventional and alternative scenarios in Putnam County were the same as indicated under the third land quality in M region in the Ikerd, et al. study. The details in each scenario were :

The conventional scenario assumed traditional farming practice with unrestricted application of inputs. It was assumed that no soil conservation practices and no specific conservation tillage practices were used for any of the identified cropping systems. Tillage operations included fall plowing, two-to-three disking operations, rotary hoeing, and one-to-two cultivations. Fall plowing was

assumed for corn and soybean production. Most chemicals were assumed to be broadcast over all the cropland.

The alternative scenario or lower-input cropping scenario was developed to 1) address practical tillage practices that facilitate soil conservation and water quality problems, 2) use commercial fertilizer and chemicals in a way such that farmers can maintain high crop yields, yet lower purchased input costs. The alternative scenario assumed a no-till system to reduce soil loss on highly erodible soils. Chemical costs were the same as for the conventional case situation although different types of chemicals would be used. Crops were not cultivated. The level of nitrogen fertilizer application was adjusted from the conventional scenario to a level equal to the quantity of N necessary for "average" crop yields (for those crops using N) plus 10 percent. Average yields for nitrogen utilizing crops were assumed to declined by 2% to compensate for those excellent production years when lower N applications would reduce yields. In 8 or 9 years out of 10 years, yields would be as high with the alternative fertilizer application rates as with the conventional case fertilizer application rates .

Rotation Definitions :

The third quality group under the M region model had ten different cropping systems. Each major crop enterprise

was used as part of a rotation. Since there was no milo in Putnam County's cropping record, two cropping system were eliminated (Milo/soybean/wheat and Continuous milo). Table 29 and 30 present the developed scenarios. The definitions of eight crop rotations are detailed below :

1) Corn/soybean - Two years of corn, two years of soybeans, any order.
2) Continuous corn - 3 out of 4 years of corn.
3) Corn/soybean/wheat - Corn, soybean, and wheat, in any order.
4) Continuous soybean - 3 out of 4 years of soybean.
5) 2 corn/soybean - Two years of corn, one year of soybeans, any order.
6) 2 soybean/corn - Two years of soybeans, one year of corn, any order.
7) 2 wheat/corn - Two years of wheat, at least one year of corn, in any order.
8) Continuous wheat - 3 out of 4 years of wheat.

Procedure for Developing each Scenario

Before the Putnam County CRP acres which were expected to revert to crop production could be placed into the Ikerd, et al. model under the third land quality in M region, the percentage of eight crop rotations needed to be estimated as a starting point for each scenario. Several steps were followed in the development. Table 29 presents the

developed scenarios based on the current crops grown in Putnam County.

First, the model of conventional and alternative production were developed using the acres of the major crop grown in Putnam County (Crop acres obtained from table 27) devoted to 8 types of crop rotations. The study of Monson and Ikerd[9] on Assessment of Changes in Missouri Farming Systems Needed to Reach T by 2000 guided the choice of crop rotations in Northern Missouri. The predominant crop rotations were continuous soybeans and corn/soybeans, respectively. The remaining crop acres were dispersed to other rotation categories in order to keep total crop acres consistent with the current crop distribution grown in Putnam County (soybean 12,734, corn 11,433, wheat 900, see table 27). Next, each category of crop rotation were expressed as a percent of total crop acres (Table 29).

Alternative production systems were developed to reflect a combination of alternative crop rotations. The model of alternative crop rotation was adjusted from the historic crop rotation model. Total acreage planted to each major crop was also maintained at the same level in the alternative as in the conventional scenario. This constraint was held to avoid analytical complications

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[9] Sandra J. Monson and John E. Ikerd, April 1993, Assessment of Changes in Missouri Farming Systems Needed to Reach T by 2000, Missouri Soil and Water Districts Commission, p.25.

associated with changing commodity prices and regional shifts in production patterns (Ikerd, et al.). Primary emphasis in developing alternative scenario was placed on cropping systems. Monocropping was eliminated whenever possible by moving to a corn/soybean (2 corn/2 soybean) rotation, the longest rotation typically used in Putnam County. This resulted in eliminating most continuous corn and continuous wheat. Nearly all acres in 2 corn/bean rotations were eliminated. Continuous soybeans was reduce from over 30 percent of the total acreage in Putnam County to about 3 percent. The corn/bean rotation was increased dramatically from 22 percent to over 78 percent. The 2 bean/corn rotations were slightly increased from 3 percent to 9 percent. The 2 wheat/corn were held constant. The corn/bean/wheat rotation had minor increases from 3 percent to 5 percent. The combination of crop rotations under conventional and alternative scenario are shown in table 29.

Many sustainable agriculture advocates would question whether a farming system which utilizes a no-till, corn-soybeans rotation is sustainable over time. The only claim made in this thesis is that a no-till, corn-soybean rotation is "more likely" to be sustainable than the continuous corn and continuous soybeans with conventional tillage.

TABLE 29. PERCENT OF CURRENT PUTNAM COUNTY LAND DEVOTED TO VARIOUS CROP ROTATIONS UNDER CONVENTIONAL SCENARIO AND ALTERNATIVE SCENARIO, PUTNAM COUNTY, MISSOURI.

Crop Rotations	Conventional		Alternative	
	Acres	%	Acres	%
Corn/Bean	5,547	22.1	19,723	78.7
Cont. Corn	4,854	19.4	0	0
Corn/Bean/Wheat	786	3.1	1,346	5.4
Cont. Bean	7,565	30.2	752	3.0
2 Corn/Bean	4,502	18.0	125	0.5
2 Bean/Corn	949	3.8	2,444	9.8
2 Wheat/Corn	677	2.7	677	2.7
Cont. Wheat	187	0.8	0	0
Total Acres[a]	25,067	100.0	25,067	100.0
Beans	12,734	50.8	12,734	50.8
Corn	11,433	45.6	11,433	45.6
Wheat	900	3.6	900	3.6

[a] The 25,067 crop acres currently grown in Putnam County.

Analysis of The CRP Acres in Putnam County

Given the result from survey, 55 percent of the CRP acres are expected to be returned to row crop. This percent times the total CRP acres in Putnam County (26,024) provided total CRP acres which were expected to be returned to crop production after current CRP contracts expire. Based on the assumption that CRP land will be used for crop production in a manner similar to land use in Putnam County in recent years, the developed scenarios from the crop acres grown in Putnam County (table 29) were used to develop a crop rotation percentage on post-CRP land. The percentage of

eight crop rotation categories in the original model for both conventional and alternative system was held constant to determine the CRP acres in the various combination of 8 crop rotations. The CRP acres which might return to crop production were substituted for the crop acres in the origin model. The percent of each crop rotation was multiplied by the total CRP acres (14,313). The results indicated the CRP acres that should be devoted to various types of crop rotations under both systems. This approach and results are illustrated in table 30.

TABLE 30 PERCENT OF POST-CRP LAND DEVOTED TO VARIOUS CROP ROTATIONS UNDER CONVENTIONAL AND ALTERNATIVE SCENARIOS, PUTNAM COUNTY, MISSOURI

Crop Rotations	Conventional		Alternative	
	Acres	%	Acres	%
Corn/Bean	3,159	22.1	11,261	78.7
Cont. Corn	2,775	19.4	0	0
Corn/Bean/Wheat	444	3.1	769	5.4
Cont. Bean	4,323	30.2	429	3.0
2 Corn/Bean	2,575	18.0	72	0.5
2 Bean/Corn	543	3.8	1,396	9.8
2 Wheat/Corn	386	2.7	386	2.7
Cont. Wheat	108	0.8	0	0
Total CRP Acres[a]	14,313	100.0	14,313	100.0
Beans Acres	7,271	50.8	7,271	50.8
Corn Acres	6,529	45.6	6,529	45.6
Wheat Acres	514	3.6	514	3.6

[a] The 14,313 CRP acres in Putnam County which were expected to revert to crop production.

Finally, projected changes in commercial inputs and output yields for the CRP acres were calculated under conventional and alternative scenarios. This study emphasized the difference in farming system's yields and production costs. No attempt was made to evaluate the environmental effects of reduced tillage and lower-input production practices. Direct production costs including fuel, chemical, fertilizer, and seed were selected to make a comparison between the systems. Identification of other production costs such as land costs, machinery depreciation & repair, overhead, returns to management, labor were beyond the scope of this study.

Variable Production Costs

The input price used in projecting production costs were based upon the 1992 recorded price. The CRP acres from 8 crop rotations were used to estimate the total input costs for conventional and alternative production methods. Estimation of farm input costs on the CRP acres were estimated for each scenario.

Fuel Cost

Ikerd, et al study provided the number of gallons of diesels fuel required in land preparation (tillage), planting, cultivation, and harvesting per acre per year (Table 31). Given the alternative scenario, diesel fuel use

was cut in half relative to the conventional production because no-till operations were used where it was possible. The average price of diesel fuel per gallon in 1992 was published in 1993 Missouri Farm Facts. The total required fuel times price per gallon which was $0.83 gave cost of fuel per acre. Fuel cost per acre were multiplied by the number of CRP acres placed in various types of crop rotations (Figures from table 30) to calculate total fuel costs on post-CRP acres. Fuel costs on post-CRP acres were added across 8 crop rotation categories under different scenarios to give total fuel cost on the CRP acres for both conventional production and alternative production, table 31.

TABLE 31 ESTIMATED FUEL COST FOR CROP PRODUCTION ALTERNATIVES ON POST-CRP LAND, PUTNAM COUNTY, MISSOURI.

Crop Rotations	Gallons of Diesels Fuel/Acre/Year					Fuel Cost/ Acre	Fuel Cost on CRP Acres
	Till	Plant	Cult	Hvst	Total		
Conventional	----------Gallons----------					-----Dollars-----	
Corn/Bean	3.0	0.69	1.47	1.6	6.76	5.61	17,722
Cont. Corn	4.76	0.69	1.47	1.78	8.70	7.22	20,038
Corn/Bean/Wheat	3.21	0.65	0.98	1.5	6.34	5.26	2,336
Cont. Bean	1.33	0.69	0.80	1.42	4.24	3.52	15,214
2 Corn/Bean	4.02	0.69	1.25	1.66	7.62	6.32	16,286
2 Bean/Corn	3.13	0.69	1.25	1.54	6.61	5.49	2,979
2 Wheat/Corn	2.79	0.61	0.49	1.45	5.34	4.43	1,711
Cont. Wheat	1.57	0.57	0	1.29	3.43	2.85	309
Total Fuel Cost on CRP[1]						5.4	76,595
Alternative							
Corn/Bean	0.57	1.18	0	1.6	3.35	2.78	31,313
Cont. Corn	0.99	1.18	0	1.78	3.95	3.28	0
Corn/Bean/Wheat	0.85	0.98	0	1.50	3.33	2.76	2,124
Cont. Bean	0.24	1.18	0	1.42	2.84	2.36	1,012
2 Corn/Bean	0.71	1.18	0	1.66	3.55	2.95	211
2 Bean/Corn	0.46	1.18	0	1.54	3.18	2.64	3,683
2 Wheat/Corn	2.0	0.77	0.81	1.45	5.03	4.17	1,613
Cont. Wheat	1.48	0.57	0	1.29	3.34	2.77	0
Total Fuel Cost on CRP[1]						2.8	39,597

[1] Estimated from 14,313 CRP acres.

Note: Total may not add due to rounding.

Chemical Cost

The report, 1992 Missouri M.I.R. Crop Costs Projected 1994 Crop Budgets[10] provided chemical cost per acre for each major crop. Chemical price for corn, soybean, and wheat were $21.74, $22.59, and $1.77 respectively. Chemical use with alternative production remained as high as in the conventional case because the alternative scenario assumed application of the chemical on the complete field to compensate for the no-till system. The chemical cost per acre of each crop rotation was calculated by adding chemical cost of major crops which were presented in that rotation category and dividing by the number of crops in that rotation. Chemical costs per acre were multiplied by the number of CRP acres placed in various types of crop rotations (Figures from table 30) to give the total chemical cost required on the CRP acres under each crop rotation. Chemical cost was added across 8 crop rotation categories for each production practice to give total chemical cost on the CRP acres under both conventional and alternative methods, table 32.

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[10] Kelvin C. Moore, 1992 Missouri M.I.R. Crop Costs Projected 1994 Crop Budgets, Farm Management Newsletter, University of Missouri-Columbia.

TABLE 32 ESTIMATED CHEMICAL COST FOR CROP PRODUCTION ALTERNATIVES ON POST-CRP LAND, PUTNAM COUNTY, MISSOURI.

Crop Rotations	# of Crop in Rot	Chemical Cost/Acre	Total Chemical Cost on CRP
Conventional		----------Dollars---------	
Corn/Bean	2	22.17	70,008
Cont. Corn	1	21.74	60,328
Corn/Bean/Wheat	3	15.37	6,823
Cont. Bean	1	22.59	97,657
2 Corn/Bean	3	22.02	56,710
2 Bean/Corn	3	22.31	12,113
2 Wheat/Corn	3	8.43	3,253
Cont. Wheat	1	1.77	192
Total Chemical Cost on CRP[1]		**21.5**	**307,083**
Alternative			
Corn/Bean	2	22.17	249,610
Cont. Corn	1	21.74	0
Corn/Bean/Wheat	3	15.37	11,811
Cont. Bean	1	22.59	9,700
2 Corn/Bean	3	22.02	1,576
2 Bean/Corn	3	22.31	31,129
2 Wheat/Corn	3	8.43	3,256
Cont. Wheat	1	1.77	0
Total Chemical Cost on CRP[1]		**21.5**	**307,083**

[1] Estimated from 14,313 CRP acres.

Note : Total may not add due to rounding

Fertilizer Cost

The Agricultural Experiment Station, University of Missouri-Columbia reported the tonnage of fertilizer used in

Putnam County.[11] Ammonium Nitrate (34-0-0), Urea (45-0-0), Nitrogen Solution (28-0-0), Superphosphate (0-45-0), Muriate of Potash (0-0-60) and Ammonium Phosphates (18-46-0) were the fertilizer used. This report[12] provided the percent of common fertilizers used in Putnam County. Average fertilizer prices paid by regions in 1992 were obtained from 1992 Agricultural Prices which was published by USDA.[13] Active nutrient (N,P,K) prices were calculated by taking the fertilizer price and dividing by the percent of nutrient available in that fertilizer. The active nutrient prices were weighted according to the percentage of fertilizer used in Putnam County to calculate an overall average price of each nutrient. Appendix C, Table I, presents the 1992 average price of N, P, K for Putnam County.

The cost of nitrogen fertilizer was substantially different between conventional and alternative production. Nitrogen application rates were estimated at lower levels for alternative than for conventional production. Nutrient price was $0.23 per pound for nitrogen, $0.22 for phosphorus and, $0.12 for potassium. Total cost for all nutrients of each crop rotation are presented in table 33. The product

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[11] Missouri Fertilizer Tonnage Report, 1993., Agricultural Experiment Station, University of Missouri-Columbia

[12] Ibid.

[13] USDA National Agricultural Statistics Service, Agricultural Prices 1992 Summary, Agricultural Statistics Board, Washington D.C., July 1993, Pr 1-3 (93).

between fertilizer cost per acre and the CRP acres that placed in each rotation category provides the total fertilizer cost on post-CRP acres. Fertilizer cost was added across 8 crop rotation categories to obtain total fertilizer cost under both production methods.

TABLE 33 ESTIMATED FERTILIZER COST FOR CROP PRODUCTION ALTERNATIVES ON POST-CRP LAND, PUTNAM COUNTY, MISSOURI.

Crop Rotations	Average Annual Cost of Fertilizer ($/Acre)				Total Fert Cost on CRP Acres
	N	P	K	Total	
Conventional	----------	----------	----------	Dollars	----------
Corn/Bean	14.40	8.43	4.80	27.63	87,268
Cont. Corn	29.90	8.80	3.12	41.82	116,051
Corn/Bean/Wheat	14.23	7.33	3.6	25.16	11,171
Cont. Bean	0	4.62	4.32	8.94	38,648
2 Corn/Bean	18.40	8.32	4.01	30.73	79,133
2 Bean/Corn	8.43	7.33	4.56	20.33	11,037
2 Wheat/Corn	22.23	6.23	1.92	30.39	11,729
Cont. Wheat	16.10	4.62	1.32	22.04	2,391
Total Fert Cost on CRP Acres[1]				**25.0**	**357,428**
Alternative					
Corn/Bean	7.84	7.70	4.32	19.86	223,619
Cont. Corn	18.83	8.43	3.12	30.38	0
Corn/Bean/Wheat	8.94	6.97	3.36	19.27	14,812
Cont. Bean	0	4.62	4.32	8.94	3,839
2 Corn/Bean	11.93	8.07	3.84	23.83	1,706
2 Bean/Corn	5.62	6.60	4.32	16.54	23,085
2 Wheat/Corn	14.4	6.23	1.92	22.55	8,714
Cont. Wheat	9.88	4.62	1.20	15.70	0
Total Fert Cost on CRP Acres[1]				**19.3**	**275,775**

[1] Estimated from 14,313 CRP acres.

Seed Cost

The same report on 1992 Missouri M.I.R. Crop Costs Projected 1994 Crop Budgets provided seed price per acres for the major crops.[14] Seed cost per acre for corn, soybean and wheat were $19.25, $10.08 and, $11.85 respectively. The procedure to estimate seed cost per acre was the same as that used for chemical costs. The seed cost per acre of 8 crop rotations was calculated by adding seed cost of major crop present in each rotation category and dividing by the number of crops in that rotation. Seed cost per acre were multiplied by the number of post-CRP acres placed in various types of crop rotations (Figures from table 30) to give the total seed cost required. Seed cost was added across 8 crop rotation categories to give total seed cost on the CRP acres for both conventional and alternative production methods. Seed costs per acre were the same for both scenarios. Differences in total seed costs between the two production methods reflect differences in the percentages of CRP acreage placed among various crop rotations.

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[14] Moore, op.cit.,pp.8

TABLE 34 ESTIMATED SEED COST FOR CROP PRODUCTION ALTERNATIVES ON POST-CRP LAND, PUTNAM COUNTY, MISSOURI.

Crop Rotations	# of Crop in Rot	Seed Cost/Acre	Total Seed Cost on CRP Acres
Conventional		----------Dollars-------	
Corn/Bean	2	14.67	46,319
Cont. Corn	1	19.25	53,419
Corn/Bean/Wheat	3	13.73	6,095
Cont. Bean	1	10.08	43,576
2 Corn/Bean	3	16.19	41,698
2 Bean/Corn	3	13.14	7,133
2 Wheat/Corn	3	14.32	5,526
Cont. Wheat	1	11.85	1,286
Total Seed Cost on CRP[1]		**14.3**	**205,052**
Alternative			
Corn/Bean	2	14.67	165,149
Cont. Corn	1	19.25	0
Corn/Bean/Wheat	3	13.73	10,550
Cont. Bean	1	10.08	4,328
2 Corn/Bean	3	16.19	1,159
2 Bean/Corn	3	13.14	18,332
2 Wheat/Corn	3	14.32	5,533
Cont. Wheat	1	11.85	0
Total Seed Cost on CRP[1]		**14.3**	**205,052**

[1] Estimated from 14,313 CRP acres.

Note: Total may not add due to rounding.

The Output

Crop production for each production method was constructed. Ikerd, et al. study[15]provided information on average yield per acre (bushels/acre) under each crop rotations. According to Ikerd et al. study, production level of corn, soybeans and, wheat in the third land quality group under M region would be at the level shown under the average yield per acre column in table 35 and 36. Monocropping yield was lower than rotation cropping yields for all major crops due to rising pest pressure, degradation of the soil, and unidentified problems. For the same reasons, crop rotations with 2 years of one crop and 1 year of another crop, had first year yield of a 2 years crop rotation slightly higher than the second year yield.

Given the conventional scenario, the total yield of each major field crop (corn, soybean, wheat) from individual 8 crop rotations was calculated. The yield per acre of each major crop multiplied by the CRP acres placed in that crop rotation category (Data from table 30) and then divided by the number of crops in the rotation, provided output data for crops in that cropping rotation system. Each major crop output was summed across all 8 crop rotations to give the total yield on the CRP acres under each scenario. The output generated for the conventional case is presented in table 35.

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[15] Ikerd, Monson, and Van Dyne, op. cit.

TABLE 35 AVERAGE YIELD PER ACRE OF EACH CROP ROTATION WITH CONVENTIONAL PRODUCTION PRACTICES, PUTNAM COUNTY, MISSOURI[a].

Crop Rotations	Average Yield (Bu./Acre)						Total Yield (Bushels)		
	Crn	Crn2	Bn	Bn2	Wht	Wht2	Crn	Bn	Wht
Corn/Bean	100		30				157,925	47378	
Cont. Corn	85						235,875		
Corn/Bean/Wht	100		30		45		14,803	4,441	6,661
Cont. Bean	2		25					108,075	
2 Corn/Bean	100	90	30				163,116	25,755	
2 Bean/Corn	100		30	25			18,104	9,957	
2 Wheat/Corn	90				40	35	11,582		9,652
Cont. Wheat					35				3,798
Total Yield on CRP							**601,405**	**195,606**	**20,111**

[a] The third land quality in M region

Under the alternative method assumption, levels of corn and wheat yields were 2 percent lower than the conventional level to reflect impacts of reduction in nitrogen use. However, the alternative scenario utilized more crop rotations and had nitrogen credits from previous crops. These factors tended to increase production relative to total applied nitrogen. The procedure of calculating total yield of each major crop was the same as that used for the conventional case. The estimate yield for alternative production methods is shown in table 36.

TABLE 36 AVERAGE YIELD PER ACRE OF EACH CROP ROTATION WITH ALTERNATIVE PRODUCTION PRACTICES, PUTNAM COUNTY, MISSOURI.[a]

Crop Rotations	Average Yield (Bu./Acre)						Total Yield on CRP Acres (Bu.)		
	Crn	Crn2	Bn	Bn2	Wht	Wht2	Crn	Bn	Wht
Corn/Bean	98		30				551,812	168,922	
Cont. Corn	83						0		
Corn/Bean/Wheat	98		30		44		25,113	7,688	11,275
Cont. Bean			25					10,735	
2 Corn/Bean	98	88	30				4,438	716	
2 Bean/Corn	98		30	25			45,596	25,590	
2 Wheat/Corn	88				39	34	11,338		9,406
Cont. Wheat					34				0
Total Yield on CRP							**638,297**	**213,650**	**20,681**

[a] The third land quality in M region.

Result of Cropping Model

The Input Cost

Table 37 presents total input costs to resume crop production on post-CRP acres. The table also compares input costs required between conventional and alternative scenarios.

On the average, it costs $66 per acre (946,158/14,313) to produce crops on the CRP acres under conventional practices. Fertilizer cost is the major cost in this practice. A comparison of costs in table 37 reveals that the fertilizer and fuel costs declined as the system become more sustainable. The average cost to produce crops under the alternative system is only $58 per acre (827,867/14,313).

This is a reduction of approximately $118,291 or 12 percent. Fuel has by far the largest cost reduction. Fertilizer is the second largest cost reduction. The difference in costs between systems can be explained by the difference practices. With a no-till system in the alternative scenario, fuel cost was cut almost 50 percent while the level of chemical and seed costs were remained unchanged relative to the conventional case. Fertilizer cost also was reduced by 23 percent under the alternative system assumption.

TABLE 37 INPUT COSTS BY CROP PRODUCTION METHOD ON THE CRP ACRES WHICH WERE EXPECTED TO RESUME CROP PRODUCTION, PUTNAM COUNTY, MISSOURI.

Direct Cost	Conventional		Alternative		%Change
	Cost/ Acre	Cost on CRP	Cost/ Acre	Cost on CRP	
Fuel ($)	5.4	76,595	2.8	39,957	-47.8
Chemical ($)	21.5	307,083	21.5	307,083	0
Fertilizer ($)	25.0	357,428	19.3	275,775	-22.8
Seed ($)	14.3	205,052	14.3	205,052	0
Total Cost ($)	66.2	946,158	57.9	827,867	-12.5

The Output

Table 38 represents total yields of each major field crop on post-CRP acres for conventional and alternative production practices. Total crop production is also compared. Under the alternative scenario, corn yield was

increased by 6 percent, soybeans by 9 percent and, wheat by 3 percent relative to conventional farming. This is because of a reduction in weed and pest problems through elimination of continuous cropping.

TABLE 38 CROP YIELDS FOR CROP PRODUCTION ALTERNATIVES ON POST-CRP LAND, PUTNAM COUNTY, MISSOURI

Crop Yield	Conventional		Alternative		% Change
	Yield/ Acre	Yield on CRP	Yield/ Acre	Yield on CRP	
Corn	92	601,405	98	638,297	+6.13
Soybeans	27	195,606	29	213,650	+9.22
Wheat	39	20,111	40	20,681	+2.83

Note: Total 14,313 CRP acres on crop production divided into 6,529 acres for corn; 7,271 acres for soybeans and 514 acres for wheat, (See table 30)

Average output prices for 1992 were obtained from the Farm Management Newsletter.[16] Price per bushel of corn was $2.02, $6.92 for soybeans and $3.06 for wheat. Total yield of corn, soybean and wheat from conventional and alternative system, therefore, multiplied by the responding price generated the total income from each major crop as shown in table 39.

By assuming 1992 prices, total row-crop income projected from post-CRP land was estimated at $2,629,972 for conventional production methods and, $2,831,102 for alternative production methods, table 39.

[16] Moore, op. cit.,

TABLE 39 TOTAL ROW CROP INCOME ON POST-CRP ACRES FOR CONVENTIONAL AND ALTERNATIVE PRODUCTION PRACTICES, PUTNAM COUNTY, MISSOURI.

Row Crop	Corn	Soybeans	Wheat	Total
Conventional Scenario				
Price ($/bushel)	2.02	6.92	3.06	
Total Yield (Bushels)	601,405	195,606	20,111	
Total Income ($)	1,214,838	1,353,594	61,540	2,629,972
Alternative Scenario				
Price ($/bushel)	2.02	6.92	3.06	
Total Yield (Bushels)	638,297	213,650	20,681	
Total Income ($)	1,289,360	1,478,458	63,284	2,831,102

Ridge Tillage As another Alternative Practices

As indicated in table 19, another tillage practice which CRP landowners expected to use was ridge-till. The information from the Ikerd, et al. study[17] also provided cost estimates for ridge-till compared to a no-till system.

The difference in costs between ridge-till and no-till operation came primarily from difference in chemical and fuel required per acre (See Appendix C table II). In a ridge-till system, chemical use was reduced by half relative to the no-till system and the conventional system. This reduction resulted from the use of narrow banding application along the row rather than broadcast application. Fuel cost was higher than in no-till operations because of

[17] Ikerd, Monson, and Van Dyne, op.cit.

additional cultivation operation to control potential weeds between rows. Still, fuel cost can be reduced almost 5 percent when compared to conventional production. Fertilizer cost and seed cost were remained unchanged. As the fertilizer cost was the same for both no-till and ridge-till operation, yields would be the same for each major crops. However, the environmental benefit from ridge-till operation would be lower than no-till system due to increasing tillage. Overall, the use of ridge-till operation reduced input cost by 25 percent relative to conventional scenario and 14 percent relative to no-till system while yielded per acre were the same as no-till method.

The alternative crop production practices either no-till or ridge-till methods proposed potential changes in commercial inputs and yields. The percentage changed in costs and returns are presented in table 40. Significant results of alternative scenario were 1) a reduction of the four purchased inputs by over 12 percent with no-till operation and by 25 percent with ridge-till; 2) increased in total income by almost 8 percent for both no-till and ridge-till system, reflecting an higher yield per acre. Thus, the return over direct costs under no-till alternative production was higher than with conventional production by almost 19 percent and 26 percent for ridge-till alternative practice relative to the conventional case as shown in

table.

TABLE 40 COMPARISON OF COSTS AND RETURNS BY CROP PRODUCTION METHODS ON POST-CRP ACRES WHICH WERE EXPECTED TO RESUME CROP PRODUCTION IN PUTNAM COUNTY, MISSOURI.

Variables	Conventional	Alternative		Alternative	
		No-Till	% Change	Ridge-Till	% Change
Variable Per Acre					
Fuel Cost ($)	5.4	2.8	-47.8	5.09	-4.9
Chem Cost ($)	21.5	21.5	0	10.7	-50.0
Fert Cost ($)	25.0	19.3	-22.8	19.3	-22.8
Seed Cost ($)	14.3	14.3	0	14.3	0
Total Cost ($)	66.2	57.9	-12.5	49.4	-25.3
Corn Yield ($)	92	98	+6.1	98	+6.1
Beans Yield ($)	27	29	+9.2	29	+9.2
Wheat Yield ($)	39	40	+2.7	40	+2.7
Total Income ($)	183.7	197.8	+7.6	197.8	+7.6
Return Over D.C. ($)	117.5	139.9	+19.0	148.4	+26.1
Total on CRP Acres					
Fuel Cost ($)	76,595	39,957	-47.8	72,863	-4.9
Chem Cost ($)	307,083	307,083	0	153,542	-50.0
Fert Cost ($)	357,428	275,775	-22.8	275,775	-22.8
Seed Cost ($)	205,052	205,052	0	205,052	0
Total Cost ($)	946,158	827,867	-12.5	707,232	-25.3
Corn Yield (Bu.)	601,405	638,297	+6.1	638,297	+6.1
Beans Yield (Bu.)	195,606	213,650	+9.2	213,650	+9.2
Wheat Yield (Bu.)	20,111	20,681	+2.7	20,681	+2.7
Total Income ($)	2,629,972	2,831,102	+7.6	2,831,102	+7.6
Return Over D.C. Cost ($)	1,683,814	2,003,235	+19.0	2,123,870	+26.1

With about 14,313 CRP acres which were expected to revert to crop production in Putnam County. The total direct cost for the four purchased inputs would be $946,158 for conventional practice, $827,867 for the no-till

alternative method, and $707,232 for the ridge-till alternative practice. This is a reduction of 12 percent and 25 percent with the adoption of no-till and ridge-till alternative crop production practices, through reduce tillage, greater cropping diversity and, better utilized of chemical and fertilizer. The result of these comparison relative to the conventional case are 1) Total fuel use was reduced by almost 50 percent by adopting no-till system and 5 percent in ridge-till system. 2) Total fertilizer use decreased about 23 percent for both tillage methods. 3) Chemical cost were unchanged due to broadcast application in no-till practices and there was a 50 percent reduction in narrow banding application under ridge-till practice. 4) Seed cost applications remained the same.

Crop rotations influenced yields of field crops expected from alternative production methods. This was because of a reduction in weed and pest problems through elimination of continuous cropping. Corn yields were expected to increase by 6 percent, soybeans by 9 percent and, wheat by 3 percent. This resulted in a greater income per acre. Income were estimated at $2,629,972 for conventional production and, $2,831,102 for no-till and ridge-till alternative productions. This is an increase of 7.6 percent relative to conventional practices.

Overall, with the adoption of alternative crop production practices, direct cost per acre was projected to

be reduced. Meanwhile, the income per acre was expected to be increased relative to conventional production practices. Thus, the return over direct costs was higher than with a conventional system by 19 percent for a no-till system and, by 26 percent for a ridge-till system.

The Livestock System

The results from the survey showed that 41 percent of the CRP acres would be used for pasture and/or hay for livestock. The CRP acres could be used in either continuous grazing or rotational grazing. This study assumed all pasture or hay acres would be used for a beef cow/calf operation. This is the major beef enterprise in the county. It was assumed that all would be placed in either a conventional or an intensive grazing systems.

A continuous grazing or conventional system was defined as a system that allowed the proper number of animals to graze one area for the entire grazing season.

A rotational grazing or intensive grazing system (MIG) required the division of grazing land into many small pastures (called paddocks). The system operated by concentrating livestock into 1 paddock to utilize accumulated pasture growth in a short period of time. The stock were rotated from one paddock to another and returned to the first paddock when the growth was sufficient to

withstand another period of grazing. Stocking rate are greater for MIG than continuous grazing and animals were moved frequently. Optimum yield and quality forage regrowth occurs in a previously grazed pasture or paddock. This system required less pasture maintenance due to the even mowing by livestock. Manure was deposited much more evenly across the fields, rather than in travel lanes and around resting and watering sites. This results in leaving land in grass and reducing the use of fertilizers and chemical. Rotational grazing system are not only more sustainable than continuous grazing but also more sustainable than cropping systems.

The Grazing System and Adjustment

Possibilities in cattle feeding system are numerous. Each situation has its own unique characteristics that will determine the potential for that specific case. Data concerning cost and return for grazing systems were obtained from Moore's study on Management Intensive Grazing : A Look at The Economics[18]. This study serves to identify areas where changes were likely to occur. It also gave some indication about the likely magnitude of changes. In Moore's study, costs were based on 80 acre units and only income & expenses for the management intensive grazing system acres were compared (See Appendix C, Table III).

[18] Moore, Management Intensive Grazing, op. cit.

Enterprise budgets for the year 1992-1993 were used to assess the potential differences between the costs and returns from a conventional grazing operation and a management-intensive grazing system. Moore's study compared and contrasted the potential costs and returns of three alternative grazing system designs (3 paddock, 12 paddock, 24 paddock). In this thesis, the 3 paddock system was selected to represent the conventional grazing system while a 24 paddock unit represented an intensive grazing system.

To evaluate the cost and return of cow/calf production under different grazing systems, enterprise budgets were developed on a per acre basis. Many adjustments of the available budget were made. Adjustments were based upon published data, unpublished data, and from consultation with knowledgeable professionals.

Since Moore's data excluded the costs of maintaining the cow herd in winter, commercial feed & grain and hay were added to the existing budget to evaluate the annual profitability of the livestock system. The estimated requirements for feed & grain and hay for conventional system were obtained from Farm Management Newsletter[19]. Commercial feed cost were $43 per cow, $20 per cow for

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[19] Plain, Ron. 1992 Missouri MIR Cow-Calf Returns, Farm Management Newsletter, University of Missouri-Columbia, FM 93-4, December 15, 1993.

grains and, $69 per cow for hay[20]. The same amount of commercial feed & grain and 75 percent of the hay which was required to feed a cow under continuous grazing was assumed to be used with intensive grazing. This was because under intensive grazing management, pasture began to produce forage earlier and produced longer than under continuous grazing, thus making more efficient use of the forage. Hay and silage, thus, are reduced when pastures are intensively managed. Initial calf weight was assumed at 100 pounds prior to grazing. The animal investments were also adjusted to reflect the whole year budget. All prices and costs in budget enterprise were reported in term of dollars per acre.

The budget was conducted under 2 extreme assumptions to cover all possible sources of hay. First, it was assumed that all hays was purchased from suppliers. Thus, all acres could be used for pasture, resulting in the maximum number of cows that could be carried in the acreage. Second, all hays needed was produced on the livestock farm but no hay was produced on pasture acres. Acres would be fenced to produced hay supplies before pasturing begins. Hay was not produced on pastured acres. This assumption resulted in the minimum number of cows.

The combination of budgets based on these two assumptions provides the range of possible outputs and costs

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[20] The price were $380.03 per ton for feed, $76.74 per ton for grains and $33.39 per ton for hay. A cow required 0.115 ton of feed, 0.261 ton of grains and 2.073 of hay.

that might be expected in operating a cow/calf enterprise. Since each system allowed steers to graze ahead of the cows for 90 days, less hay purchases or more hay production could have been supported on the system if the steers were not used. This implied that more cows could be supported from both systems, so the number of cows possible are much above the figure shown in this thesis. The original budget from Moore's study was shown in Appendix C, Table III.

Assumption 1. No Hay Production on The Farm

The first step was to define the number of cows that could be raised on the CRP acres which are projected to return to livestock. Under conventional grazing system (3 paddock system), one acre of pasture could feed 0.31 cow/calf. A cow/calf pair would require 3.2 pasture acres. Since all post-CRP acres could be used for pasture (no hay production), this figure was divided the number of CRP acres which were expected to be used as hay/pasture (10,696 acres) to identify the number of cows that could be raised on the CRP acres under conventional system with no hay production. About 3,321 cow/calf could be supported with this system.

Similar procedures were used to calculated the number of cows that could be raised on the CRP acres under rotational grazing system. Under rotational grazing system (24 paddock), one acre of pasture could feed 0.48 cow/calf. A cow/calf pair would require 2.08 acres. The same acreage

could raise 5,142 cows with an intensive grazing system. More cows are carried per acre under this system. The adjusted budget for both grazing system are compared in table 41.

Assumption 2 All Hay Produced on Farm

As mentioned above, hay needs would be 2.073 tons per cow under a continuous grazing system and 75 percent less under a rotational grazing system (1.554 tons of hay). Yield per acre of mixed hay was estimated at 2.01 tons as reported in the Farm Management Newsletter.[21] If all hay was produced on the livestock farm, one acre would be required to produce hay under continuous system and 0.75 acres under a rotational grazing system. Given on-farm hay production, a pair of cow/calf required 3.22 pasture acres plus one acres of hay production which totaled 4.22 acres/cow. About 2,535 cow/calves could be supported on the CRP land under continuous system.

Under a rotational grazing system, a pair of cow/calf needed 2.08 pasture acres plus 0.75 acres of hay production which totaled 2.83 acres/cow. Total 3,780 cow/calves could be carried with this system. The number of acres required for a beef cow/calf were greater than the previous model. The hay budget was adjusted to reflect on-farm hay

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[21] Moore, 1992 Missouri M.I.R. Crop Costs Projected 1994 Crop Budgets, op. cit.,

production. Costs for producing hay in 1992 were adopted from The Farm Management Newsletter.[22] Average operating costs/acre for hay was $55.72. (See Appendix C, Table IV). The adjusted budget by grazing system is given in table 42.

[22] Ibid.

TABLE 41 ANNUAL COSTS AND RETURNS PER ACRE BY GRAZING SYSTEM WITH NO HAY PRODUCTION, PUTNAM COUNTY, MISSOURI.

Cost Per Acre	Continuous	Rotational
Cow-Calf Pair Per Acre	0.31	0.48
Acres/ a pair of cow-calf	3.22	2.08
No. of Cows on CRP Acres[a]	3,321	5,142
Return Per Acre		
Calf Gain @ $0.85	$107.1	$152.15
Steer Gain @ $0.55	31.9	57.75
Initial calf weight @ $0.85	26.4	40.8
Total Returns	$165.35	$250.7
Pasture Cost Per Acre		
Fence (10Yr @ 8.5%)	$0.84	$5.49
Water (10Yr @ 8.5%)	2.44	5.22
Establish (10Yr @ 8.5%)	14.52	19.23
Fertility (Estimated)	10.44	10.44
Clipping	5.0	0.41
Pasture Cost	$33.24	$40.79
Feed Cost Per Acre		
Feed & Grain	$19.56[b]	$30.29[c]
Hay	21.43	24.87
Total Feed Cost	$40.99	$55.16
Animal Costs Per Acre		
Vet-Cow/Calf	$3.26	$5.05
Vet-Steers	2.28	3.54
Int.($600 Cow @ 10%)	18.60	28.80
Int.($500 Cow @ 10%)	4.38	6.75
Total Animal Costs	$28.5	$44.1
Total Cost	$102.7	$140.1
Income Over Pasture, Animal and Int. Costs	$62.65	$110.6

[a] Estimated from 10,696 CRP acres.

[b] Under continuous grazing, total feed & grain cost per cow ($63) and hay cost ($69) were converted to dollars per acre by dividing by 3.22.

[c] Feed & grain needs was assumed the same amount of continuous system ($63). Hay needs was assumed 75 percent of continuous system ($51.75). Total Feed and hay cost per cow were divided by 2.08 to give dollars per acre.

TABLE 42 ANNUAL COSTS AND RETURNS PER ACRE BY GRAZING SYSTEM UNDER WITH HAY PRODUCTION, PUTNAM COUNTY, MISSOURI.

Cost Per Acre	Conventional	Intensive
Cow-Calf Pair Per Acre	0.236	0.353
Acres/ a pair of cow-calf	4.22	2.83
No. of Cows on CRP Acres[a]	2,535	3,780
Return Per Acre		
Calf Gain @ $0.85	$107.1	$152.15
Steer Gain @ $0.55	31.9	57.75
Initial Calf Weight @ $0.85	26.35	40.80
Total Returns	$165.35	$250.7
Pasture Cost Per Acre		
Fence (10Yr @ 8.5%)	$0.84	$5.49
Water (10Yr @ 8.5%)	2.44	5.22
Establish (10Yr @ 8.5%)	14.52	19.23
Fertility (Estimated)	10.44	10.44
Clipping	5.0	0.41
Pasture Cost	$33.24	$40.79
Feed Cost Per Acre		
Feed & Grain	$15.0[b]	$22.26[c]
Hay Production	13.27	14.77
Total Feed Cost	$28.27	$37.03
Animal Costs Per Acre		
Vet-Cow/Calf	$3.26	$5.05
Vet-Steers	2.28	3.54
Int.($600 Cow @ 10%)	18.60	28.80
Int.($500 Cow @ 10%)	4.38	6.75
Total Animal Costs	$28.52	$44.14
Total Cost	$90.03	$121.96
Income Over Pasture, Animal and Interest	$75.32	$128.74

[a] Estimated from 10,696 CRP acres

[b] Under continuous grazing, total feed & grain cost per cow ($63) and hay production cost per cow ($55.72) were converted to dollars per acre by dividing by 4.22.

[c] Feed & grain needs was assumed the same amount of continuous system ($63). Hay needs was assumed 75 percent of continuous system ($41.79). Total Feed and hay cost per cow were divided by 2.83 to give dollars per acre.

Result of The Livestock Model

Under the conventional grazing system with no hay production, the number of Putnam County post-CRP acres that were expected to be used for hay and/or pasture could provide pasture for 3,321 cows in a cow/calf operation. The same CRP acres could support 5,142 cows with an intensive grazing system. When on-farm hay production was assumed, the number of cows per acre became smaller due to a part of pasture acres being converted to hay production. However, hay costs would decline as farmers produced hay on their own farms. In order to assess the relative costs of production and profitability of continuous grazing and rotational grazing more accurately, the budget under both assumptions were combined to give the range of possible outputs and production costs that could be occurred on livestock farms. The combined budget is shown in Appendix C, Table V.

The middle value of each range was selected to represent the average of each operating cost per acre and number of cows per acre under different grazing systems. This number multiplied by the post-CRP acres gives the total costs and outputs on the CRP acres under each grazing systems. Table 43 presents the potential differences between costs and returns when moving from a conventional grazing operation to a management intensive grazing system for the CRP acres.

TABLE 43 COMPARISON OF COSTS AND RETURNS BETWEEN CONVENTIONAL AND INTENSIVE GRAZING SYSTEM ON POST-CRP LAND, PUTNAM COUNTY, MISSOURI

Variable	Conventional	Rotation	% Change
Average Per Acre			
No. of Cows	0.273	0.416	+52.4
Total Return	165.35	250.7	+51.6
Pasture Cost	33.24	40.79	+22.7
Feed Cost	34.63	46.1	+33.1
Animal Cost	28.52	44.14	+54.7
Total Cost	96.39	131.02	+35.9
Income Over Pas, Feed, Animal Cost	68.98	119.7	+73.5
Total Cost on CRP Acres[a]			
No. of Cows	2,928	4,461	+52.4
Total Return	1,768,584	2,681,487	+51.6
Pasture Cost	355,535	436,290	+22.7
Feed Cost	370,402	493,031	+33.1
Animal Cost	305,050	472,121	+54.7
Total Cost	1,030,987	1,401,443	+35.9
Income Over Pasture, Feed and, Animal Cost	737,597	1,280,044	+73.5

[a] Estimated from 10,696 CRP acres.

About 16,096 CRP acres that were expected to convert to pasture or hay if the CRP was not extended could raise 2,928 cows under a conventional production system and 4,461 cows under a rotational production system. More cows are carried per acre under intensive grazing. The use of an intensive grazing system increased input costs from $96 per acre for the continuous grazing to about $131 per acre. This is an increase by almost 36 percent. Although pasture maintenance costs including weed chemical, insect chemical, and

fertilizers were reduced, the cost was higher than continuous grazing because of the increased cost with subdivision fencing, more water system, and an additional animal investment per acre. This resulted in increased input cost per acre.

Despite higher initial costs, profit per acre was greater under the intensive grazing system than for the continuous grazing system. Initial calf weight prior to grazing were the same. The higher return per acre resulted from the greater saleable animals gain per acre. Calf gains per acre are 126 pounds for conventional grazing and, 179 pounds per acre for intensive grazing. The increases in gain per acre under rotational grazing system resulted from the greater stocking rate per acre and, more efficient use of the forage. The use of intensive grazing system increased the number of cow/calf per acre by 52 percent. The difference in returns was high enough to cover any other costs. Thus, the net income per acre under intensive grazing was higher than with a conventional system by almost 74 percent.

CHAPTER V

SUMMARY AND CONCLUSIONS

The major objectives of this study were to 1) identify terms which would be required by landowners for extension of the Conservation Reserve Program (CRP) and expected land use if there were no extensions of the program. The study was restricted to comparing the decisions of resident and non resident landowners. 2) to estimate farm inputs and yields if the CRP land returns to production. Each alternative land use was evaluated for both conventional and alternative production systems. 3) to document the problems and marketing service needed in each post-CRP alternative land use.

Putnam County, Missouri was selected for analysis because agricultural practices and CRP involvement were typical for Northern Missouri. As of the 9th sign-up, Putnam County had about 26,024 acres through 249 contracts enrolled in the CRP program. A mail survey was conducted among 185 participants to obtain information about expected post-CRP use of land in Putnam County, a typical North Missouri county. A response rate of 60.5 percent was obtained. Respondents owned 62 percent of the Putnam County's CRP land. This study was based on the first nine signups period. Statistical procedure were used to

determine if the in-area and out-of-area landowners viewed post-CRP land use alternatives in the same way. The plan for post-CRP land use identified in the survey provided the basis for estimating agricultural production and inputs under each alternative land use. Conventional and alternative systems were employed to estimate the input costs and yields for agricultural production. The survey also provided information about requirements for marketing services. The main conclusion drawn from this survey are :

CRP participants are interested in extending CRP contracts. The percent of respondents who desire a 5-year extension of CRP contracts was slightly higher than those who want a 10-year renewal. No differences were detected among the residence classes concerning the rental required. Both within area and out-of-area landowners preferred to take a higher rate than current one ($64/acre/year) for both a five year and a ten year contract extensions. The option to renew the program is now likely unrealistic due to the pressure from government budget deficit (Carlson, 1994). This is especially true if CRP participants required higher rental payment.

Though many respondents indicated they would require a higher rental rate if they were to continue in the CRP, over 75 percent of the respondents would accept a reduction in CRP payments if permitted to hay or graze the CRP land. At a fifty dollars CRP rental rate, 80 percent of the

respondents' acres would stay in the program.

If the CRP program is not renewed, the survey showed contract holders plan to return fifty-five percents of enrolled acres to crop production. Forty one percent would be used for grass for livestock grazing or hay production. Three percent would remain in grass or trees. Only one percent of those responding chose other uses.

Residence location was a variable which would influence landowners' decisions on post-CRP alternative land use. Respondents who lived out-of-area tended to plan to return the CRP land to crop production. Local residences would more likely place the CRP land in pasture or hay for livestock once contracts expired.

This study attempted to evaluate each alternative land use in Putnam County. Input costs and yields were estimated for crop and livestock production for both conventional and alternative systems. Prices for inputs and production were set at 1992 levels. The costs and returns data were obtained from University of Missouri Extension publication and extension personnel. Costs were presented on a per acre basis. A comparison of the costs and returns generated by the cropping model and livestock model under both systems are summarized in table 44.

TABLE 44 COMPARISON OF COSTS AND RETURN BETWEEN CONVENTIONAL AND ALTERNATIVE SYSTEM FOR ALTERNATIVES POST-CRP LAND USE IN PUTNAM COUNTY, MISSOURI.

Future Land Use	Conventional	Alternate	Change (%)
Crop Production with No-Till			
Income ($)	183.7	197.8	+7.6
Direct Cost ($)	66.2	57.9	-12.5
Return Over D.C. ($)	117.5	139.9	+19.0
Crop Production with Ridge-Till			
Income ($)	183.7	197.8	+7.6
Direct Cost ($)	66.2	49.4	-25.3
Return Over D.C. ($)	117.5	148.4	+26.1
Livestock Production			
Income ($)	165.35	250.7	+51.6
Direct Cost ($)	96.39	131.02	+35.9
Return Over D.C. ($)	68.98	119.7	+73.5

The result from the analysis showed that the use of an alternative agricultural production practice increased the return over direct cost for both crop and livestock systems.

For crop production, commercial input costs per acre were projected to be reduced by over 12 percent with alternative no-till operations and by 25 percent with ridge-till alternative practices. The income per acre was expected to be increased by almost 8 percent for both no-till and ridge-till production methods relative to conventional practices. Thus, the return over direct costs was increased by 19 percent with no-till method and 26 percent for ridge-till alternative practice.

For livestock production, total operation costs per acre was projected to be increased by almost 36 percent for intensive grazing as compared to conventional pasture. Although rotational grazing required higher total input costs than a continuous grazing system, it generated higher income and profit per acre. With the adoption of alternative practices, the livestock alternative practices required higher input purchases per acre than crop alternative practices. The benefit to local agribusiness from higher input purchases per acre from rotational grazing system more than offset the lower input requirement per acre for alternative cropping practices. Hence, the more land used in alternative livestock production rather than alternative cropping system, the greater the benefit generated to local communities.

If the CRP land is returned to crop production, the survey indicated that the need for minimum tillage equipment and weed control will be a problem. Education service on production practices and land moving services would be needed for respondents to get land back into crop production. The largest need for marketing service are local buyers and local haulers. Most respondents indicated an intention to purchase crop inputs from local suppliers.

Respondents expect to face several problems in returning the CRP land to livestock production. The major problems are fencing and water supply. Most respondents

indicated the need for fence building and developing water supplies. For marketing activities, respondents would expect to buy inputs from and sell their livestock to local business.

Limitation of Study

Difficulties are encounter in any forward-looking analysis. The uncertainties of the future constitute limitations of the present work. Economic conditions (Price, commodity program) will be important factors in determining future use of the CRP land. If the economy changes over time, landowners' behavior and attitude on post-contract uses may differ from those anticipated in this survey. The geographical areas studied, sample sizes, economics conditions, and the time period in which the studies were conducted may generate inconsistent results.

This study developed the alternative scenario by systematically shifting the percentages of corn, soybean and wheat acreage among various crop rotations to hold total acreage planted to each field crops unchanged from the conventional production analysis. Many appropriate alternative scenarios could be developed depending on the author's judgement. The bottom line on total input costs and yields from each crop rotation will vary with the percent of post-CRP acres put in each crop rotation. The same problem applies to livestock enterprise. Costs and

returns from shifting to intensive grazing will depend on many things. The estimation will vary with the forage base, supplemental feeding program being used, stocking rate, livestock system. Technical coefficients used in the cost and yield analysis were developed from estimates of University of Missouri Extension, references that provided the most guidance for this study. These data represent average operations. The specific assumptions with regard to model specification projected prices, costs, and the probable levels of future management provided the cost and yield figures in this study. The different estimations can be obtained from other sources.

Labor requirements may be substantially different for different production practices. This study didn't evaluated the differences in labor costs between conventional and alternative production methods.

APPENDICES

APPENDIX A

POST-CRP SURVEY

CRP Contract Number[1][2]_____

Post-Conservation Reserve Program Survey - Putnam County

Within 3-5 years most of the current CRP contracts will expire. Unless there are attractive alternatives, or an extension of the current program, the land presently in CRP may return to crop production. While this action might increase economic activity in local communities, the soil conservation benefits of the CRP program would be lost. However, there may be alternative opportunities that maintain all or most of the conservation benefits of the current program that also have the potential to enhance the economic viability of local communities.

The purpose of this survey is to gain information about current plans of CRP landowners regarding use of CRP land when current contracts expire and to find out how they might respond to various alternative CRP follow-up government programs. Information gained from this survey will be used to evaluate economic development alternatives for Putnam County.

1. When your CRP contract(s) end, who will decide how the land under contract will be used? (Check one)

I will decide	☐
Another family member will decide	☐
A tenant or manager will decide	☐
Don't know	☐

2. If you will not be the post-CRP decision maker could we have the name, address and phone number of the person who you anticipate will decide how your land now in CRP will be used after the program ends?

Name: _____

Address: _____

Phone: (____)_____-_____

Thank you. Please return this questionnaire.

[1] This information is needed to verify respondents. All information provided will be handled confidentially. No information on individual farms will be released.
[2] This survey covers only contracts for the first nine sign-up periods for the CRP program (1986-89).

3. How many acres of land do you own/manage in Putnam County or nearby areas?

a. Acres in CRP (Please indicate all the CRP acres in _____(acres)
b. Cropland acres not in CRP _____(acres)
c. Pasture _____(acres)
d. Woods _____(acres)
e. Other (Specify_____) _____(acres)

f. Total _____(acres)

4. What type of vegetative cover do you have on your CRP acreage?

a. Cool season grasses (fescue, orchard grass, etc.) _____(acres)
b. Warm season grasses (bluestem, switchgrass,etc.) _____(acres)
c. Grass/legume mixture _____(acres)
d. Trees _____(acres)
e. Other (Specify_____) _____(acres)
f. Total _____(acres)

Total of all categories should equal the answer to question 3a.

5. Have you continued to farm other land during the time you have had land in the CRP program? _____Yes _____No

If yes, how many acres of :

a. Row crops _____(acres)
b. Hay _____(acres)
c. Pasture _____(acres)

6. Indicate the number of acres of cropland you own or operate not enrolled in CRP that employ the following conservation practices: (Note: You may specify more than one conservation practice on the same acres.)

a. Do not require conservation practices _____(acres)
b. Use no-till or ridge-till _____(acres)
c. Are or will be terraced _____(acres)
d. Use reduced till or conservation tillage _____(acres)
e. Are farmed on the contour without terraces _____(acres)
f. Use rotations that include grass/legume pasture _____(acres)

7. Are you committed to or strongly inclined to sell your land which is in CRP when your CRP contract expires?

_____Yes _____No If yes, please return the questionnaire.

8. Assuming the current CRP program is extended without major changes, how many yearly payment would be required for you to continue to leave land in the program?

a. Five Years $_____/Year
b. Ten Years $_____/Year

9. Assuming there is no extension or follow up to the CRP program, indicate the number of acres of land that you currently have in CRP that you anticipate will be in each category after CRP:

a. Maintain in grass or trees without haying/grazing _____(acres)
b. Use the land as pasture or hay for livestock _____(acres)
c. Resume row crop production _____(acres)
d. Other:_____ _____(acres)

10. "Assuming that you could preserve your cropland base while using the land which is presently in CRP for haying and grazing, would you anticipate leaving the land in vegetative cover?

_____Yes _____No

If yes, how many acres? _____(acres)

Note: If you are not willing to consider using any land which you now have in CRP for haying or grazing or crop farming, go to question 27.
Note: If you are not willing to consider using any land which you now have in CRP for haying or grazing after your CRP contract expires, but would consider crop farming, go to question 17.

11. If you were allowed "unrestricted" haying and grazing privileges, how many of your current CRP acres would you leave in vegetative cover at the following levels of annual payments?

Annual Payment	Acres
a. $50/acre	_____
b. $30/acre	_____
c. $10/acre	_____

12. Intensive grazing programs which have the potential to increase beef production by 50 percent as compared to conventional pastures are being developed. If you could intensively graze the land which you presently have in CRP, how much annual payment would be required to maintain the vegetative cover?

Annual Payment	Acres
a. $50/acre	☐
b. $30/acre	☐

13. What problems would you have to deal with in getting the land which you now have in CRP back into livestock production?

a. Fences to build ☐
b. Provides water source ☐
c. Building for hay ☐
d. Building for livestock ☐
e. Wrong kind of vegetative cover ☐
f. Inadequate Stand ☐
g. Weed problems ☐

14. What hired services will you require to get your land which is presently in CRP back into livestock production?

a. Fence building ☐
b. Developing water supply ☐
c. Information on cattle sources ☐
d. Other (Specify)_____ ☐

15. Where do you anticipate you will purchase livestock production inputs?

	Local Suppliers	Out of County Suppliers
a. Feed	☐	☐
b. Animal health products	☐	☐
c. Livestock equipment	☐	☐
d. Other(Specify_____)	☐	☐

16. Where do you anticipate you will sell livestock which you produce on your land which is presently in CRP after the program ends?

Local buyers ☐ Out of county buyers ☐

Note: If you do not plan to use any land which you now have in CRP for row crops after your CRP contract expires, go to question 27.

17. If you plan to return CRP land to row crop production when your CRP contract expires, will this be the permanent or indefinite use for the land?

☐ Yes ☐ No

18. Will you row crop for a limited time for the purpose of establishing a different type of pasture/hay cover?

☐ Yes ☐ No

If yes, please explain_____

_____

19. A conservation compliance plan will need to be approved and implemented when you bring CRP land back into production if you are going to participate in government farm programs.

☐ Yes ☐ No

If no, please explain_____

20. What conservation practices are you most likely to use on the cropland which you plan to use for row crop production after CRP?

a. Terrace	_____(acres)
b. Contour without terraces	_____(acres)
c. Conservation tillage or residue management	_____(acres)
d. No-till or ridge-till	_____(acres)
e. Crop rotations that include grass/legume pasture	_____(acres)
f. Other (Specify_____)	_____(acres)
g. Total[4]	_____(acres)

21. Who will produce crops on the land which is presently in CRP when your CRP contract expires?

a. Owner/operator	☐
b. Tenant on shares	☐
c. Hired custom farmer	☐

22. What problems will you have to deal with in getting the land which you now have in CRP back into crop production?

	Yes (Acres)	No
a. Wrong kind of cover crop on the land	☐ (_____)	☐
b. Weed problems	☐ (_____)	☐
c. Need for terraces	☐ (_____)	☐
d. Need for minimum tillage equipment	☐ (_____)	☐

[4] The total may not match question 9c if some acres will use more than one conservation practice.

23. What services do you anticipate requiring to get your land which is presently in CRP back into crop production?

a. Land moving ☐
b. Education service on production practices (no-till, weed control) ☐
c. Other (Specify_____) ☐

24. Will you need to purchase equipment to farm your CRP land when your CRP contract expires?

	Yes	No
a. Tractor(s)	☐	☐
b. Planting equipment	☐	☐
c. Tillage equipment	☐	☐
d. Combine(s)	☐	☐
e. Other (Specify____)	☐	☐

25. Where do you anticipate you will purchase crop production inputs?

	Local Supplies	Out of County Supplies
a. Consultant	☐	☐
b. Fertilizer	☐	☐
c. Spreading services	☐	☐
d. Seed	☐	☐
e. Chemicals	☐	☐
f. Application service	☐	☐

26. What marketing services do you anticipate you will need for the crops which you produce on your land which is presently in CRP after the program ends?

	Local Supplies	Out of County Supplies
a. Buyers	☐	☐
b. Haulers	☐	☐
c. Storage	☐	☐
d. Other (Specify_____)	☐	☐

27. After your CRP contract expires, do you anticipate adding value through processing and/or retail marketing of product(s) which you produce on land which is now in the CRP program?

a. ☐ Yes ☐ No
b. If yes, please describe your plans.

28. Relative to the amount of the following assets you had prior to CRP, check the quantity of these assets you expect to have after CRP: (Check one)

	More	Same	Less	None Before or After
a. Livestock	☐	☐	☐	☐
b. Row Crop Machinery	☐	☐	☐	☐
c. Farm Buildings	☐	☐	☐	☐
d. Machinery for Livestock	☐	☐	☐	☐
e. Farm Real Estate (Land)	☐	☐	☐	☐

29. What has happened to the number of wildlife on your land since you entered the CRP program?

	Higher	Same	Lower	Don't know
a. Deer	☐	☐	☐	☐
b. Quail	☐	☐	☐	☐
c. Pheasant	☐	☐	☐	☐
d. Turkey	☐	☐	☐	☐
e. Waterfowl	☐	☐	☐	☐
f. Squirrel	☐	☐	☐	☐
g. Rabbit	☐	☐	☐	☐
h. Dove	☐	☐	☐	☐
i. Furbearers	☐	☐	☐	☐

30. Does your land support a huntable population of the following wildlife species?

	Yes	No
a. Deer	☐	☐
b. Quail	☐	☐
c. Pheasant	☐	☐
d. Turkey	☐	☐
e. Waterfowl	☐	☐
f. Squirrel	☐	☐
g. Rabbit	☐	☐
h. Dove	☐	☐
i. Furbearers	☐	☐

31. Are you interested in increasing wildlife numbers and/or wildlife related recreation on your land?

a. For your own use
☐ Yes ☐ No

b. For the use of others
☐ Yes ☐ No

Thank you for your cooperation.

APPENDIX B

THE CHI-SQUARE STATISTIC ANALYSIS

APPENDIX TABLE I STATISTIC ANALYSIS FOR RENTAL PAYMENT REQUIRED OF 5 YEAR EXTENSION BY RESIDENCE AREA

OBS	FIVEYEAR	RESIDENT	COUNT
1	LOW	LOCAL	23
2	LOW	OUTSIDE	10
3	HIGH	LOCAL	29
4	HIGH	OUTSIDE	17

Note: Low refers to $64 or less than; High refers to greater than $64

TABLE OF FIVEYEAR EXTENSION BY RESIDENT

FIVEYEAR / RESIDENT	LOCAL	OUTSIDE	Total
HIGH	29	17	46
	30.278	15.722	
	36.71	21.52	58.23
	63.04	36.96	
	55.77	62.96	
LOW	23	10	33
	21.722	11.278	
	29.11	12.66	41.77
	69.70	30.30	
	44.23	37.04	
Total	52	27	79
	65.82	34.18	100.00

STATISTICS FOR TABLE OF FIVE YEAR BY RESIDENT

Statistic	DF	Value	Prob
Chi-Square	1	0.378	0.539
Likelihood Ratio Chi-Square	1	0.381	0.537
Continuity Adj. Chi-Square	1	0.140	0.708
Mantel-Haenszel Chi-Square	1	0.373	0.541
Fisher's Exact Test (Left)			0.356
(Right)			0.803
(2-Tail)			0.633
Phi Coefficient		-0.069	
Contingency Coefficient		0.069	
Cramer's V		-0.069	

Sample Size = 79

APPENDIX TABLE II STATISTIC ANALYSIS FOR RENTAL PAYMENT REQUIRED OF 10 YEAR EXTENSION BY RESIDENCE AREA

OBS	TENYEAR	RESIDENT	COUNT
1	LOW	LOCAL	17
2	LOW	OUTSIDE	11
3	HIGH	LOCAL	31
4	HIGH	OUTSIDE	18

Note: Low refers to $64 or less than; High refers to greater than $64

TABLE OF TENYEAR EXTENSION BY RESIDENT

TENYEAR RESIDENT

Frequency / Expected / Percent / Row Pct / Col Pct	LOCAL	OUTSIDE	Total
HIGH	31	18	49
	30.545	18.455	
	40.26	23.38	63.64
	63.27	36.73	
	64.58	62.07	
LOW	17	11	28
	17.455	10.545	
	22.08	14.29	36.36
	60.71	39.29	
	35.42	37.93	
Total	48	29	77
	62.34	37.66	100.00

STATISTICS FOR TABLE OF TENYEAR BY RESIDENT

Statistic	DF	Value	Prob
Chi-Square	1	0.049	0.824
Likelihood Ratio Chi-Square	1	0.049	0.824
Continuity Adj. Chi-Square	1	0.000	1.000
Mantel-Haenszel Chi-Square	1	0.049	0.825
Fisher's Exact Test (Left)			0.681
(Right)			0.507
(2-Tail)			1.000
Phi Coefficient		0.025	
Contingency Coefficient		0.025	
Cramer's V		0.025	

Sample Size = 77

APPENDIX TABLE III STATISTIC ANALYSIS FOR CROP ALTERNATIVE BY RESIDENCE AREA

OBS	CROP	RESIDENT	COUNT
1	HIGH	LOCAL	27
2	HIGH	OUTSIDE	25
3	LOW	LOCAL	44
4	LOW	OUTSIDE	16

Note : Low refers to less than 50% of CRP land would be placed in crop ;

High refers to 50% or more of CRP land would be placed in crop

TABLE OF CROP ALTERNATIVE BY RESIDENT

CROP / RESIDENT	LOCAL	OUTSIDE	Total
HIGH	27	25	52
Expected	32.964	19.036	
Percent	24.11	22.32	46.43
Row Pct	51.92	48.08	
Col Pct	38.03	60.98	
LOW	44	16	60
Expected	38.036	21.964	
Percent	39.29	14.29	53.57
Row Pct	73.33	26.67	
Col Pct	61.97	39.02	
Total	71	41	112
	63.39	36.61	100.00

STATISTICS FOR TABLE OF CROP BY RESIDENT

Statistic	DF	Value	Prob
Chi-Square	1	5.503	0.019
Likelihood Ratio Chi-Square	1	5.530	0.019
Continuity Adj. Chi-Square	1	4.619	0.032
Mantel-Haenszel Chi-Square	1	5.454	0.020
Fisher's Exact Test (Left)			0.016
(Right)			0.995
(2-Tail)			0.030
Phi Coefficient		-0.222	
Contingency Coefficient		0.216	
Cramer's V		-0.222	

Sample Size = 112

APPENDIX TABLE IV STATISTIC ANALYSIS FOR PASTURE ALTERNATIVE BY RESIDENCE

OBS	PASTURE	RESIDENT	COUNT
1	HIGH	LOCAL	42
2	HIGH	OUTSIDE	13
3	LOW	LOCAL	29
4	LOW	OUTSIDE	28

Note : Low refers to less than 50% of CRP land would be placed in pasture ;
High refers to 50% or more of CRP land would be placed in pasture.

TABLE OF PASTURE ALTERNATIVE BY RESIDENT

PASTURE / RESIDENT	LOCAL	OUTSIDE	Total
HIGH	42	13	55
Expected	34.866	20.134	
Percent	37.50	11.61	49.11
Row Pct	76.36	23.64	
Col Pct	59.15	31.71	
LOW	29	28	57
Expected	36.134	20.866	
Percent	25.89	25.00	50.89
Row Pct	50.88	49.12	
Col Pct	40.85	68.29	
Total	71	41	112
	63.39	36.61	100.00

STATISTICS FOR TABLE OF PASTURE BY RESIDENT

Statistic	DF	Value	Prob
Chi-Square	1	7.835	0.005
Likelihood Ratio Chi-Square	1	7.975	0.005
Continuity Adj. Chi-Square	1	6.775	0.009
Mantel-Haenszel Chi-Square	1	7.765	0.005
Fisher's Exact Test (Left)			0.999
(Right)			4.40E-03
(2-Tail)			6.21E-03
Phi Coefficient		0.264	
Contingency Coefficient		0.256	
Cramer's V		0.264	

Sample Size = 112

APPENDIX TABLE V STATISTIC ANALYSIS FOR GRASS OR TREE ALTERNATIVE BY RESIDENCE

OBS	GRASS	RESIDENT	COUNT
1	HIGH	LOCAL	4
2	HIGH	OUTSIDE	3
3	LOW	LOCAL	67
4	LOW	OUTSIDE	38

Note : Low refers to less than 50% of CRP land would be placed in grass; High refers to 50% or more of CRP land would be placed in grass.

TABLE OF GRASS ALTERNATIVE BY RESIDENT

GRASS / RESIDENT	LOCAL	OUTSIDE	Total
HIGH	4	3	7
	4.4375	2.5625	
	3.57	2.68	6.25
	57.14	42.86	
	5.63	7.32	
LOW	67	38	105
	66.563	38.438	
	59.82	33.93	93.75
	63.81	36.19	
	94.37	92.68	
Total	71	41	112
	63.39	36.61	100.00

STATISTICS FOR TABLE OF GRASS BY RESIDENT

Statistic	DF	Value	Prob
Chi-Square	1	0.126	0.723
Likelihood Ratio Chi-Square	1	0.123	0.726
Continuity Adj. Chi-Square	1	0.000	1.000
Mantel-Haenszel Chi-Square	1	0.125	0.724
Fisher's Exact Test (Left)			0.507
(Right)			0.779
(2-Tail)			0.705
Phi Coefficient		-0.033	
Contingency Coefficient		0.033	
Cramer's V		-0.033	

Sample Size = 112
WARNING: 50% of the cells have expected counts less than 5. Chi-Square may not be a valid test.

APPENDIX TABLE VI STATISTIC ANALYSIS FOR OTHER LAND USE BY RESIDENCE

OBS	OTHER	RESIDENT	COUNT
1	HIGH	LOCAL	1
2	HIGH	OUTSIDE	1
3	LOW	LOCAL	70
4	LOW	OUTSIDE	40

Note : Low refers to less than 50% of CRP land would be placed in other use; High refers to 50% or more of CRP land would be placed in other use.

TABLE OF OTHER LAND USE BY RESIDENT

OTHER / RESIDENT	LOCAL	OUTSIDE	Total
HIGH	1	1	2
Expected	1.2679	0.7321	
Percent	0.89	0.89	1.79
Row Pct	50.00	50.00	
Col Pct	1.41	2.44	
LOW	70	40	110
Expected	69.732	40.268	
Percent	62.50	35.71	98.21
Row Pct	63.64	36.36	
Col Pct	98.59	97.56	
Total	71	41	112
	63.39	36.61	100.00

STATISTICS FOR TABLE OF OTHER BY RESIDENT

Statistic	DF	Value	Prob
Chi-Square	1	0.157	0.692
Likelihood Ratio Chi-Square	1	0.152	0.697
Continuity Adj. Chi-Square	1	0.000	1.000
Mantel-Haenszel Chi-Square	1	0.156	0.693
Fisher's Exact Test (Left)			0.600
(Right)			0.868
(2-Tail)			1.000
Phi Coefficient		-0.037	
Contingency Coefficient		0.037	
Cramer's V		-0.037	

Sample Size = 112
WARNING: 50% of the cells have expected counts less than 5. Chi-Square may not be a valid test.

APPENDIX C

APPENDIX TABLE I. AVERAGE NUTRIENT PRICE IN 1992, PUTNAM COUNTY, MISSOURI

Nutri	Fertilizer	% Used	Fert. Price[1] ($/ton)	Nut. Price ($/#)	Avg. Nutri Price ($/#)
N	Amo. Nitrate (34-0-0)	30	166	.24	.23
	Urea (45-0-0)	20	198	.22	
	N.Solution (28-0-0)	50	121	.22	
P	Superphos. (0-45-0)	100	194	.22	.22
K	Potash (0-0-60)	100	147	.12	.12

[1] Price is marketing year average price.

Source : Agricultural Experiment Station, University of Missouri-Columbia and USDA National Agricultural Statistics Service

APPENDIX TABLE II. INPUT COST COMPARISON BETWEEN CONVENTIONAL SYSTEM AND ALTERNATIVE RIDGE-TILL OPERATION ON CRP ACRES WHICH WERE EXPECTED TO RESUME CROP PRODUCTION, PUTNAM COUNTY, MISSOURI.

Crop Rotations	Total Input Cost on CRP Acres				
	Fuel	Chem	Fert	Seed	Total Cost
Conventional	----------Dollars----------				
Corn/Bean	17,722	70,008	87,268	46,319	221,317
Cont. Corn	20,038	60,328	116,051	53,419	249,836
Corn/Bean/Wheat	2,336	6,823	11,171	6,095	26,425
Cont. Bean	15,214	97,657	38,648	43,576	195,094
2 Corn/Bean	16,286	56,710	79,133	41,698	193,827
2 Bean/Corn	2,979	12,113	11,037	7,133	33,262
2 Wheat/Corn	1,711	3,253	11,729	5,526	22,219
Cont. Wheat	309	192	2,391	1,286	4,178
Total Conventn Cost	76,595	307,083	357,428	205,052	946,158
Alternative					
Corn/Bean	58,512	124,805	223,619	165,149	572,086
Cont. Corn	0	0	0	0	0
Corn/Bean/Wheat	3,604	5,905	14,812	10,550	34,872
Cont. Bean	1,632	4,850	3,839	4,328	14,649
2 Corn/Bean	417	788	1,706	1,159	4,069
2 Bean/Corn	7,135	15,565	23,085	18,332	64,117
2 Wheat/Corn	1,562	1,628	8,714	5,533	17,437
Cont. Wheat	0	0	0	0	0
Total Alternative Cost	72,863	153,542	275,775	205,052	707,232
Percent Change	-4.9	-50.0	-22.8	0	-25.3

APPENDIX TABLE III. COST AND RETURN BY GRAZING SYSTEMS AT THE MU F.S.R.C., 1992-1993

Cost Per Acre	Continuous	Intensive
Acre/a Cow-Calf Unit	0.31	0.48
Grazing Days-Cows	225	215
Grazing Days-Calf	181	181
ADG-Calf	2.27	2.07
Gain Per Acre-Calf	126	179
Conception Rate	97.5%	96.7%
Steers/Acre	0.35	0.54
Grazing Days-Steers	90	90
ADG-Steers	1.84	2.18
Gain Per Acre-Steers	58	105
Return Per Acre		
Calf Gain @ $0.85	$107.1	$152.15
Steer Gain @ $0.55	31.9	57.75
Total Returns	$139.0	$209.90
Pasture Cost Per Acre		
Fence (10Yr @ 8.5%)	$0.84	$5.49
Water (10Yr @ 8.5%)	2.44	5.22
Establish (10Yr @ 8.5%)	14.52	19.23
Fertility (Estimated)	10.44	10.44
Clipping	5.0	0.41
Pasture Cost	$33.24	$40.79
Income Over Pasture Costs	$105.76	$169.11
Animal Costs Per Acre		
Salt, Min-Cows	$3.39	$5.26
Salt, Min-Steers	2.37	3.68
Vet-Cow/Calf	3.26	5.05
Vet-Steers	2.28	3.54
Total	$11.30	$17.53
Interest Costs		
$600 Cow @ 10%	$11.47	$16.96
$500 Steer @ 10%	4.38	6.75
Income Over Pasture, Animal and Int. Costs	$78.61	$127.87

APPENDIX TABLE IV. 1992 AVERAGE MIXED HAY OPERATING COST IN MISSOURI.

Operating Costs/Acre	Amount ($)
Seed	2.62
Plant Food (Fert&Lime)	10.15
Crop Chemicals	1.44
Crop Insurance	0.41
Machinery Fuel, Oil, & Repair	19.24
Machine Hire and Services	9.16
Miscellaneous	9.72
Operating Interest @ 8%	2.98
Total Operating Cost Per Acre	55.7

Source : 1992 Missouri M.I.R. Crop Costs Projected 1994 Crop Budgets, University of Missouri-Columbia.

APPENDIX TABLE V. THE COMBINED ANNUAL COSTS AND RETURN PER ACRE BY GRAZING SYSTEM BETWEEN BOTH NO HAY AND WITH HAY PRODUCTION IN 1992.

Variable	Conventional	Rotational
Average Per Acre		
No. of Cows	0.236-0.31	0.353-0.48
Total Return	165.35	250.7
Pasture Cost	33.24	40.79
Feed Cost	28.27-40.99	37.03-55.16
Animal Cost	28.52	44.14
Total Cost	90.03-102.75	121.96-140.09
Income Over Past, Feed and, Anim cost	62.65-75.32	110.6-128.74

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The undersigned, appointed by the Dean of the Graduate Faculty, have examined a thesis entitled

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presented by Suthijit Traiyongwanich

a candidate for the degree of Master of Science

and hereby certify that in their opinion it is worthy of acceptance.