Spring 2008: Volume 7, Number 1

Western Economics Forum

A Journal of the
Western Agricultural Economics
Association

Farm & Ranch Management

Marketing & Agribusiness

Natural Resources & the Environment

Policy & Institutions

Regional & Community Development

The Western Economics Forum

A peer-reviewed publication from the Western Agricultural Economics Association

Purpose

One of the consequences of regional associations nationalizing their journals is that professional agricultural economists in each region have lost one of their best forums for exchanging ideas unique to their area of the country. The purpose of this publication is to provide a forum for western issues.

Audience

The target audience is professional agricultural economists with a Masters degree, Ph.D. or equivalent understanding of the field that are working on agricultural and resource economic, business or policy issues in the West.

Subject

This publication is specifically targeted at informing professionals in the West about issues, methods, data, or other content addressing the following objectives:

- Summarize knowledge about issues of interest to western professionals
- To convey ideas and analysis techniques to non-academic, professional economists working on agricultural or resource issues
- To demonstrate methods and applications that can be adapted across fields in economics
- To facilitate open debate on western issues

Structure and Distribution

The *Western Economics Forum* is a peer reviewed publication. It usually contains three to five articles per issue, with approximately 2,500 words each (maximum 3,000), and as much diversity as possible across the following areas:

- Farm/ranch management and production
- Marketing and agribusiness
- Natural resources and the environment
- Institutions and policy
- Regional and community development

There are two issues of the *Western Economics Forum* per year (Spring and Fall).

Editor – Term ending 30 June 2008:
Dr. Rhonda Skaggs
Editor, *Western Economics Forum*
Dept. of Ag Economics & Ag Business
New Mexico State University
MSC 3169 Box 30003
Las Cruces, NM 88003
Phone: 505-646-2401
Fax: 505-646-3808
email: rskaggs@nmsu.edu

Editor – After 1 January 2008 send submissions to:
Dr. Don McLeod
Editor, Western Economics Forum
Dept. of Ag & Applied Economics
University of Wyoming
Dept. 3354 1000 E. University Avenue
Laramie, WY 82071
Phone: 307-766-3116
Fax: 307-766-5544
email: dmcleod@uwyo.edu

Western Economics Forum

Volume VII, Number 1

SPRING 2008

Table of Contents

Comparing Continuous Corn and Corn-Soybean Cropping Systems

Stan Daberkow, James Payne, and James Schepers[1]

Introduction

Recent projections by USDA indicate that several million acres of corn above historical levels will be needed over the next several years to meet increased industrial demand for corn by-products, especially ethanol (Collins 2007). A large share of the increased corn acreage will likely come at the expense of soybean acres (which are often planted in rotation with corn) leading to an increase in continuous corn cropping systems. However, monoculture corn production is often associated with adverse yield, cost, and environmental risks compared to more diverse cropping systems. For example, Neilsen et al. (2006) cite studies where continuous corn suffered average yield losses of 9%, nitrogen use increased 30-50 pounds per acre, and additional insect and weed management was required compared to corn-soybean rotations. Increased nitrogen and pesticide use may also lead to additional environmental risks (National Research Council 2007).

Despite these adverse yield, cost, and environmental risks, continuous corn is grown on a substantial share of U.S. acreage. The most recent national data indicate that about one-fourth of all corn acreage was planted to corn for at least two consecutive years (ERS 2006). Given that continuous corn is fairly widespread and persistent over time, these producers have apparently adopted practices that allow them to profitably grow corn without rotating with other crops. Neilsen et al. (2006) suggest a number of production practices which continuous corn producers should adopt to mitigate the risks associated with continuous corn production. They suggest that switching from a corn-soybean rotation to continuous corn will likely require changes in residue, nutrient, pest, seed, and equipment management. However, an empirical question is: to what extent do current production practices, costs, and yields differ between corn-soybean and continuous corn fields? Contrasting these two cropping systems would give some indication about the changes that could be expected in terms of corn production, input use and costs, and environmental risks as continuous corn acreage increases over the next several years.

Objectives

Using data from a 2005 national survey of fields growing corn for grain, we tested for differences between the two major cropping systems used to produce corn, focusing on differences in residue, nutrient, pest, and seed management; expected and actual yields; seed, pesticide, and fertilizer costs; and planting and harvesting machine capacity. Where the sample size was

[1] Stan Daberkow is Agricultural Economist, Resource and Rural Economics Division, Economic Research Service, U.S. Dept. of Agriculture; James Payne is formerly with the Resource and Rural Economics Division, Economic Research Service, U.S. Dept. of Agriculture; and James Schepers is Soil Scientist, Agricultural Research Service, U.S. Dept. of Agriculture. The views expressed here are those of the authors, and may not be attributed to the Economic Research Service, the Agricultural Research Service, or the U.S. Department of Agriculture. Daberkow is corresponding author: daberkow@ers.usda.gov.

sufficient, we also tested for regional differences in selected cropping practices, yields, and input costs. The two cropping systems were compared by statistically testing for differences in: 1) the share of planted acres on which a specific practice, input or technology was used or 2) mean values of selected input rates, yields or costs. A by-product of the comparative analysis provides an estimate of the adoption level of recommended practices by corn producers which may be instructive for grower education and Extension activities as well as for managers of environmental and conservation cost-sharing programs, such as the Conservation Security Program and Environmental Quality Incentives Program.

Background

Neilsen et al. (2006) presented a comprehensive overview of the variety of risks that continuous corn producers face relative to corn-soybean producers. They suggest that continuous corn yields are adversely affected (relative to corn-soybeans) because of the increased challenges associated with insect, disease, weed, residue, equipment, and nutrient management. However, they also suggest production practices which may help mitigate the adverse yield risks typically linked to continuous corn cropping systems. For example, continuous corn generates large amounts of residue, which can reduce soil erosion, but can leave cooler and wetter soils after planting, encourage diseases and insects, and decrease the efficacy of soil applied herbicides (see also, Randall et al. 1996). Additional tillage passes and/or avoiding no-till or minimum tillage systems may reduce yield reducing risks from increased residue.

Nutrient management practices, such as setting reasonable yield goals, soil and tissue testing, and use of crop consultants, are recommended for all corn producers but especially for continuous corn acreage (University of Nebraska 2000). Compared to corn after legumes, additional nitrogen and phosphate and less potassium may be required for corn after corn, leading to a net increase in fertilizer costs. Insect pest management is typically problematic in continuous corn, especially for soil pests such as Western rootworm, and may require more intensive scouting, use of soil insecticides, or Bt seed. While fungicides are used infrequently for any corn cropping system, pre- and/or post-emerge weed treatment may differ between cropping systems because of residue levels, weather, cultivation, or use of herbicide tolerant seeds (Erickson et al.). Finally, Neilsen et al. (2006) discuss potential yield loss in continuous corn due to reduced stand establishment (e.g., residue, disease, and cold soil concerns) and lengthened harvesting season (i.e., stalks may remain in the field longer before harvest)[2]. Continuous corn may result in producers starting to plant later because of cooler and wetter soils. This could require larger equipment or long working days to mitigate these concerns if the desire is to complete planting on the same date as with a corn-soybean rotation.

[2] A reviewer took issue with the "lengthened harvest season" argument and offered the following persuasive counter example: For a given location, the time available for timely harvest of 100 acres of corn exceeds the time available for timely harvest of 50 acres of corn and 50 acres of soybeans. Corn harvest can be extended over many weeks without substantial loss of yield. On the other hand, to minimize yield loss and maintain quality, soybean harvest must be performed in a relatively (compared to corn) narrow window.

Data and Methods

Data for the analysis come from USDA´s 2005 Agricultural Resource Management Survey (ARMS) which is a multi-frame, probability based sample of corn producers[3]. The ARMS data used in this study are from a field-level survey of farms producing corn for grain in the 19 largest corn producing states[4]. Information was collected on input use (i.e., seed, fertilizer, and pesticides), production practices (i.e., tillage, pest, and nutrient management), sources of information on nutrient management, field operations, and machinery size (i.e., tillage, planting, cultivation, fertilizer and pesticide applications, and harvesting), and bio-tech and precision agriculture technologies used in the production of corn for grain. Respondents were also asked about costs per acre for three major inputs: seed, fertilizer, and pesticides. In addition, the sampled field’s cropping history for the two previous years was recorded which allowed us to distinguish fields growing continuous corn (for at least three years) from those in a corn-soybean rotation[5]. Restricting the analysis to these two major cropping systems resulted in 1,044 usable observations (i.e., fields) of which 223 were in continuous corn and 821 were in a corn-soybean rotation.

Each corn field sampled in the ARMS represents a known number of fields with similar attributes. By appropriately weighting the data for each field, inferences about the entire planted area of the surveyed states is possible. Only fields which were planted for grain and in a continuous corn (CC) or corn-soybean (CS) cropping system were examined. These two production systems were estimated to account for about 50.2 million acres of corn planted for grain in the surveyed states in 2005 (Table 1)[6]. About 42 million acres were planted in a CS rotation and 8.2 million acres were in CC.

Paired t-tests were used to test for differences in means and proportions between the two cropping systems and, due to the complex design of the ARMS survey, standard errors were estimated using a jackknife replication approach (Dubman 2000). Comparison of means is often used to analyze results from experiments in which factors other than the item of interest or “treatment” (i.e., crop rotation in this case) are "controlled" by making them as similar as possible. In the case of ARMS, the fields were selected randomly irrespective of whether they were in a CC or CS crop rotation. When comparing means from "uncontrolled experiments," caution must be exercised in interpreting the results (Fernandez-Cornejo and McBride 2000). Conditions other than the "treatment" are not equal in surveys where farms or fields are selected randomly. Thus, differences between mean estimates for yields or other variables from the survey cannot necessarily be attributed to the use of crop rotation since the results are influenced by many other factors not controlled for, including irrigation, weather, soils, nutrient and pest management practices, other cropping practices, operator characteristics, pest pressures, and others.

[3] ARMS documentation and questionnaires can be accessed at: http://www.ers.usda.gov/Data/ARMS/.
[4] The surveyed states were: CO, GA, IL, IN, IA, KS, KY, MI, MN, MO, NE, NY, NC, ND, OH, PA, SD, TX, and WI. These states accounted for nearly 90% of all the 81.8 million acres planted to corn for all purposes in 2005.
[5] Cropping history was available for four years for most but not all sampled fields. A preliminary analysis using this smaller sample size showed results similar to those reported here.
[6] Other rotations were used on another 21 million acres of corn planted for grain in the surveyed states in 2005.

Results

Traditionally, corn production in the United States is concentrated in three regions: the Northern Plains, Lake States, and Cornbelt (Table 1). The regional acreage distribution of the two cropping systems was much different, with the Cornbelt states accounting for most (61%) of the CS acres but only 38% of the CC acres. Also, a large share (20%) of continuous corn production was located outside the three major corn growing regions, compared to only about 4% of the CS acreage[7]. Similar proportions of the two cropping systems were found in the Northern Plains and Lake States.

Table 1. Comparison of location, physical characteristics, and selected technologies used on continuous corn (CC) and corn-soybean (CS) fields on farms producing corn for grain, 2005.

Item	CC	CS
Number of fields in survey	223	821
Planted acres in states surveyed (mil.)	8.2	42.0
	(percent of planted acres)	
Region 1/		
Northern Plains	24	20
Lake States	18	16
Corn Belt	38_B	61_A
Other States	20_B	4_A
Highly erodible land (HEL) designation	29	20
Wetland designation	4	4
Irrigated	30_B	8_A
Precision technologies		
Yield monitor	47	47
Guidance system	10	13
VRT (fertilizer, pesticides or seed) 2/	11	12

1/ Northern Plains=ND, SD, NE & KS; Lake States=MN, WI, & MI; Cornbelt=OH, IN, IL, IA, & MO; Other States=CO, GA, KY, NY, NC, PA, & TX.
2/ VRT=variable rate technology

A and B indicate significant column difference tests based on pairwise two-tailed [Ho:B_1=B_2] delete-a-group Jackknife *t*-statistics at a 90% confidence level or higher with 15 replicates and 28 degrees of freedom.

Source: 2005 USDA Agricultural Resource Management Survey.

The survey also included questions about several physical characteristics of the sampled fields and whether selected technologies were used in 2005 (Table 1). With the exception of irrigation, the choice of cropping system was not related to either a highly erodible land (HEL) or wetland designation of the field or to the adoption of precision technologies. A much larger share of CC acreage was irrigated which is related to the large amount of corn production in the lower rainfall areas of the Northern Plains. Regardless of cropping system, yield monitors have

[7] The largest continuous corn acreage outside of the three major corn regions was in TX and CO.

become fairly widespread but guidance systems and variable rate technology (VRT) adoption remains modest.

Actual and Expected Yields by Cropping System

Contrary to much of the research literature, neither expected yields nor actual yields reported by corn-for-grain producers in 2005 differed significantly between the CC and CS crop rotations (Table 2)[8]. Furthermore, the ratio of yield goals (or expected yields) to actual yields, an indication of yield loss due to weather, pests, or other unexpected factors, did not vary by cropping system. Apparently, at least in 2005, continuous corn producers did not suffer a significant yield penalty compared to corn-soybean producers[9]. Producers who have already switched to CC note that it is difficult to avoid a yield penalty with second-year corn unless they have taken into account differences imposed by the corn residue and differences in nutrient requirements or unless weather conditions are favorable. The likelihood of a third-year yield penalty is considerably reduced because the soil-plant system is well on its way to establishing a new equilibrium (Wieland 2007).

Residue Management by Cropping System

Residue management is clearly one of the major challenges associated with continuous corn production. Given the larger amounts of residue, no-till systems are more difficult to manage in CC production than in CS[10]. As expected, a larger share of the CS acreage uses a no-till system compared to CC (Table 3). Likewise, it is more difficult for CC to be conventionally tilled, unless a moldboard plow is used, than a CS system. In fact, the survey data indicate that a greater share of the CS acres was conventionally tilled while no CS acres were moldboard plowed[11]. As recommended by Neilsen et al. (2006), continuous corn producers reported significantly more tillage trips (and total field operations) than did the corn-soybean producers (Table 2). The survey indicates that, for both cropping systems, most acres are currently utilizing either reduced or conservation tillage systems which can generate energy and labor cost savings as well as address soil erosion concerns (Werblow 2005).

Nutrient Management by Cropping System

Because of the implications for crop yields, profitability, and the environment, nutrient use and management are critical aspects of corn production in general. While some research (e.g., Neilsen et al. 2006) suggests that nutrient management should differ by cropping system, the 2005 survey found only modest differences (Tables 2 and 4). Nitrogen application rates, soil testing, and most application timing indictors were not significantly different between CC and CS production. When the previous crop was soybeans, a higher share of acres received all commercial nitrogen in the Fall whereas, when the previous crop was corn, a higher share was applied in the Spring before planting—which may be related to the higher residue associated with continuous corn. Phosphate and potassium use did vary by cropping system with higher

[8] Both yield goal (yield the producer expected at planting) and actual yield (yield at harvest) were reported by the farmer. No independent actual yield measurement was available.

[9] A reviewer pointed out that our statistical test may have had insufficient power to detect yield differences and that the differences reported in Table 2 were in fact real (i.e., the CS yield of 149 bu/ac was higher than the CC yield of 143). Such an explanation is closer to conventional wisdom about differences in yields between cropping systems, but other considerations, as discussed in the conclusion, could also account for our statistical result.

[10] The tillage system data presented in this table are based on an estimate of residue left on the field after planting. The residue estimate is a function of the previous crop and the number and type of tillage operations used on the field prior to and including the planter.

[11] This result is not surprising given that very little residue remains after soybean harvest and moldboard plowing is much more costly than other tillage operations such as chiseling.

applications of both nutrients reported for CS production[12]. With the exception of the use of crop consultants for nitrogen recommendations, information often used for nutrient recommendations, such as soil and tissue testing, was no different between the two systems. Manure use was more probable on CC acres which likely reflects proximity to local livestock production rather than the choice of cropping system.

Table 2. Comparison of mean yields, input use and costs, equipment, and field operations on continuous corn (CC) and corn-soybean (CS) fields on farms producing corn for grain, 2005.

Item	Unit	CC	CS
Yield goal	Bu./acre	155	160
Actual yield	Bu./acre	143	149
Ratio: yield goal/actual yield	---	1.08	1.07
N application rate	Lb./acre	134	125
P_2O_5 application rate	Lb./acre	39_B	53_A
K_2O application rate	Lb./acre	45_B	68_A
Seeding rate	Seeds/acre	28,500	28,500
Days from State mean planting date 1/	Days	-1.5_B	-6.0_A
Days from Jan. 1 to plant date	Days	119_B	115_A
Equipment size:			
Planter	No. rows	7.96_B	10.14_A
Harvester	No. rows	5.67_B	6.63_A
Number of field operations:			
Total trips 2/	No.	6.31_B	5.83_A
Tillage trips (prior to and including planting)	No.	3.50_B	2.77_A
Input cost			
Seed	$/acre	41.13	39.14
Pesticides	$/acre	27.74	25.72
Fertilizer	$/acre	58.50	64.12

1/ Difference from the state average planting date which is defined as the first day of the most active planting period published in NASS, 1997.

2/ Includes tillage, planting, fertilizer and pesticide applications, cultivation, and harvesting.

See footnotes on Table 1.

Source: 2005 USDA Agricultural Resource Management Survey.

[12] Anecdotal evidence suggests that, given the immobility of P and K, some CS producers apply sufficient amounts of these nutrients on the soybean field to also fertilize the following crop of corn (i.e., apply sufficient amount of P and K on soybeans for both crop-years). While we ask respondents about the cropping history of our surveyed corn fields, we only ask for P and K application data for the current crop on that field. Consequently, we do not have data on the input use of the previous crop. Our questionnaire asks that farmers report the amount of P and K applied for the production of the current crop. Therefore, if a producer is applying nutrients this year for next year's crop he should only report the net amount intended for use by the current crop planted on the surveyed field.

Table 3. Comparison of residue management practices on continuous corn (CC) and corn-soybean (CS) rotated fields on farms producing corn for grain, 2005.

Item	CC	CS
	(percent of planted acres)	
Tillage system		
Conventional till (< 15% residue after planting)	15_B	25_A
Moldboard plow	6_B	0_A
Reduced till (15-30% residue after planting)	35	31
Conservation till (> 30% residue after planting)	49	43
No till	15_B	28_A

See footnotes on Table 1.

Source: 2005 USDA Agricultural Resource Management Survey.

Table 4. Comparison of nutrient management practices on continuous corn (CC) and corn-soybean (CS) fields on farms producing corn for grain, 2005.

Item	CC	CS
	(percent of planted acres)	
Nutrient use		
Treated with commercial nitrogen	95	96
Nitrogen application rate > 200 lb./acre	12	8
N inhibitor	2_B	12_A
Manure use	12_B	7_A
Treated with commercial phosphate	85	85
Treated with commercial potassium	58_B	74_A
Nitrogen application timing		
All applied before planting--fall	3_B	18_A
All applied before planting-spring	42	32
All applied after planting	16_B	8_A
Applied in fall and before planting-spring	9	17
Applied before planting-spring and after planting	12	11
Applied before planting-fall and after planting	6	6
Applied in fall and before and after planting	na	2
Soil/tissue testing		
N soil test	32	26
N app. rate 10% > recommended rate	9	5
N app. rate 10% < recommended rate	10	11
P soil test	35	34
Tissue test	2	6
Source of information about nitrogen application rates		
Crop consultant	31_B	18_A
Fertilizer dealer	32	38
Extension service	5	6
Yield goal 20% > actual yield	29	21

N=nitrogen; P=phosphorus; >= greater than; <=less than;
na= insufficient observations
See footnotes on Table 1.
Source: 2005 USDA Agricultural Resource Management Survey.

Regardless of the cropping system, the use of most nutrient management practices is limited and remained similar between the two cropping systems. For example, nitrogen soil testing was used on less than 35% of all acres[13]. Fertilizer dealers were listed as a primary source of information about nitrogen application rates on 32-38% of the corn acres, while only 5-6% of the acres relied on the Extension Service. Also, the share of acres receiving over 200 lbs. per acre of nitrogen (a rate about 33% above the average) was statistically the same (8-12%) for both cropping systems. Yield goal can be another critical aspect of nitrogen management because Extension services often make application rate recommendations based on a farmer's yield goal (e.g., University of Nebraska 2000). Yield is becoming less important when making fertilizer N recommendations in some corn producing areas, especially where weather uncertainties cause unpredictable N losses. Many producers still relate yield goal to crop N requirement and prefer to adjust fertilizer N rates based on anticipated losses and credits.

To the extent that yield goals influence nitrogen application rates, an unrealistic yield goal in excess of actual yields can lead to more nitrogen being applied than is used by the crop[14]. Setting realistic yield goals seems to be problematic (i.e., yield goal greater than 20% above actual yield) for producers on 21-29% of all acres, depending on the cropping system (Table 4). Production records from a 500,000 acre-area in South Central Nebraska between 1988 and 1992 showed corn producers set overly optimistic yield goals by an average of 10% (16 bu/acre) and N applications exceeded fertilizer N recommendations by 26% (28 lb N/acre) (Schepers et al. 1997). Between 1988 and 2005, yield goals exceed production by 19 bu/acre and N application rates exceeded recommendations by 26 lb. N/acre. In 2005, yield goals for irrigated corn in this management area averaged 6.5 bu/acre above the average production level (183 bu/acre) and the average fertilizer N application rate was 46 lb. N/acre (37%) above what was recommended (Moravek 2007).

Pest Management by Cropping System

Weed and insect management in a continuous corn cropping system is typically considered more challenging because of increased residues which may lead to loss of efficacy of soil applied pesticides, an increase in certain weed species, and greater populations of insects, especially corn rootworm and European corn borer (Neilsen et al. 2006). In 2005, there was little difference between the two cropping systems in terms of herbicide or fungicide use, herbicide timing, or in the share of acreage planted to herbicide-tolerant seed varieties[15] (Table 5). However, insect management did vary by cropping system with CC producers more likely to use insecticides and CS producers utilizing Bt seed varieties. Also, weed control through cultivation was more prevalent in continuous corn production[16]. As Neilsen et al. (2006) note, pest scouting is recommended for all cropping systems but is more critical for monoculture systems. CC producers did report using paid scouting on a larger share of acreage than the CS producers. Despite the large share of acreage treated with pesticides, particularly herbicides, only about half of the acreage of either crop rotation was systematically scouted.

[13] Surprisingly, of the 26% of the CS acres that are soil-tested about 1/5 received at least 10% more nitrogen than the recommended rate (Table 4). Also, about 2/5 of the soil-tested acres report applying less than the recommended rate.

[14] The data indicate that producers tend to be somewhat optimistic with respect to their yield goal (i.e., yield goals exceeded actual yields by 7-8%) regardless of cropping system (Table 2). It should be pointed out that national yields in 2005 were not influenced by extreme weather events—based on USDA's 2001 baseline (WAOB/USDA 2001) the expected or trend yield for 2005 was 146 bu/acre while actual yields were 148.

[15] Neilsen et al. (2006) suggest that the both the herbicide product mix and rates may have to be adjusted when switching to a CC cropping system.

[16] Most producers using CC cropping on furrow-irrigated fields also use cultivation to build the ridges.

Table 5. Comparison of pest management practices on continuous corn (CC) and corn-soybean (CS) fields on farms producing corn for grain, 2005.

Item	CC	CS
	(percent of planted acres)	
Pest management		
Applied herbicide	94	96
Applied before weed emergence	57	66
Applied after weed emergence	72	64
Applied insecticide	38 B	23 A
Applied fungicide	*	*
Cultivated to control weeds	35 B	11 A
Systematic scouting for insects or weeds	48	50
Paid scouting service	24B	13A
Seed technologies		
Herbicide-tolerant 1/	36	25
Bt 1/	26 B	39 A

1/ Includes stacked varieties.
*= <1%
See footnotes on Table 1.
Source: 2005 USDA Agricultural Resource Management Survey.

Seeding and Equipment Management by Cropping System

Neilsen et al. (2006) suggest that residue levels and related soil temperature should have an impact on seeding rates and dates (Table 2). Relative to CS producers, CC producers did plant several days later based on our measure of both national and state adjusted planting dates[17]. However, the seeding rate did not differ between the two cropping systems.

One of the benefits of a corn-soybean rotation is the possibility of spreading out the planting seasons and possibly utilizing smaller equipment. CC producers reported using significantly smaller planters and harvesters than the CS farmers. However, machine capacity may not be so much a function of cropping system as size of farm, climate considerations, or other enterprises on the farm. Based on data from the entire farm (not presented here) we tested for differences in both the type of farm and acres planted to corn and soybeans on the farm. Total soybean plus corn acreage on farms with continuous corn averaged 436 acres compared to 709 acres for farms with a corn-soybean rotation (a statistically significant difference). Furthermore, only 68% of the farms with a continuous corn system were classified as a crop (rather than livestock) farm, compared to 87% of farms with a corn-soybean system[18].

Selected Regional Comparisons

While national means and proportions were used to analyze differences between the two major cropping systems, regional comparisons can be useful in highlighting practices that seem to be

[17] Days between Jan. 1 and the plant date is a national measure of planting date and does not account for the very early planting dates in, for example, Texas. Days between the State typical plant date and sampled field plant date, adjusts for the different planting dates between the northern and southern states.
[18] Farm type was based on the largest share of sales for either crop or livestock commodities.

concentrated in a particular part of the country due to climate, soils, or other factors[19]. For example, moldboard plowing is prevalent on CC in the Lake States; no-till systems on CS areas of the Northern Plains; nitrogen soil tests, paid scouting, insecticide use, and irrigation on CC in the Northern Plains; and manure use through-out the Lake States (Table 6). Some clear differences between CC and CS were apparent for certain regions for seeding rates and tillage trips—seeding rates were significantly higher for CC in the Northern Plains while there were more tillage trips for CC in the Northern Plains and Lake States[20]. No consistent regional patterns emerged for two key variables of interest to this study: yield indicators and nitrogen application rates[21]. Nitrogen application rates tended to be higher in the Cornbelt States (for both rotations) compared to most (but not all) other regions and systems.

Table 6. Regional comparison of selected production indicators on continuous corn (CC) and corn-soybean (CS) fields on farms producing corn for grain, 2005.

Item		**Northern Plains**		**Lake States**		**Cornbelt States**	
		CC	CS	CC	CS	CC	CS
Number of fields in survey		36	184	46	157	48	355
Planted acres in states surveyed (mil.)		2.0	8.4	1.5	6.5	3.1	25.6
		Percent of planted acres					
Moldboard plow		0_{CD}	1_{C}	11_{ABDF}	1_{AC}	8	0_{C}
No till system		20_{B}	49_{ACDEF}	8_{BF}	6_{BF}	13_{B}	24_{BCD}
Irrigated		80_{BCDEF}	33_{ACDEF}	10_{ABEF}	3_{ABE}	0_{ABCDF}	1_{ABCDE}
Manure use		6_{CD}	5_{CD}	19_{ABF}	15_{ABF}	12	6_{CD}
All nitrogen applied in Fall		2_{BDF}	10_{ACDF}	0_{BDF}	27_{ABCE}	6_{DF}	19_{ABCE}
Nitrogen soil test		69_{BCDEF}	49_{ACDEF}	14_{ABD}	35_{ABCEF}	10_{ABD}	15_{ABD}
Applied insecticide		33_{BD}	12_{ACEF}	29_{B}	14_{AEF}	48_{BD}	29_{BD}
Paid scouting service		57_{BDEF}	22_{ADE}	na	8_{AB}	3_{ABF}	12_{AE}
	Units	Units per acre					
Yield goal	Bu.	159	149_{F}	151_{F}	155_{F}	161	166_{BCD}
Actual yield	Bu.	143_{D}	143_{D}	160	164_{ABEF}	142_{D}	149_{D}
Nitrogen application rate	Lbs.	127	125_{CEF}	91_{BEF}	125_{E}	154_{BCD}	139_{BC}
Seeding rate	Seeds	27900_{BDE}	25500_{ACDEF}	28600_{B}	30200_{ABF}	29800_{AB}	29000_{BD}
Tillage trips (through planting)	Number	3.0_{BC}	2.3_{ACDEF}	3.8_{ABDF}	3.2_{BCF}	3.3_{B}	2.8_{BCD}
Input costs							
Seed	\$	42.12_{B}	37.27_{AD}	36.57	41.00_{B}	46.59	39.28
Pesticides	\$	na	22.37_{CF}	28.37_{BD}	21.33_{CF}	28.27	27.41_{BD}
Fertilizer	\$	59.55	50.22_{DEF}	44.73_{EF}	57.09_{BF}	66.37_{BC}	69.85_{BCD}

na=insufficient observations
Letters A, B, C, D, E, and F indicate significant column difference tests based on pairwise two-tailed [Ho:B_1=B_2] delete-a-group Jackknife *t*-statistics at a 90% confidence level or higher with 15 replicates and 28 degrees of freedom. A=column 1, B=column 2, etc.
Source: 2005 USDA Agricultural Resource Management Survey.

[19] Of course, the statistical tests become less robust due to the smaller sample size as found in Table 6.
[20] Some of the extra trips in the Northern Plains could be attributed to cultivation required for furrow irrigation. Also, producers with irrigation have a higher yield potential which may explain the higher seeding rates.
[21] Actual yields in the Lake States that exceeded yield goals is apparently due to the exceedingly favorable temperature and rainfall in that region in 2005.

Input Cost Comparisons
For individual producers, differences in input costs between CC and CS are a critical economic consideration in the choice of cropping system (Table 2). At the national level, 2005 per acre costs for seed, pesticides and fertilizer were not significantly different between the two cropping systems. Even at the regional level, there was only limited evidence that CC production was more costly (i.e., seed costs in the Northern Plains and pesticide costs in the Lake States). While fertilizer costs tended to be higher in the Cornbelt (for both systems) than in other regions, they were not significantly different from, for example, continuous corn in the Northern Plains[22]. Despite concerns in the literature about higher production costs for continuous corn compared to corn-soybean rotations, the 2005 survey data did not reveal consistent cost differences using our particular statistical test.

Conclusion

Our objective in this analysis was to use field-level survey data to contrast the two major cropping systems used to produce corn in the United States: continuous corn and corn in rotation with soybeans. The comparisons focused on differences in nutrient, pest, seed, and residue management practices but also examined selected input costs, yields, and selected physical characteristics of the fields. Significant differences between the two cropping systems for many production practices implies that, as CS producers switch to continuous corn production, they may want to consider adopting practices commonly used by current continuous corn producers in order to maintain yields and profits. For example, no-till systems, early planting, and fall nitrogen fertilization are much more prevalent in corn-soybean systems than in continuous corn which has to deal with large crop residues after harvest. Other practices or technologies associated with a particular cropping system, such as irrigation, use of crop consultants, manure use, and adjustments in equipment size, are less common in corn-soybean production and would not likely change, at least in the short-run, with a switch to continuous corn since these characteristics are likely linked to such factors as region, availability of crop consultant services, livestock production and farm size. Some of the ambiguity about the impact of changing cropping systems may be related to the assumptions underlying the statistical technique employed in this analysis which does not control for the wide variety of factors associated with the decision to adopt a particular cropping system or practice.

One of the most interesting findings of this analysis is that there are many similarities between these two major cropping systems. The share of acres using the most common nitrogen and weed management practices was not significantly different across the two systems. At the national level, the proportion of corn acres exhibiting different levels of environmental sensitivity (i.e., HEL, wetlands) did not vary by cropping system, nor did the use of precision technologies, reduced and conservation tillage, input costs, or seeding rates.

Perhaps the most puzzling result from the survey was that our statistical tests comparing yield indicators (expected or actual) or nitrogen application rates did not reveal significant differences between cropping systems, which is contrary to much of the literature and Extension

[22] Regional differences in input use are well-documented. For example, K is not required in large quantities in Nebraska, but much more is needed in the Corn Belt. Also, the potential for N losses is greater in the Corn Belt where fall N application is permitted. In contrast, major parts of Nebraska have various types of N management regulations that are aimed at reducing N rates by avoiding N applications before critical leaching periods.

recommendations. One likely implication of our results is that there is extensive variability within the different production systems with respect to yields and nitrogen fertilizer use. Without additional analysis beyond comparisons of means between cropping systems, we cannot fully explain these results[23]. For example, analysis of yields typically requires a multivariate approach which includes such factors as weather, previous year's yield on that field, pest levels, residue levels, tillage systems, inherent soil productivity of each field, input quantities, etc. Likewise, nitrogen application rates would likely be influenced by factors beyond the previous crop such as manure use, yield goal, fertilizer cost, application timing, soil-tests, etc. Furthermore, these results were for only one year and the summary statistics are based on farmer responses not from experimental plots where many factors can be controlled. Another explanation is that continuous corn producers, over time, have learned to manage production risks associated with monoculture corn and avoided yield reductions, at least in 2005. For example, producers who have used the CC system for a number of years manage crop residues by cutting the stalks, cleaning residues from the area where the seed will be placed and timely planting. Also, farmers are likely well aware of productivity differences across fields and may utilize the more highly productive soils for CC.

References

Collins, K. (2007). Chief Economist, U.S. Department of Agriculture, *Statement before the U.S. House of Representatives Committee on Agriculture*, October 18, Washington, DC.

Dubman, R.W. (2000). *Variance Estimation with USDA's Farm Costs and Return Surveys and Agricultural Resource Management Study Surveys*. Economic Research Service, ERS Staff Paper AGES 00-01. April.

Economic Research Service (ERS) (2006). *Farm Business and Household Survey Data: Customized Data Summaries from ARMS,* U.S. Department of Agriculture. Available online: http://www.ers.usda.gov/Data/ARMS/app/Crop.aspx (accessed Jan. 16, 2006).

Erickson, B., B. Johnson, and G. Nice (undated). *Weed Management Issues in Continuous Corn.* Available online: http://ceu.farmresearch.com/Modules/ModuleDetail.asp?ModuleID=55 (accessed Jan. 26, 2006).

Fernandez-Cornejo, J. and W.D. McBride (2000). *Genetically Engineered Crops for Pest Management in U.S. Agriculture: Farm-Level Effects*. AER No. 786, U.S. Department of Agriculture, Economic Research Service, April.

Moravek, M. (2007). Assistant Director, Central Platte Natural Resources District, Grand Island, NE. Personal communication, March.

[23] A reviewer pointed out an alternative explanation of our statistically insignificant result involving the possible lack of sufficient power of our tests which resulted in a type II error. The implication of such an explanation can be illustrated using the summary data for the Cornbelt (Table 6) where actual yields, input use and input costs were, in general, not found to be significantly different between the two cropping systems. If the reported mean data for the two systems were really different then there would be a 7 bu/ac yield advantage for CS; a 15 lb/ac lower nitrogen application rate for CS; and a $7.31/ac lower seed cost for CS compared to CC. The net economic advantage for CS relative to CC of the additional nitrogen (15 lb/ac @ $0.45/lb), additional seed cost, and reduced yield (7 bu/ac @ $3/bu) is approximately $36/ac.

National Research Council (2007). *Water Implications of Biofuels Production in the United States.* National Academy of Sciences, Washington, DC, October.

National Agricultural Statistics Service (1997). *Usual Planting and Harvesting Dates for U.S. Field Crops*, Agricultural Handbook No. 628, U.S. Department of Agriculture, December.

Nielsen, R.L, B. Johnson, C. Krupkeand, and G. Shaner (2006). Mitigate the Downside Risks of Corn Following Corn, Purdue University, West Lafayette, IN. Published at the Chat ‘n Chew Café, 21 November 2006. Available online: http://www.kingcorn.org/news/articles.06/CornAfterCorn-1121.pdf (accessed Jan. 26, 2006).

Randall, G. W., S. D. Evans. J. F. Moncrief, and W. E. Lueschen (1996). *Tillage Best Management Practices for Continuous Corn in the Minnesota River Basin.* Available online: http://www.extension.umn.edu/distribution/naturalresources/DD6672.html (accessed Jan. 26, 2006).

Schepers, J.S., M.G. Moravek, R. Bishop, and S. Johnson (1997). Impact of Nitrogen and Water Management on Ground Water Quality. Pages 267-278. In: A. Ahmed (ed.) *Groundwater Protection Alternatives in the U.S.A.* Amer. Soc. Civil Eng.

University of Nebraska (2000). *Nutrient Management for Agronomic Crops in Nebraska, EC155*. Available online: http://www.ianrpubs.unl.edu/sendIt/ec155.pdf (accessed Oct. 10, 2006).

World Agricultural Outlook Board (2001). *Agricultural Baseline Projections to 2010,* WAOB Staff Report No. (WAOB2001-1), U.S. Department of Agriculture, Washington, DC.

Werblow, S. (2005). *New Math: Will Fuel and Fertilizer Bills Drive Adoption of Conservation Tillage*. Conservation Technology Information Center: Partners 23(3):3-6, November.

Wieland, R. (2007). Crop consultant, Laura, IL. Personal communication, February 6.

Out With the Old, In With the New: Are Western Commodity Producers Ready for Buyouts?

Amy M. Nagler, Christopher T. Bastian, Bradley D. Lubben, and Dale J. Menkhaus[1]

Introduction

Current agricultural policy offers U.S. producers subsidies evolving from policies dating back to the 1970s (Flinchbaugh and Knutson 2004). Increased globalization in agricultural markets has prompted policy makers to search for trade-friendly policy alternatives. Such alternatives, called new generation policies, "decouple" the linkage between program payments and agriculturists' production decisions.

One new-generation policy tool being discussed is a buyout bond. A bond scheme proposed by policy analysts in the United States and the European Union provides income support but is not linked to agricultural production. During a transition period of 15 to 25 years individual producers would receive a bond associated with a guaranteed income stream in exchange for giving up all future government subsidies. This bond, much like a savings bond, would have financial value and could be sold over its life (Orden and Diaz-Bonilla 2005). The amount of the bond would be based on previous production. Payments would be eliminated altogether at the end of the transition period. Such a policy would allow farmers who wanted to retire or diversify into other sectors to cash in their future entitlement and receive a lump sum. Others might want to use returns from the bond to invest in an agricultural enterprise or to supplement household income.

A buyout of agricultural supports is not entirely new to American producers or the policy arena. Both peanut and tobacco farmers have received buyouts or transitional payments associated with the end of traditional marketing quotas for their crops (Womach 2003). Citigroup proposed a voluntary buyout bond program be considered in the 2007 farm bill debate for traditional commodity program recipients (Brasher 2007). The buyout bond proposal was briefly considered in the House Committee on Agriculture during initial farm bill debate, but was not included in the bill passed by the committee and approved by the full House in July 2007. The Senate did not consider the buyout bond proposal when it debated and eventually passed its bill in December 2007. Without House or Senate language moving forward, the buyout bond proposal will not be in the latest farm bill.

The question then becomes whether such policies will be considered in future farm bills? With the existing safety net based on relatively low price support levels compared with today's record commodity market prices, there is an opportunity to reform the design of the safety net. The expected capitalized value of the existing safety net is quickly drawing towards zero given current prices and price expectations for the next few years. That, however, has not led to calls for a buyout while there is still some value left in the existing safety net. Instead, the calls have been for the adoption of a revenue safety net that tracks price movements over time and "climbs" to current price levels (Orden 2008). As a result, the final farm bill could have a safety

[1] Amy M. Nagler is Research Scientist, Christopher T. Bastian is Assistant Professor, and Dale J. Menkhaus is Professor, all with the Department of Agricultural and Applied Economics, University of Wyoming. Bradley D. Lubben is Assistant Professor and Extension Public Policy Specialist, Department of Agricultural Economics, University of Nebraska-Lincoln. Bastian is corresponding author: bastian@uwyo.edu.

net that is much more costly should prices fall from current levels toward historical averages more quickly than support price levels can fall under the new farm bill. If this were to happen, farm program costs could be well over levels prescribed in our WTO commitment. Moreover, given current concerns over deficit spending, it seems likely that such a scenario would increase concerns about farm program costs, and discussion would again turn to farm program reforms that would be decoupled and provide some opportunity for reduced program costs in the future.

Are commodity producers ready to embrace policies that increase market-orientation in the agricultural sector, should the policy arena choose to move in that direction? Such an orientation would mean producers might eventually give up subsidies from fixed direct payments, countercyclical payments, loan deficiency payments, and marketing loans.

We explore the potential preferences of western producers regarding a buyout bond option in this paper. Such knowledge should help agricultural economists as they conduct analyses and develop educational programs designed to help both policy makers and producers regarding this policy alternative.

The 2005 National Agricultural, Food, and Public Policy Preference Survey

A national policy preference survey asked U.S. producers for opinions regarding their preferences for a range of policy alternatives being discussed as part of the 2007 Farm Bill debate. The National Agricultural, Food, and Public Policy Survey, sent to more than 63,000 producers, was a collaborative effort involving land grant university policy specialists, state statisticians, USDA personnel, and the Farm Foundation. Statistically valid surveys were conducted between October 2005 and April 2006 in 27 participating states representing four regions (Figure 1). The survey had a usable response rate of 24%. A complete statistical description of results has been published (Lubben et al. 2006). A question asking producers specifically about preferences regarding a potential buyout bond in lieu of current commodity program payments was part of the national survey:

> *Some have suggested that current commodity programs could offer a buyout program similar to that recently implemented for tobacco. In a buyout program, producers would be offered a lump-sum payment or series of payments in exchange for eliminating all future rights to federal commodity program payments. Please indicate your preference for each of the following buyout options.*
>
> *Producers should be offered a buyout of existing commodity programs.*
> *□Yes □No □No Opinion/Don't Know.*

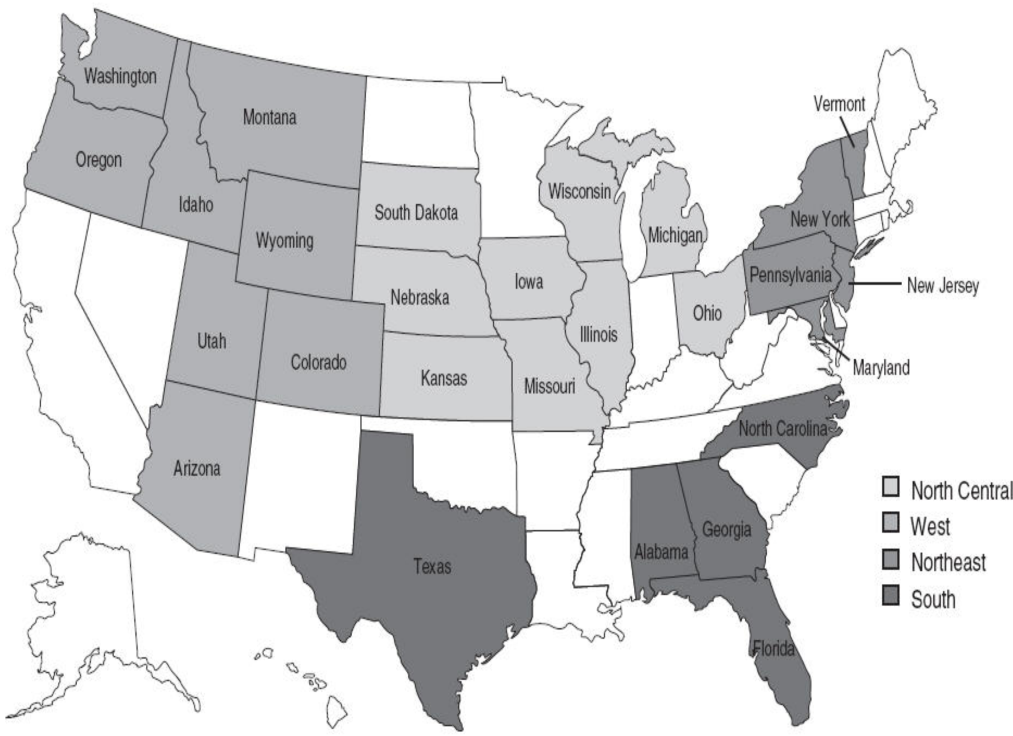
Commodity Program Participants Largely Didn't Want or Didn't Know About Buyout Alternative

Results from the recent national survey indicate that producers may not be enthusiastic about the buyout bond option. Among the 51% of all respondents who reported participation in or receiving benefits from commodity programs in recent years (direct payments, price supports, commodity loans, loan-deficiency payments, etc.), the potential buyout policy presented in the survey was not popular: only 23% answered "yes." Nearly twice as many (50%) responded that existing programs should not be bought out (Figure 2). This may not be a surprise since U. S.

producers received $10.8 billion dollars in direct commodity program payments in 2006 overall, with states represented in the survey receiving $6.3 billion of that total (USDA ERS 2007).

Nearly a third (27%) of program participants responding indicated they had no opinion or did not know when asked whether producers should be offered a buyout of current commodity payments. This significant proportion of producers who did not voice an opinion may indicate a lack of producer education regarding buyout policies and their potential impacts.

Figure 1. States participating in the National Agricultural, Food and Public Policy Preferences Survey and regional definitions.

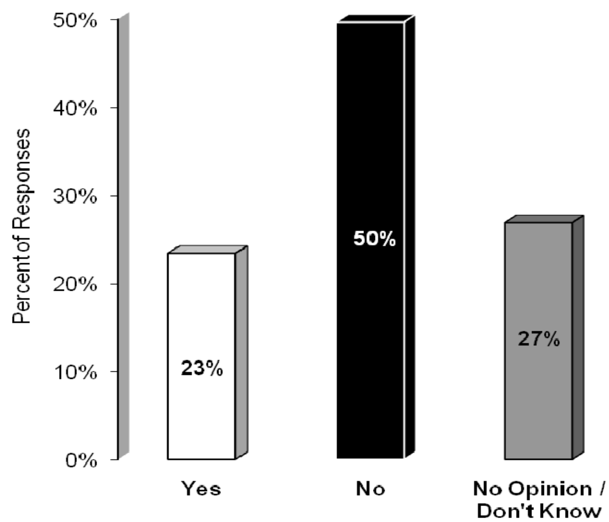


Regional Differences

Regionally, western, southern, and northeastern commodity program participants were the most accepting of a potential buyout with 26%, 28%, and 27% of respondents saying “yes” to a buyout being offered. North central commodity program participants were the least in favor of a buyout of commodity payments with 53% of respondents indicating “no” versus 20% saying “yes” (and 27% responding “no opinion/don’t know”). Northeast commodity participants, had the largest percentage of respondents (35%) indicating “no opinion/don’t know” about whether buyouts should be offered (Figures 1 and 3). These overall trends are not surprising given the level of dependence of the above regions on commodity program payments. The north central states represented in the survey captured 56% of the $6.3 billion in commodity program payments in 2006 received by all the states participating in the survey, while the Northeast received only about 3%. The southern and western states responding to the survey received nearly 33% and almost 9% of that $6.3 billion in payments, respectively (USDA ERS 2007).

While the western region as a whole received just 9% of the total $10.8 billion in commodity program payments in 2006, those payments continue to be a significant factor in the western region agricultural economy at approximately $1 billion annually. In addition, the western region has a greater stake in the direction of policy for some specific program crops. For wheat in particular, the western region has 23% of the nation's program base acres (USDA ERS 2003). A more in depth examination of survey responses from the western region suggests further differences among producers relating to farm size, level of education, age, and expectations after retirement and their preferences for buyouts.

Figure 2. Commodity program participants' buyout program preferences: "Producers should be offered a buyout of existing commodity programs."



<u>A Closer Look at Western Producer Preferences for a Buyout Policy</u>

Despite the lack of overall enthusiasm for a buyout policy, demographic differences in preference for a buyout program within the western region, encompassing both north- and south-western states of Arizona, Colorado, Idaho, Montana, Oregon, Utah, Washington, and Wyoming, provide some interesting insights regarding potential regional acceptance of this policy.

Farm Size

Farm size classifications for the National Policy Survey were based on the average annual market value of agricultural sales. While acceptance of a buyout program remained relatively similar for small and medium-sized operations in the West, program participants from the smallest farms (with less than $10,000 in sales) were more likely to respond "no opinion/don't know" (39%) when asked about a potential buyout program (Figure 4). This is not surprising as these producers receive a smaller portion of payments. Nationally, farms with less than $10,000 in sales received 5% of all payments in 2005 (USDA ERS 2006).

Figure 3. Commodity program participants' buyout preferences by region.

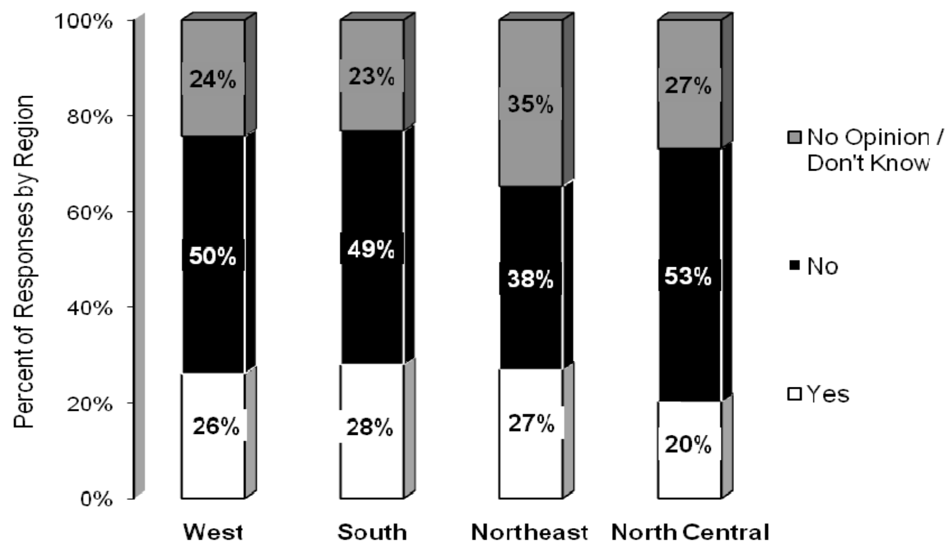
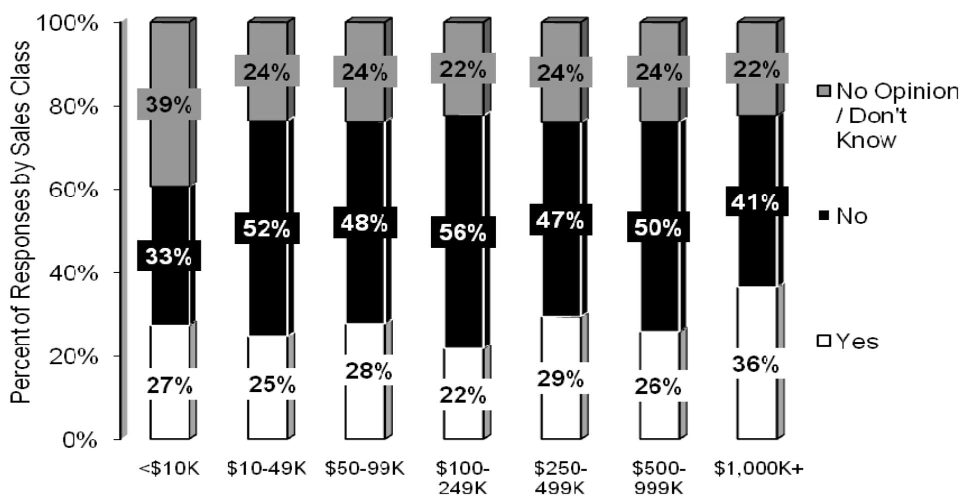


Figure 4. Western region commodity program participants' buyout preferences by farm size (annual market value of agricultural products sold).



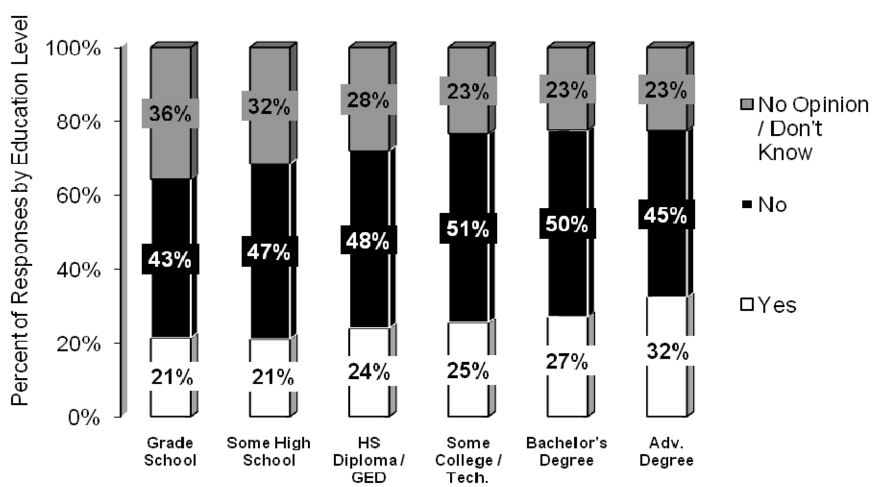
Western commodity program participants from mid-sized operations were more likely to reject a buyout. Between 47% and 56% of participants reporting $10,000 to $999,999 in sales responded "no" compared to only 22% to 29% who responded "yes". Among producers reporting over $1 million in sales, 41% of participants responded "no" compared to 36% "yes" (Figure 4). A higher acceptance rate from farms reporting $1 million or more in annual market value of agricultural sales may be due to these farms being less dependent on commodity payment income transfers as a percentage of total income. Although commodity payments increase with farm size, the percentage of gross income of farm payments decreases; payments are only 6% of gross sales for farms with annual sales over $1 million (Hoppe and Banker 2006). As the largest commercial farms are less dependent on program payments, they are less likely to be affected by a possible buy-out.

Education

Commodity program participants from western states holding an advanced college degree were more likely to agree that a buyout program should be offered (36% of respondents in that category indicated "yes"). They also were more certain of their opinion (only 23% indicating "no opinion/don't know"). This positive response may indicate educated producers are more likely to keep up on current policy issues or are more accepting of market-oriented policies.

Figure 5 further reinforces the relationship between all levels of education and buyout policy preferences. The proportion of western respondents answering "no opinion/don't know" is steadily replaced by those answering "yes" as the level of education increases, while the proportion responding "no" remains fairly consistent.

Figure 5. Western region commodity program participants' buyout preferences by level of education.



Age and Expectations after Retirement

The age of western survey respondents participating in commodity programs did not influence buyout preference. This lack of association is worth mentioning because it suggests using buyout payments as retirement income may not be an issue affecting policy preference. That is, producers may want to pass benefits on to the next generation. This conclusion is reinforced by an analysis of producers' expectations after retirement.

Commodity program participants from western states who expected their farm or ranch would be operated by a family member after their retirement were the least likely to approve of a buyout option with 25% responding "yes". Commodity producers who expected their farms would be converted to non-farm uses were more likely to agree that a buyout should be offered with 34% approving.

What Does This All Suggest?

It seems likely that the political economy surrounding agricultural policy will require decision makers to revisit the notion of decoupled policies such as the buyout bond at some point in the future, even if the current farm bill does not offer this alternative. Overall, the policy preference survey results indicate there are regional and demographic differences in acceptance of a commodity program buyout among American agricultural producers participating in commodity programs. Generally, however, results suggest there may be considerable political resistance from producers to a buyout bond, even for producers in the West who are less dependent on commodity program payments than other regions of the country. This resistance is especially strong among those producers with less education and whose income would be most affected by a change in policy. Education will be required before producers may be ready to accept a decoupled policy such as a buyout bond. Agricultural economists will need to estimate potential benefits and costs at the firm level as part of this education. Moreover, analyses regarding such issues as potential impacts of a buyout policy on agricultural trade and market prices, agricultural land values, and indirect impacts on productivity from such programs may also provide important information to policy makers and producers thinking about this potential policy alternative. As the policy environment changes and "new generation" policy alternatives are anticipated, agricultural economists have an opportunity to be proactive in providing such information.

References

Brasher, P. (2007). Citigroup Proposes Ag Subsidy Buyouts. *The Des Moines Register*. May 12, 2007.

Flinchbaugh, B. and R. Knutson (2004). The Agricultural Policy Outlook: Looking Back Focuses the Road Ahead. *Choices* 19(4). Available online: http://www.choicesmagazine.org/2004-4/policy/2004-4-07.htm.

Hoppe, R. A. and D.E. Banker (2006). *Structure and Finances of Family Farms: 2005 Family Farm Report.* (USDA Economic Information Bulletin No. EIB 12). Washington D.C.: Government Printing Office. Available online: http://www.ers.usda.gov/publications/EIB12/.

Lubben, B. D., N.L. Bills, J.B. Johnson, and J.L. Novak (2006). *The 2007 Farm Bill: U.S. Producer Preferences for Agricultural, Food, and Public Policy.* National Policy Education Committee Publication No. 2006-01. Oakbrook, IL: Farm Foundation. Available online: http://www.farmfoundation.org/projects/documents/2007FarmBillProducerSurveyFINAL.pdf.

Orden, D. (2008). The Pending 2008 U. S. Farm Bill in Perspective. Paper presented at the Policy Roundtable. Washington, D. C.: International Agricultural Trade Research Consortium. January, 2008. Available online: http://aede.osu.edu/programs/Anderson/trade.

Orden, D. and E. Diaz-Bonilla (2005). Holograms and Ghosts: New Ideas for Agricultural Policy. Chapter IV in Agricultural Trade Reform and the Doha Agenda. Washington D.C.: The World Bank. Available online: siteresources.worldbank.org/INTTRADE RESEARCH/Resources/ Ch11_AgTradeBook_Orden_Diaz.pdf.

United States Department of Agriculture Economic Research Service (2006). *Briefing Rooms/ Farm Income and Costs: Farms Receiving Government Payments*. Available online: http://www.ers.usda.gov/Briefing/FarmIncome/govtpaybyfarmtype.htm.

United States Department of Agriculture Economic Research Service (2007). *Farm Income: Data Files. Government Payments by State and Program 1990-2006*. Available online: http://www.ers.usda.gov/data/farmincome/FinfidmuXls.htm. Accessed March 18, 2008.

United States Department of Agriculture Economic Research Service (2003). *Farm Program Acres Data Files: 2002 Farm Act Base Acres*. Available online: http://ers.usda.gov/data/BaseAcres//Download.aspx. Accessed March 20, 2008.

Womach, J. (2003). *Comparing Quota Buyout Payments for Peanuts and Tobacco.* Congressional Research Report RS21642. Congressional Research Service, Library of Congress. Available online: http://www.uky.edu/Ag/TobaccoEcon/publications/womach_rs21642.pdf.

Who Are Today's Farmers and What are Their Educational Needs?

Jeffrey E. Tranel, Tauhidar Rahman, John P. Hewlett, Randolph R. Weigel, Trent Teegerstrom, and Cole Ehmke[1]

Introduction

The rural West has experienced dramatic demographic and economic transformations over the past decade. Although a great deal is known about agriculture's contribution to the economy, much less is known about the changing makeup of farm and ranch operators. A better understanding of farm operators, including what they perceive to be the greatest challenges for their operations, is important to effectively design outreach and Extension education efforts.

Census of Agriculture data show the profile of western farm operators to indeed be changing. However, more in-depth information is necessary to address the questions: Who are today's farmers and ranchers? What are their preferences for learning? What are their perceived threats? What information do they believe would be helpful to them as they manage their agricultural operations? And finally, what role might Extension play in answering these questions?

Extension is the forum for land-grant institutions to "extend" their resources to the citizens of each state. Congress created the extension system nearly a century ago to address exclusively rural, agricultural issues through non-formal, non-credit programs. Despite the sharp decline in the size and economic importance of rural America, the national Cooperative Extension System has adapted to changing times and landscapes. It continues to address a wide range of human, plant, and animal needs in both urban and rural areas in all 50 states. Colorado State University Extension's mission statement reflects the purposes and values of many state Extension systems: "to provide information and education, and encourage the application of research-based knowledge in response to local, state, and national issues affecting individuals, youth, families, agricultural enterprises, and communities of Colorado."

In the earlier years of Extension the transfer of knowledge occurred primarily through face-to-face education. While face-to-face education continues to be an effective method, other delivery mechanisms have been used to keep pace with the emerging communication technologies, increased time constraints of both the producers and Extension personnel, and the structural change in the U.S. agricultural sector in general. These changing methods of education delivery include public radio in the 1930s, television in the 1950s and more recently satellites in the 1980s and the internet in the 1990s.

[1] Tranel is an Agricultural and Business Management Economist with Colorado State University. Rahman is Assistant Professor and Extension Specialist and Teegerstrom is Associate Specialist, both with the University of Arizona. Hewlett is Senior University Extension Educator, Weigel is Professor and Extension Human Development Specialist, and Ehmke is Assistant University Extension Educator, all with the University of Wyoming. Tranel is corresponding author: jtranel@colostate.edu.

Western Agriculture

According to the 2002 Census of Agriculture, there are 48,085 farms in Arizona, Colorado, and Wyoming. Seventy eight percent of all farms have annual gross sales of less than $50,000. Most farm operators own and live on their own properties and operate them as sole proprietorships. Farms and ranches are increasingly being operated by females, and most farm operators have off-farm employment, many working off-farm 200 or more days per year. The average age of farm operators in Arizona and Wyoming declined from 1997 to 2002, while the average age of farm operators in Colorado increased during the same period. Farms reporting between 1 to 49 acres of harvested cropland totaled 10,204. This represents 45% of farms across the three-state region. A total of 4,982 farms reported 1 to 9 head of cattle or 23% of all farms (12,228 farms reported 1 to 49 head or 57%) reporting cattle and calves in the three states (NASS 2002).

Smaller operations constitute a sizable portion of those involved in crop and livestock production across the three states. While current census data do not provide details about the type or scale of smaller agricultural enterprises, it seems likely that smaller operators might engage in a wider diversity of animal and crop enterprises than larger operators. Smaller operators also may manage those enterprise activities in a manner unlike commercial operators.

Methodology

A statistically valid survey of farmers and ranchers in Arizona, Colorado, and Wyoming was conducted in 2006 by university Extension educators and researchers (the authors) in cooperation with the National Agricultural Statistics Service of the United States Department of Agriculture. The target population consisted of farm operations with annual sales of less than $50,000. To ensure a representative sample from each state, the numbers of survey instruments were allocated based on the population of small farm operators in each state. A total of 2,645 surveys were completed for a total response rate of 53.6% (Table 1). Data were collected on small operator's demographics, sources of risks, information sources and preferences, resource management, and income status. Multi-variate statistical analysis including cluster analysis, and classification techniques were employed.

Table 1. Survey response rates by state.

	Surveys Mailed	Surveys Returned		Surveys and Interviews Returned [1]	
State	**Number**	**Number**	**Percent**	**Number**	**Percent**
Arizona	742	319	43.0%	353	47.6%
Colorado	3,298	1,662	50.4%	1,798	54.5%
Wyoming	899	466	51.8%	494	54.9%
Total for 3 States	4,939	2,447	49.5%	2,645	53.6%

[1] Following the survey mailing, a post card reminder was sent to those people not yet returning their surveys. Telephone interviews with non-respondents were conducted by NASS personnel.

Results

Preliminary analyses provide insight into the characteristics of small farmers and ranchers in the states of Arizona, Colorado, and Wyoming. The results present a first look at the descriptive statistics derived from responses by all survey respondents. Further investigation will likely reveal additional insight into underlying factors only briefly outlined here. Also, data from survey respondents outside the target audience will be eliminated to help clarify the implications for extension education and the sustainability of small scale agricultural business activities. Following is a summary of the make-up of farmers and ranchers in the three states.

Demographics

The majority of small farm operators have lived many years within their communities and on their farms and ranches. Small farm operators are typically male, older than 54 years of age, and Caucasian. These operators' spouses help manage the business. About one-half of the two primary farm operators have at least a two-year college degree.

The survey found that 77% of the first operators (operator 1) are male, and the remaining 23% are female. On the other hand, 68% of the second primary operator (operator 2) are female; indicating they manage the operation as a couple. More than 45% of both operators (operator 1 and operator 2) are in the age group 55 years and over. Summary statistics indicate that on average operator 1 has lived for 19 years on their property.

Survey recipients were asked whether the primary farm operators or their family members hold off-property jobs, and if they do, how far does the individual who travels the farthest commute to work. Responses indicate that 71% of operator households have off-property jobs. The average distance traveled by an individual holding an off-property job is approximately 29 miles, while most travel only 10 miles.

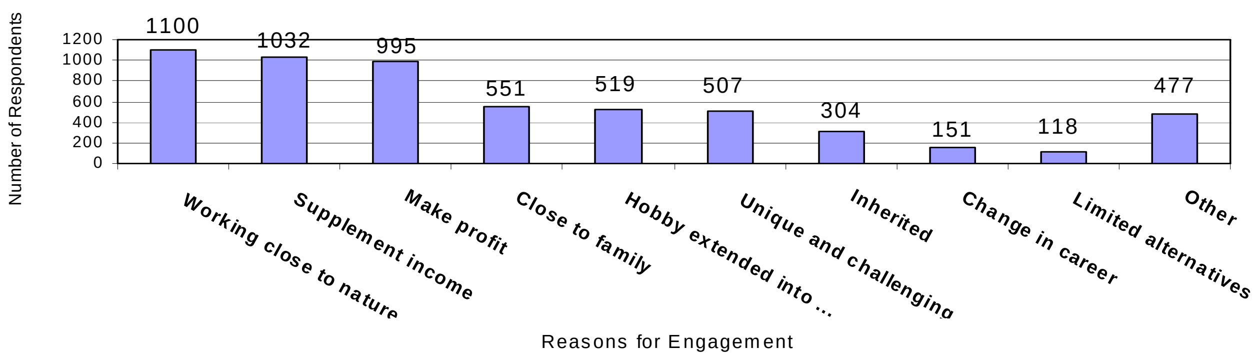
Farm properties in the western United States were classified into five categories: completely rural, mostly rural, mix of rural and urban, mostly urban, and completely urban. The survey data suggest that 63% of all properties are identified as completely rural and only 1% is completely urban. In between, 19% are mostly rural and 2% are mostly urban. In other words, 82% of all properties can be identified to be either completely or mostly rural. An overwhelming majority (84% of operators) have their primary residence on their property.

Attitudes

Just as there is no one-type of family business, the reasons people are involved in rural family businesses vary. When asked to indicate why they engaged in their particular enterprise (Figure 1), respondents indicated that “working close to nature” was the most frequently stated reason for engaging in their particular enterprise. Respondents also indicated a prime reason for family businesses is to earn money and support the family income. Though it was hypothesized that factors such as rural isolation, lifestyle changes, and inheritance would be significant reasons for owning/operating a rural family business; “limited alternatives”, “change in career”, and “inherited” were not seen by the respondents as major reasons for engaging in their rural family business.

For many, living and working in a rural family business is more than being in business. Some would say it is almost like a calling. The general impression is that family business owners are totally committed to the family business. The researchers wanted to know how committed the farmers were to their businesses. Would certain developmental or lifestyle conditions lead rural family business operators to leave their business? But, the results of this survey (Figure 2) clearly illustrate that respondents overwhelmingly expect to manage their property, “until I can no longer do the work”.

Figure 1. Reasons small operators in Arizona, Colorado and Wyoming are engaged in their particular enterprise.



Perception of Risk

The USDA has identified five primary sources of risk for agricultural operations: production, marketing, legal or institutional, financial, and human. Respondents were asked to rate the importance of each risk to their operation. As Figure 3 shows, a majority of respondents ranked financial risk higher than any other area of risk.

Figure 2. Planned length of property management by small operators in Arizona, Colorado, and Wyoming.

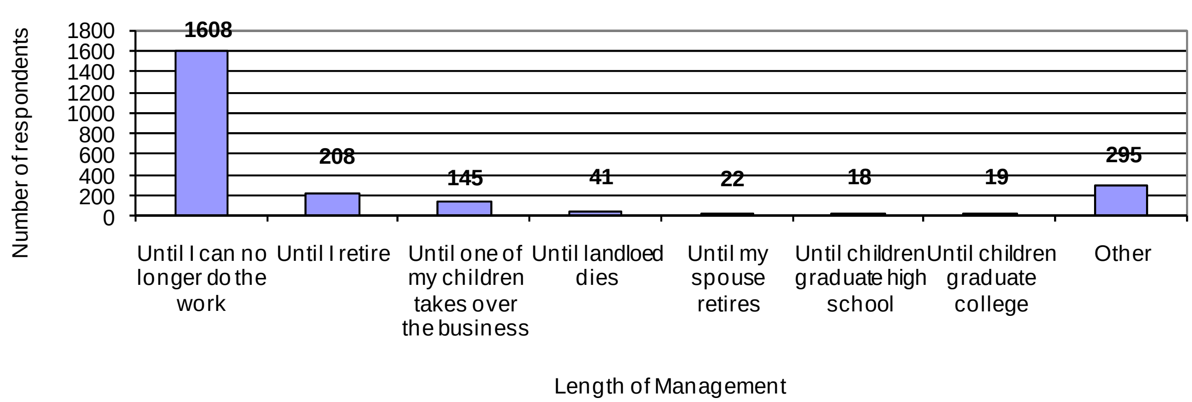
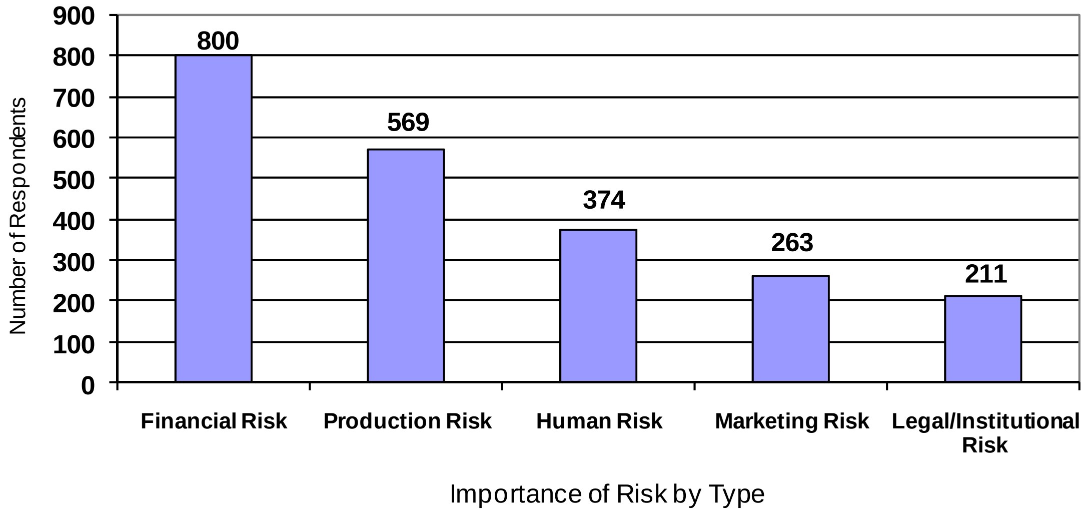


Figure 3. Importance of risk by type to small agricultural operators in Arizona, Colorado, and Wyoming.



Regarding their attitudes toward their operations, western producers are confident in their abilities to manage their family businesses and to achieve their goals; however, they are somewhat less confident in dealing with changes in the business environment. They appear optimistic about the future of the business, but they are not very comfortable balancing work and family demands.

Income

Two-thirds of the operators reported less than $10,000 in annual farm sales and file agricultural revenues and expenses via the Schedule F income tax form. For more than 80% of the operators surveyed, the income generated on-farm accounts for less than 20% of total household income. Fully 71% of operator households also work off-farm. To accomplish this, the average household commuted 29 miles to the jobsite. Most, however, traveled only 10 miles. Paid employees are not typical for small operations in Arizona, Colorado, and Wyoming. Many respondents from small agricultural operations do not see themselves as farm and ranch operators.

Operational

Operators of smaller acreages constitute a sizable percentage of the total number of operators across the three states in the study area. Characteristics of the operations include:

- Average number of acres owned was 265 with a mode of 40 acres.
- Wells are the most common source of water, but surface water on or bordering the properties is also typical.
- Less than half of the property owners use some type of irrigation on their pastures.
- Many of the operators use agricultural chemicals, but only 56% reported holding a chemical applicator's license.

Table 2. Primary enterprises generating income in 2005 for small operators in Arizona, Colorado, and Wyoming.

Primary Income Generating Enterprise	Number of Survey Respondents
Beef Cattle	698
Hay Farming	400
Sheep and Goat Production	125
Grain and Oilseed Farming	52
Aquaculture and Other Animal Production	28
Other Crop Farming	27
Specialty Products	27
Tourism and Recreation	20
Hog and Pig Production	20
Vegetables and Melon Farming	13
Hunting	13
Cattle Feedlots	10
Dairy Cattle and Milk Production	9
Greenhouse, Nursery, Floriculture	7
Other	820

Beef cattle, hay, sheep, and goats are the primary livestock enterprise on small farms. However, enterprise types for small operations are just as diverse as for larger operations. Just over half the animal producers indicated they have beef cattle, and the average herd size is 39 head. About 20% indicated owning horses, irrespective of purpose. Approximately one-third of livestock owners raise their own feed, while the other two-thirds purchase their feed within a short distance of their farms. Table 2 shows the primary enterprises generating income in 2005 for small operators in Arizona, Colorado, and Wyoming and the numbers of respondents indicating such.

Respondents also tend to heavily graze their own property. They reported typically grazing pastures 7.5 months a year and leaving none or almost none of the forage. Their pastures have a 50/50 chance of being managed with a pasture management system. If they have a grazing management plan, respondents are also likely to have a 4-pasture rotation. Very few have public land leases to supplement production from their own land.

The small acreage managers who reported crop production tend to be irrigated crop producers, with a majority of the acres in alfalfa or hay production. The typical alfalfa producer grows about 60 acres, and the typical hay (not pure alfalfa) producer grows about 51 acres. Small operators usually do not participate in government programs such as the Conservation Reserve Program.

Information Sources

In order to provide relevant Extension information, the researchers were interested in the farmers' preferred sources of information and preferred forms for information. Figure 4 shows that when seeking information relevant to their operations, survey respondents reported they primarily prefer receiving information from peer/support groups or networks. After peers, producers look to Internet websites, trade magazines, and Extension. The producers were not likely to seek information from commodity groups, consultants, nor community colleges. Regarding most preferred forms to receive information (Figure 5), the overwhelming preference was print media followed by two other types of printed information – newsletters and direct mailings. Workshops, email, and video/DVD were not preferred forms for information.

To determine Extension's role in useful and practical information dissemination, the researchers wanted to know if small scale farmers were actually receiving Extension information and participating in Extension programs. Most survey respondents (1,830) indicated they had received information form Extension. But when asked if they had participated in an Extension program (other than 4-H) in the last 12 months, more than 80% of the respondents reported not participating in any Extension program during the last year. Understandably, given the average age of producers, most small farm families have not had any family members participate in 4-H for at least two years.

Figure 4. Sources of information preferred by small farmers in Arizona, Colorado and Wyoming.

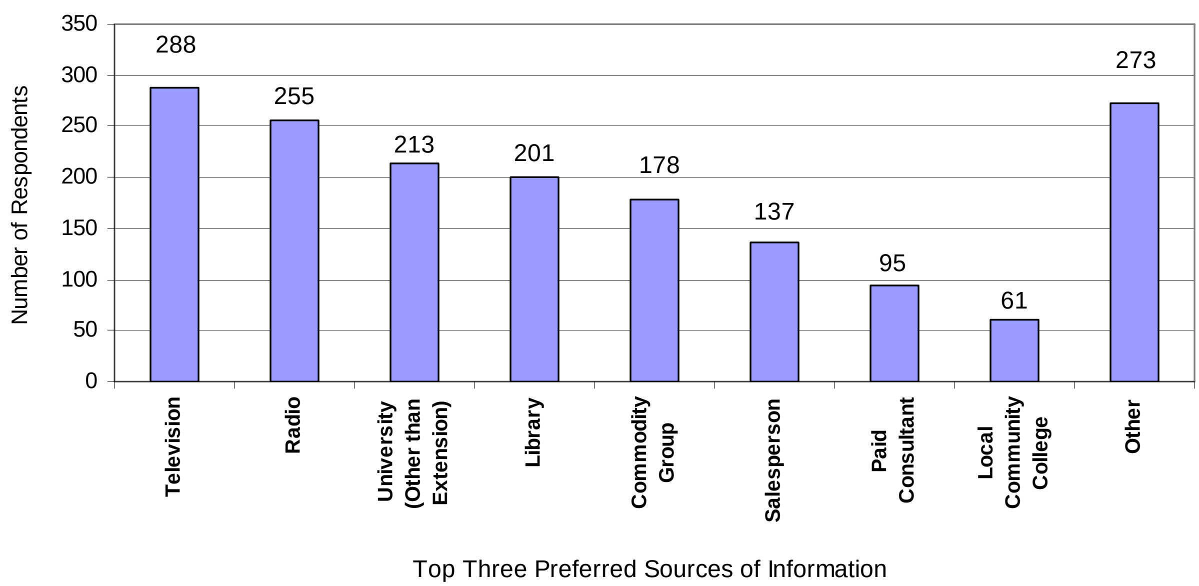
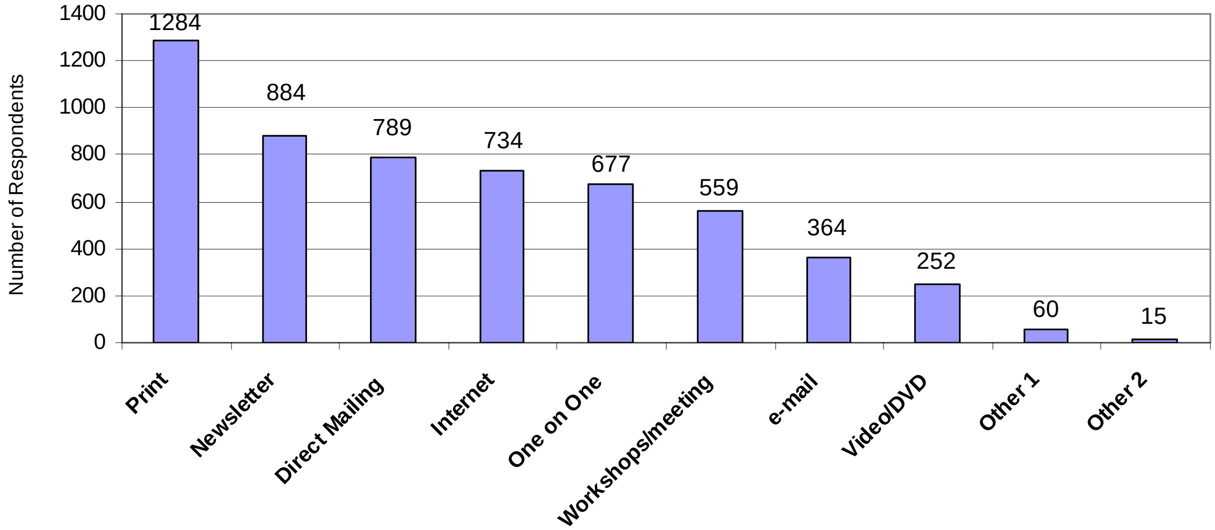


Figure 5. Most preferred forms to receive information by small operators in Arizona, Colorado and Wyoming.



Implications

Results of this study provide a profile of a large segment of agricultural producers – the 78% of all farms and ranches with annual sales less than $50,000 – in Arizona, Colorado, and Wyoming. Potential differences in the characteristics of "traditional" farm and ranch clientele and today's farmers and ranchers for Extension education programs are highlighted in Table 3. Though the characteristics of Extension's traditional clientele are still relevant, the characteristics of "today's" clientele provide new educational opportunities. The results of the survey indicate that today's clientele would benefit from information on managing the demands of off-farm employment and farming tasks, health and farming adaptations as one ages, farming as a couple, and opportunities for profit on small acreage.

Extension should consider application of its resources to address the educational needs of smaller farmers on topics such as the financial risks associated with beef cattle, hay, and sheep and goat production. Such consideration is consistent with the mission of at least three western land-grant universities and the purpose of the Extension system as indicated by the Cooperative State Research, Education, and Extension Service. Expanding their knowledge of irrigation, other water issues, and chemical application would not only allow small producers to better manage such resources but would enhance safe water supplies on an each farm within a water system.

In recent years, Extension has decreased one-on-one interactions with clientele and expanded use of video and group education methodologies with the intentions of improving efficiency of program delivery. However, new educational methodologies may not appeal to smaller farm operators. Extension administrators and faculty must develop relationships with small farm and ranch operators, study their needs and choices for education, and deliver high quality programs addressing specific clientele needs. Delivery may have to occur in atypical settings and times and using formats desired by an aging, educated, and increasing female audience.

Table 3. Characteristics of farmers and ranchers in Arizona, Colorado, and Wyoming as traditional extension clientele and today's extension clientele.

Traditional Farm and Ranch Clientele	Today's Farm and Ranch Clientele
Commercial Agriculture	Small Acreage
Full-time Farming	Off-Farm Employment
Workshop Education	Print/Technology Education
Livestock and Crop Production	Health and Adaptation
Increasing Production	Balancing Work and Family
Marketing and Legal Risk	Financial and Production Risk
Employee Supervision	Farming as a Couple

From this study comes a better understanding of western producers' educational needs and the threats facing their operations. Researchers are cautiously optimistic that the end result may be twofold: a more efficient use of already scarce Extension resources and an enhanced adoption of risk management strategies by agricultural producers across the three states. University and Extension administrators across the West may want to revisit the relationship Extension has with its clientele. Survey responses to questions pertaining to the value of extension as a source of information have far reaching implications for Extension's ability to fulfill its mission and for the long-term sustainability of small farms and ranches. Though it is difficult to predict how Extension will respond to meet the educational and informational needs of today's small farm and ranch operators, the potential for engagement is great.

References

Arizona Cooperative Extension. *About Us.* Available online: http://cals.arizona.edu/extension/about/index.html. Accessed March 3, 2008.

Colorado State University Extension. *About Us.* Available online: http://www.ext.colostate.edu/coop/mission.html. Accessed March 3, 2008.

Cooperative State Research, Education, and Extension Service (CSREES). *About Us*. Available online: http://www.csrees.usda.gov/qlinks/extension.html. Accessed January 28, 2007.

National Agricultural Statistics Service (NASS), United States Department of Agriculture. *2002 U.S. Census of Agriculture*. Accessed Oct. 19-20, 2005 and May 5, 2006. Available online: http://www.nass.usda.gov/Census_of_Agriculture/index.asp.

Tranel, Jeffrey E., J.P. Hewlett, R.R. Weigel, T. Rahman, T. Teegerstrom, and C. Ehmke. *A New Look at the Agricultural Community as Extension Clientele in the West*. Report to the Western Center for Risk Management Education. April 2007. Available online: http://RuralFamilyVentures.org.

A Plan for Excellence - The Strategic Plan. University of Wyoming Cooperative Extension Service, February 2002.

What Future for the U.S. Reserve Programs?

Michael R. Dicks[1]

Background

There are three primary farmland reserve programs in the United States—the Conservation Reserve Program, the Wetlands Reserve Program, and the Grassland Reserve Program. These three long term land retirement programs combined contain more than 37 million acres, roughly 10% of the total U.S. cropland area.

U.S. long-term farmland diversion programs began in the 1930s to manage agriculture's persistent excess capacity by reducing production to meet demand through the withdrawal of cropland from cultivation. The diversion programs were later expanded to include conservation by compensating producers to move from soil-depleting to soil-building crops. The increasing demand for food during WW II led to the return of most of the previously diverted acres. As agricultural production regained its foothold in the war zones food demand in the United States declined and excess capacity in agriculture became again problematic. A decade after the end of World War II, the Soil Bank was put in place and contained both a 10 year conservation reserve and annual acreage reduction to manage excess capacity as potential production rather than stocks.

Early into the 1970s cropland was being returned to production to fulfill expanding export demand. However, within a decade excess capacity again became a concern. As in the 1956 farm legislation that established the Soil Bank, the Food Security Act of 1985 (FS Act) reauthorized the annual land retirement programs and established the longer term Conservation Reserve Program (CRP).

Today, expansion in production of biofuels, the absence of government managed stocks, and widespread adverse weather conditions, has led to a sharp decline in excess capacity. The reduced excess capacity has led to record high grain prices and both economic incentives and political pressure to return the reserve acres to production. The fate of this acreage in the future will be debated with increasing intensity the longer food commodity prices remain at the current levels.

The Conservation Reserve Program

The Conservation Reserve Program (CRP) is a voluntary long-term cropland diversion program. CRP relies on incentives to induce owners, operators, and tenants to convert highly erodible or otherwise environmentally sensitive cropland with appropriate cropping history into a conserving use.

The CRP's primary objective was to reduce soil erosion. Secondary objectives were to protect the long-term capacity to produce food and fiber (cropland reserve), reduce sedimentation,

[1] Dicks is Professor of Agricultural Economics at Oklahoma State University: michael.dicks@okstate.edu.

improve water quality, create fish and wildlife habitat, curb surplus production of commodities, and provide income support.

When the CRP was first implemented in 1986, land owners, operators, and tenants who wished to enroll in the program submitted bids for eligible lands with appropriate cropping history to county Farm Service Agency (FSA) offices. Bids less than the maximum acceptable rental rates were accepted. CRP contract holders were paid an annual rental payment over 10 to 15 year contracts in exchange for establishing and maintaining cropland in some conserving use including introduced or native grass and forest covers. Most successful bidders realized returns to land and management from CRP payments that were equal or more than returns would have been under continued crop production. National CRP enrollment by 1990 was 33.9 million acres. The Food, Agriculture, Conservation and Trade Act of 1990 (FACT Act) extended CRP enrollment authority through 1995. Eligible lands were expanded to include cropland devoted to filter strips and other easement practices in state water quality areas, wellhead protection areas, and areas subject to scour erosion. The CRP bid process expanded to two phases. First, the CRP bid had to be less than the county-average cropland rental rate adjusted for the inherent soil productivity of the three most predominate soil types relative to the county average productivity. Second, bids were evaluated to determine their benefits through an Environmental Benefits Index (EBI). The EBI embodied goals for surface and ground water quality and improvement and preservation of soil productivity. The details for both the rental rate maximum and the EBI criteria were not revealed to the public. As a result, for the three sign-ups in 1991 and 1992, many offers from potential program participants from the Great Plains and western states required too-high rental rates and FSA ended up ignoring the EBI criteria, accepting any offer that met the rental rate criteria. National-level enrollment in 1995 was 35 million acres.

The Federal Agriculture Improvement and Reform Act of 1996 (FAIR Act) and the Farm Security and Rural Investment Act of 2002 (FSRI Act) extended CRP enrollment authority to 2002 and 2007, respectively. One change was to allow specific environmentally sensitive lands (e.g., riparian areas) to enroll at any time (continuous) rather than only during specific enrollment periods (periodic). Eligible lands for periodic CRP sign-ups are similar to those under the FACT Act. The two-phase bid procedure was modified. First, the rental rate and EBI criteria were made public. Second, several elements of the EBI were modified to emphasize wildlife benefits. National-level CRP enrollment in 2002 was 34.0 million acres. This enrollment included acres from periodic sign-ups and included acres from continuous sign-ups for cropland determined suitable for practices such as filter strips, shelter belts, and salt tolerant vegetation, Additionally, the enrollment includes acres added under the Conservation Reserve Enhancement Program (CREP), a program to coordinate federal and non-federal funds to improve water quality, erosion control, and wildlife habitat related to agricultural uses of resources in specific geographic areas. National-level enrollment as of February 2008 in CRP is about 34.67 million acres with 30.68 million acres from the periodic sign-ups, 2.73 million acres from continuous sign-ups, 1.08 million acres in CREP and 0.18 million acres in farmable wetlands. Approximately 58% of CRP acreage is located in the 10 Great Plains states, but only 22% of the continuous enrollment and 9% of the CREP enrollment is located in these states.

Historically CRP lands were made available for grazing and haying only under emergency conditions with contract holders assessed a partial reduction in annual payments for such uses. The FSRI Act provided for periodic managed grazing and harvesting of CRP in return for partial reductions in the annual CRP payments. Studies are underway to consider the number of years for a haying or grazing rotation and the economic benefits of managing for game and non-game wildlife.

Recently passed farm legislation extends the CRP for an additional 10 years but reduces the enrollment cap to 32 million acres. However, between 2009 and 2014 the contracts on more than 62% of acres will expire, including 71% of the plains states CRP acreage.

The Wetlands Reserve Program

The Wetland Reserve Program (WRP) was established by the FACT Act. WRP focuses on the restoration of high-risk agricultural land located in or adjacent to flood-prone areas. Protection, restoration, and enhancement of the functions and values of wetland ecosystems to obtain habitat for migratory birds and wetland-dependent wildlife, protection and improvement of water quality, attenuation of water flows due to flooding, recharge of ground water, protection and enhancement of open space and aesthetic quality, protection of native flora and fauna contributing to the Nation's natural heritage, and contribution to education and scholarship are the objectives of the WRP. Landowners may participate in WRP through compensated permanent and 30-year easements and 10-year restoration cost-share agreements.

Enrollment began in 1992 with WRP pilot programs in a few states. WRP expanded in geographic coverage and acres and reached its initial 1 million acre authorization in 2001. The FSRI Act re-authorized WRP and expanded the acreage cap to 2.275 million acres. WRP management strategy changed from a "walk away" strategy of the FACT Act to the current "full restoration" strategy wherein at least 70% of the land area is restored to the original natural condition to the extent practicable. By September 2004 there were 1.6 million acres enrolled in WRP, primarily through permanent easements.

The Grassland Reserve Program

The Grassland Reserve Program (GRP) was authorized in the FSRI Act and first implemented in 2003. The GRP is a voluntary program that assists landowners and operators restore and protect grassland. The objectives of GRP are as follows: preservation of native and natural grasslands and shrublands; support grazing operations; and maintain and improve plant and animal diversity. Emphasis has been placed on the first objective. Only in special cases is GRP used to curb urban encroachment on grasslands, given extreme program costs and availability of other USDA programs to curb urban encroachment.

GRP is implemented through easements and long term contracts. Grazing, haying and harvesting for seed are permitted when such activities are done in a manner to preserve resource viability. Landowners and operators are also allowed to use fire rehabilitation and make resource improvements including watering facilities consistent with maintaining the grassland. Agricultural commodity production that requires disturbance of the soil surface is prohibited.

The FSRI Act provided a 2 million acre cap for GRP and authorized a spending limit of $254 million for the period 2003 through 2007. Currently, 608.2 thousand acres have been enrolled.

Issues

The end of the second decade of the CRP has instigated a debate similar to what occurred at the end of the first decade of the program. The debate centers on what to do with expiring contracts. Embedded in this debate are questions over the continued need for supply control, the need for reserve type programs for resource management, the impact of reserve programs on rural economies and the geographical distribution of acres and benefits.

Excess capacity in U.S. agriculture has persisted at roughly 10-15% since the 1920s with the exception of brief periods such as 1940 to1947 and 1973 to1976. The annual set-aside programs were used from 1950 through 1995 to manage excess capacity, increasing the percent of acreage required to be idled in response to rising levels of stocks and declining prices. From 1988 through 1995 the reserve programs began to substitute for annual set-aside programs and following the FAIR Act of 1996 became the only remaining land retirement program, continuing to hold about 10% of the agricultural cropland productive capacity idle. Failure to renew these programs at current levels may impact crop prices and government commodity program payments and curb improvements in environmental amenities. Non-renewal would save CRP expenditures and may lead to reduced commodity prices, increased economic activity and increased exports.

The programs and policies to manage excess capacity may be limited by international trade considerations. Negotiations at the World Trade Organization to limit subsidies that distort trade will also restrict the United States' ability to use subsidies to induce supply management as in the past. Reserve programs are not considered to be trade distorting and thus offer an avenue for indirect supply management and income transfer. These "green box" payments however, may come under increasing scrutiny in the current WTO Doha round of trade negotiations.

The dual goals of supply and resource management that gave birth to the acreage goals and targeting efforts for the current reserve programs continue today. There are still 20-25 million acres of fragile croplands that cannot be continuously farmed, even under the best management practices available without an annual net soil loss and associated environmental damages. There are still millions of acres of riparian areas, wildlife habitats, and wetlands that would benefit from removal from annual cropping practices. The use of an Environmental Benefits Index to enroll the most fragile of lands with limited funds nationwide has led to a pattern of enrollment that is concentrated in the Great Plains, Corn Belt and Palouse.

In some instances the concentration of enrollment in specific regions of the country has been tied to an exacerbation of the economic crises in rural America. The effect of the CRP on rural communities has been its most controversial aspect. A recent study by USDA's Economic Research Service concluded that there is no strong evidence that the CRP has been a leading factor in the decline in vitality of rural communities, although there are cases where it may contribute to economic stress. Previous studies demonstrated various levels of economic consequences on rural communities from the CRP. The extent of the economic consequences depends on concentration of CRP acres enrolled, the structure of agriculture before and after CRP enrollment, the established cover, and the economic activities associated with that cover (e.g., hunting, tourism, forestry) and the level of rural economic stress in the community prior to CRP enrollment.

While the CRP contains a provision that no more than 25% of a county's cropland may be enrolled in the CRP, there is no provision as to the dispersion of those acres throughout a county or the impact of the enrollment on rural communities. Indeed, in many Great Plains counties enrollment is heavily concentrated in specific parts of a county and has had severe impacts on small rural economies within those areas much the same as if a major employer such as a military instillation or manufacturing plant were closed. However, ameliorating the negative impact resulting from reduced cropping activities, the abundance of wildlife attributed to the CRP has led to the enhancement of outdoor recreational opportunities, especially hunting, which has brought income and jobs into many rural communities. And, in the South moving from crop production to timber production has often provided a net increase in economic activity over the long run. In addition, the CRP has yielded improvements in the rural environment such as reduced particulate matter in the air (Sullivan et al. 2004).

There is also no link between the percent of cropland in a county that may be enrolled in combination with the other reserve programs. In western portions of the Great Plains states GRP participation may be viewed as an option when CRP enrollment has been maximized. With the reserve programs implemented independent of one another the potential exists for the three reserve programs to enroll cropland in a county beyond the 25% limit imposed by the CRP.

The concentration of the nearly $2 billion of annual payments for the reserve programs in specific areas of the country has not gone unnoticed by representatives and senators of the more populated coastal areas. Until the expansion of the Environmental Quality Incentives Program (EQIP) began in 2002, expenditures on the reserve programs comprised nearly 90% of conservation dollars spent through USDA programs. The FSRI Act of 2002 included funding allocations for GRP and other conservation programs (e.g., Wildlife Habitat Incentives Program, Farm and Ranchland Protection Program, and EQIP) to address these distributional inequities. The 2002 Act required that states receive a minimum of $12 million in conservation funding from the four conservation programs. The mandated spending pattern benefited several smaller and more densely populated northeastern states, and some coastal states such as South Carolina, Alaska, and Hawaii. Collectively, these four programs with mandated spending levels provided over $1.1 billion in conservation funding in fiscal years 2004 and 2005. Even as EQIP reaches full funding levels in 2006, the reserve programs will still constitute nearly 60% of the total conservation expenditures. The geographic distribution of the conservation expenditures will be a point for discussion in the next farm bill debate, and likely involve a retooling of the bid selection criteria.

Policy Alternatives and Consequences

Re-authorize Reserve Programs under Current Rules–the Status Quo

For two decades the CRP has been an important program for conservation and supply management. During this period the CRP has been under constant change. As new information and methods of analysis combine with program experience the program has been modified to increase social benefits and reduce costs.

The WRP and GRP are small programs in comparison to the CRP[2], but the WRP has played a major role in restoring wetland habitat and the GRP, a new program, has the potential to have similar impacts on grassland habitat. A continuation of the three reserve programs under

[2] http://www.ers.usda.gov/publications/arei/ah722/arei6_2/DBGen.htm.

current rules will likely continue to improve these programs' ability to obtain greater conservation and wildlife benefits and implementation efficiency, maintain excess capacity as idled acreage rather than commodity stocks, provide an important program for income transfer that is compliant with WTO rules and provide a constant source of income for many rural communities that are dependent on agriculture. However, the reserve programs will likely continue to target roughly $2 billion to the areas with highest yield variability (and the lowest average yields) and contracts on 22 million of these CRP acres will expire in the first two years of a reauthorized program.

In addition, tenants and other non-owner operators in high enrollment areas will continue to face cropland rental markets where rental rates have increased due to reductions in available cropland and the existing CRP rules for rental rate determination that allows for the disparity in rental rates between most and least productive soils to be three fold.

In the face of higher food and feed prices and the current situation where land economically substitutes for fertilizer in forage production, increasing pressure on the status quo CRP has led to the opening of the acreage to haying and grazing (without adjustment to rental rates) by the Secretary and a change in the new farm legislation to return cropland base on CRP acres upon contract expiration. When CRP was extended under the FAIR Act in 1996 new contracts explicitly removed base from expiring acreage. This would provide a disincentive to return the acreage to crop production upon future contract expiration.

Discontinue Current Programs

The new farm legislation, Food, Conservation, and Energy Act of 2008 (FCEA), has continued the program with a lower ceiling of 32 million acres. However, the returning of base acreage on expiring contracts coupled with the new revenue assurance (ACRE) and permanent disaster (SURE) programs may lead to a reduction in CRP acreage through contract attrition. From a budgetary standpoint a reduction in funds expended for the selection or servicing of new contracts and easements or for cost-share assistance in cover establishment or restoration would occur, but there would be a continuous reduction in budgetary exposure for contracts and easements in place. Annual contract payments will be made and costs incurred for the monitoring of easements for adherence to terms.

During the current farm legislation cycle (2008-2012), landowners/operators on roughly 22 million acres will have to decide whether to return these lands to annual crop production or retain the land in a conserving use for grazing, haying, or wildlife habitat, etc. Prior to the 2007/2008 farm bill debate, surveys indicate that for CRP contract holders who are/were primarily crop producers, a high percentage of the acres would return to annually planted cropland. For those who were primarily livestock producers or those with integrated operations, a substantial portion of the CRP acreage would be used for grazing or haying. Planting grass crops for cellulosic ethanol cannot be considered an option until processing plants are constructed within close proximity. Crops produced on land returned to cropland will be eligible for commodity program benefits, especially marketing assistance loans. Production from these lands would likely increase crop supplies, reduce prices and increase future commodity program payments. In some areas the average annual rental payment exceeds the long run average annual income support from the direct and counter-cyclical payments while in other areas the reverse is true. How the rental rate compares to future revenue from cropping activities will like change as a result of the new commodity programs.

In the Plains States the patchwork of CRP acres has reduced wind erosion and dust storms are now very rare. Water quality and wildlife gains have also been made. Reduction of CRP acres would certainly reduce these environmental gains.

For the WRP most of the environmental benefits would continue as most of the enrolled acres are under permanent easements. While existing renovation contracts would be fulfilled no new acres would be enrolled. For the GRP the consequences vary with the type of contract. Most of the acres are contracted under permanent and long term easements and thus benefits of the program would be retained.

Re-authorize Reserve Programs with Changes

While the FCEA provides an extension of two distinctly different set of conservation programs, dividing nearly $4 billion per year between programs that remove land from production and programs that obtain environmental benefits through the management of lands remaining in annual crop production. The funding levels and eligibility requirements for the reserve and conservation programs are set at the national level by Congress. However, Farm Service Agency (FSA) selects acreage based upon the Environmental Benefits Index and rental rates and both can be changed within the jurisdiction of the FSA. With the new cap at 32 million acres and roughly 22 million acres able to return to crop production there is considerable room for a spatial reallocation of CRP acres. The program could enable more targeted state and local conservation priorities rather than federal priorities. Local communities might more efficiently allocate financial resources to deal with specific local conservation issues that would provide the greatest social benefits. For instance, in the western areas of the Great Plains, grasslands are highly fragmented, adversely impacting critical species habitat, crop and livestock production costs, and land rental rates, and in some cases may adversely impact the economic viability of the local economies. As a 10 year program the CRP may assist in transitioning landowners to grassland production but may not provide sufficient duration or flexibility to restore the grassland or enable development of a sustainable grassland habitat as does the GRP. Relative to the CRP, the easement option available in GRP is limited both in area and spending levels. A reorganized set of reserve programs may reallocate funds from CRP to GRP or add GRP conservation practices to CRP. This would allow for the expansion of contiguous grassland areas to aid native wildlife populations, expand buffers in riparian areas and increase economic activity.

Avenues for Change

Cost effectiveness, in an era of limited budgets, and local flexibility are two concerns facing the reserve programs. Program changes that minimize adverse impacts on rural communities, obtain greater environmental benefits per dollar cost, or assist in allocating acres more uniformly throughout the country may be considered.

On the cost side, for reserve program participants who are landlords, the opportunity cost for program participation is the cropland rental rate. CRP rental rates based on soil rental rates above prevailing cropland rental rates result in excess taxpayer costs and no increases in environmental benefits. Commodity program payments above rental rates also may result in excess taxpayer costs.

If USDA and Congress are willing to consider more comprehensive changes in program implementation, program costs could be reduced through bidding mechanisms that encourage lower bids from any landowners whose reservation price (for offering land into the CRP) is less then the soil rental rate. For example, landowners could submit several rental rate bids in a competitive bidding process (e.g., open auction). This occurred in the first five sign-ups as eligible participants with rejected bids re-bid at lower rates in the following sign-ups. Additionally, using cost-benefit ratios on offered land, rather then including cost as a separate factor, could increase the per-dollar environmental impacts. Whether the positive impacts of these kinds of cost-conscious changes are worth the extra burden on both farmers and program administrators, is an open question.

For national programs, local flexibility is a complex issue. On one hand, national programs are a means of meeting national goals. These may entail modest improvements to concerns that have broad appeal to the entire citizenry. On the other hand, national programs could assist localities in addressing their concerns. Though such concerns may matter just to the population of the region, addressing such concerns could lead to more significant resource and environmental improvements.

To date, the reserve programs, especially the CRP, have incorporated a limited amount of information on local concerns. Granting states and communities the flexibility to address wetlands, grasslands, water quality, air quality, or other environmental goals based on local priorities might lead to more efficient use of available resources. That is, local targeting of federal funds across all resource concerns may provide greater benefits than a national allocation by program.

CRP goals to limit soil erosion and improve water quality may not be met in the predominant wind erosion regions. Soils with lower CRP rental rates are often left in crop production because returns to land from crop production exceed the CRP rental rates.

An extension of this flexibility would be merging the several programs into a single reserve program. A single reserve program could provide the flexibility to use limited fiscal resources for short term amelioration of environmental problems or permanent easements to protect unique environmental features in a landscape (e.g., wetlands, wildlife habitat, riparian areas, old growth forests). A single reserve program could provide the cost-share assistance needed to re-establish non-industrial private forests (replacing the Forest Incentives Program) or replace some of the commodity program income transfer and assist farmers in moving from the production of annually-planted crops to conserving uses such as grasslands and forest.

For example, a single reserve program could offer three different enrollment options: 1) permanent easements on the most fragile of land resources; 2) 10-15 year contracts on cropland managed with limited/prescribed use; and 3) 10-15 year contracts on cropland with unlimited use excluding the production of annually planted crops.

Some of the cropland now in the CRP has been enrolled for nearly 20 years and may elect to re-enroll. This landowner/operator has certainly indicated the desire to maintain the land in permanent cover. A permanent easement coupled with prescribed management would allow an economic use of the land with environmental benefits. Wetlands and grassland restoration as well as riparian area and habitat protection would fit well under this option. The grassland patchwork in the Great Plains resulting from the CRP and the more recent GRP has minimized wind erosion and the associated dust storms common to the region. The idling of cropland for 10-15 years provides soil productivity restoration and wildlife nesting areas. On many farms, the acres in enrolled in the CRP changed at the end of the first contract so that the “rested” acres were returned to production while the “tired” acres were enrolled in the CRP. The second option (which is the current CRP program) would allow for a continuation of this effort. In light of record high fertilizer price, this resting rotation could also be used to use legumes to load the rested soils with nutrients. After the implementation of the FAIR Act income supports became decoupled from production and large areas of cropland were converted to forage covers. The third management option for the single reserve program would enable farmers to continue this practice under the reserve and thus transfer payments from blue box to green box for WTO negotiations.

In each of these management options a lease-back provision could be included in the easement or the contract providing conditions that may enable a producer to return the land to crop production or intensive haying or grazing during the contract/easement period. The lease back provision has become more interesting in light of tighter crop supplies and higher prices.

While a single reserve program, by increasing flexibility and enhancing coordination, offers the chance at greater efficiency, it does introduce an element of risk. In particular, use of several programs guarantees that the goals of each program are met on some minimal level. In a single program, it is more likely that in some localities, certain goals (say, wetland preservation) will receive no attention. To the extent that attaining these goals have a broad national appeal, creating a single program with strong local input might actually diminish the delivery of improvements that the bulk of the U.S. population cares about.

Conclusions

The CRP has been the cornerstone of USDA’s conservation efforts for nearly two decades. During this time the program has gone through numerous legislative and rule changes. Both the WRP and GRP have added to the conservation effort through targeting of more specific problems.

At the beginning, the CRP’s main goal was erosion reduction but now includes other environmental goals. The ability to obtain various environmental amenities through targeting has increased at a steady rate as new science and data have become available. USDA continues to develop better data and methods and in the near future will be able to better target problems related to land use of specific fields within the landscape and determine the land use change necessary to improve the overall landscape. Flexibility in the implementation of the programs will be increasingly important to capture the efficiencies.

Payments for reserve program participation are considered green box under the WTO guidelines and thus are not subject to challenge by other countries. The reserve programs provide environmental benefits to the general society and income support to participants. But, the reserve programs remove land from economic use and may adversely impact some agribusinesses and rural communities. The reserve programs induce land use changes that are not market driven and have varying impacts on land prices. Program benefits have generally been received mostly in mid-America and thus lack support from the two coasts.

A single reserve program with local flexibility in contract length, payment rates, easements, and land use and environmental objectives has strong potential. A single reserve program could reduce implementation costs, encourage a more even distribution of program expenditures, and increase the ability of communities to target specific environmental concerns. However, poor or narrowly defined implementation could reduce several net benefits to the entire nation.

References

Broomhall, D.E. and Thomas Johnson (1990). The Impact of the Conservation Reserve Program on a Region in Rural East Georgia. *Review of Regional Studies* 20(2) Spring: 66-75.

Hyberg, B.T., M.R. Dicks and T. Hebert (1991). Economic Impacts of the Conservation Reserve Program on Rural Economies. *Review of Regional Studies* 21(2) Spring: 91-105.

Johnson, James B., C, Robert Taylor, Richard T. Clark, Stephen H. Amosson, and H. Arlen Smith (1994). The Conservation Reserve Policy. In: *1995 Farm Bill Policy Options and Consequences.* Texas Agricultural Extension Service.

Johnson, James B., and Richard T. Clark (2001). Conservation Reserve Program. In: *Farm Bill: Options and Consequences*. Farm Foundation and Agricultural and Food Policy Center, Texas A&M University.

Johnson, James B. (1996). The Soil Rental Rate Approach to Setting CRP Payment Limits. Unpublished paper submitted to the Farm Service Agency.

Martin, M., H. Radtke, B. Eleveld, and S.D. Nofziger (1988). The Impacts of the Conservation Reserve Program on Rural Communities: The Case of Three Oregon Counties. *Western Journal of Agricultural Economics* 13(2): 225-32.

Mortensen, Timothy L., F. Larry Leistritz, Jay A. Leitch, Randal C. Coon, and Brenda L. Ekstrom (1990). Socioeconomic Impact of the Conservation Reserve Program in North Dakota. *Society and Natural Resources* Vol 3: 53-61.

Seigel, Paul B. and Thomas Johnson (1991). Conservation Reserve Program May Be Good for the Environment, Farms and Rural Communities. *Rural Development Perspectives* 8(3) Spring: 25-31

Sullivan, Patrick, Daniel Hellerstein, Leroy Hansen, Robert Johansson, Steven Koenig, Ruben Lubowski, William McBride, David McGranahan, Michael Roberts, Stephen Vogel, and Shawn Bucholtz (2004). *The Conservation Reserve Program: Economic Implications for Rural America*. USDA/ERS Agricultural Economic Report No. 834 (AER834) 112 pp.

What Marketing Measures Can Organic Apple and Pear Growers Take to Increase Their Receipts?

H. Holly Wang and Yuanlong Ge[1]

Introduction

A significant interest in organic tree fruit production has developed over the last 10 to 15 years. Total U.S. sales of organic food were about $13.8 billion for 2005, and is growing by nearly 20% annually (OTA 2006). Fresh fruits and vegetables are the largest category of organic food sales domestically (Dimitri and Greene 2002). Apples and pears are the dominant fruits grown in the Northwest.

The driving force for growers to convert from conventional production into organic production is the price premium the market provides for organic products. Unfortunately, it has been observed that the price premium is becoming smaller, which brings about the question of whether or not organic production can be profitable. Due to reduced price premiums, certified organic apple and pear acreages in Washington State dropped since their peaks in 2002 with only a slight increase in 2006 (Granatstein and Kirby 2006).

Several general discussions on organic fruit marketing have recently emerged. Some of the studies find the organic system for fruit is more profitable (Dimitri and Greene 2002; Greene and Kremen 2002), but this higher return is achieved only by a premium quality in the right market with the right marketing strategies (Parsons 2005; Estes and Smith 1996; Thompson and Kidwell 1998). The existing studies also claim that successful organic growers will choose suitable market channels from among farmers' markets, local grocery stores, restaurants and wholesale markets as well as brokers and processors (Dimitri and Greene 2002; Gaskell et al. 2000; Hansen et al. 2004). Processors of higher value products such as baby food may be able to offer better prices to producers for processing organic fruits. Consequently, a key question rises whether selling low grade organic fruits to processors instead of selling them to the fresh market will boost the price of higher grade fruits and bring higher profits to growers.

Despite the existing studies on organic fruit marketing, analysis of the marketing factors' impacts on market price is rarely found. The goal of this paper is to empirically analyze marketing factors affecting organic apple and pear prices in the Northwest. Specific objectives of this paper include: 1) investigating the general price response to some key physical attributes and marketing factors of fruits; 2) studying the seasonal effect on price; and 3) analyzing the profit effect from a reduction in lower grade supplies. This empirical analysis based on Washington organic apples and pears will provide some general understanding of organic fruit marketing for the industry.

[1] Wang is Associate Professor, Department of Agricultural Economics, Purdue University and Adjunct Associate Professor, School of Economic Sciences, Washington State University. Yuanlong Ge is a Graduate Research Assistant, Department of Agricultural Economics, Purdue University. Wang is corresponding author: wanghong@purdue.edu. The authors thank Larry Makus, Garth Taylor, and Joseph Sherburn for their contribution to the project and the financial support of WSU CSANR.

Model and Data

We estimate an inverse demand function to reveal price response to quantities and other factors for organic apples and pears. Hedonic price functions are incorporated in this case to measure a wide variety of commodity characteristics such as size and grade, based on Lancaster's (1966) theory that consumers take commodity characteristics as the fundamental sources of utility.

The regression model uses the price of each grade in each variety of apples and pears as the dependent variable, so that we have a separate regression equation for each grade and each variety of apples and pears. The explanatory variables used in each equation include all quantities sold for the variety, one for each grade, dummy variables for 2004/2005 and 2005/2006 crop years, medium (original size 88 to 125) and large (size 80 and larger) size dummies, Euro pack (using a 2 layer or 3 layer tray pack with a 27 or 40 pounds net weight) and bag pack dummies, and a regular (RG) cold storage dummy. We leave the 2003/2004 crop year, small size (135 and under), regular tray pack, and fruits from controlled atmosphere (CA) storage as the defaults.

Fruit prices are highly seasonal. Thus, we include additional five seasonal dummy variables to allow flexibility. They are bimonthly dummies for September/October, through May/June, leaving July/August as the default. Each of the bimonthly dummies is also included in combination with the regular cold storage dummy, so that the seasonality effect is allowed to be different for fruits from RG versus from CA storage.

Weekly shipment data from November 10, 2003 to August 28, 2006 for apples and from August 23, 2004 to August 28, 2006 for pears were provided by the Wenatchee Valley Traffic Association (WVTA). WVTA keeps a record of most transactions for apples and pears grown in Washington, a primary apple/pear production state in the United States. We analyze the five biggest apple varieties and three top pear varieties. Over the three year period, the largest apple variety is Gala, accounting for 29.80% of the total quantity, followed by Red Delicious, Fuji, Golden Delicious, and Granny Smith. The dominating pear variety is D'Anjou, accounting for 74.34%, followed by Bartlett, and Bosc. There are 31,130 entries for apples, and 4,453 for pears, by week and by grades/size/pack/storage categories.

Grades appear in the data range from the lowest US#1, US Fancy, US Extra Fancy (USXF), Washington Fancy (WAF), up to Washington Extra Fancy #1 (WAXF1), #2 (WAXF2), and Premium (WAXFP). Any apple grades lower than WAF are considered as low grades. We do not consider any pear to be low grade because only two grades are marketed, WAF and US#1 with the latter being the more popular grade.

All quantity units are converted into a standard 42 pound box for apples and 44 pound box for pears, although they are reported differently for different pack types. The prices range from \$5.04/box to \$77.78/box with a weighted average of \$23.10/box for apples and from \$7.04/box to \$62.04/box with a weighted average of \$23.93/box for pears. The low grade apples are currently marketed as fresh. For the five varieties over the three years, about 2.30% of apples are in grade US Extra Fancy or lower. Fuji has the highest percentage, 4.47%, in low grades, followed by Granny Smith (3.80%). The other three varieties have less than 3% each in the lower category. Because the prices of these grades are lower, the sales revenues they bring to the industry only account for 1.56% of the total. They range from 3.12% for Fuji down to 0.58% for Red Delicious (Table 1).

Table 1. Quantities and sales for organic apples (2003-2006) and pears (2004-2006).

		Percent Weight				Percent by Sale	
	Quantity	**Over all varieties**	**Low Grade***	**Small Size**	**Sales**	**Low Grade***	**Small Size**
	(million lbs)	(%)	(%)	(%)	(million $)	(%)	(%)
Apple							
Fuji	27.49	19.65	4.47	14.57	16.56	3.12	10.55
Gala	41.69	29.80	1.20	34.29	23.55	0.95	27.65
Golden Delicious	24.73	17.68	2.55	22.04	13.58	1.68	17.30
Granny Smith	17.77	12.70	3.80	30.92	9.81	2.51	24.18
Red Delicious	28.21	20.17	0.89	34.42	13.31	0.58	31.54
Apple Total	139.89	100.00	2.30	27.88	76.81	1.56	20.86
Pear							
D'Anjou	22.34	74.34	83.26	15.26	11.98	85.55	10.62
Bartlett	5.39	17.94	83.94	6.94	2.99	88.97	4.42
Bosc	2.32	7.72	94.04	6.19	1.28	95.35	3.38
Pear Total	30.05	100.00	84.21	13.07	16.25	86.99	8.91

*"Low grade" for pears refers to US#1 in the table, which is not a low grade actually.

Results

Detailed numerical regression results are not reported in this paper but are available from the authors upon request. General regression results are discussed below.

Price Effect of the Key Physical Attribute and Market Factors

In general, grade has the most price effect in that higher prices are clearly observed for higher grades. Size also has some significant effect but is secondary to grade, since it is only significant for higher grade Fuji, Gala, and Red Delicious apples, but not for lower grade Golden Delicious and Granny Smith apples, or WAF grade pears. For example, medium sized apples have $0.08 to $0.19 price premiums over the small sized ones while large sized have $0.02 to $0.05 price premiums for Fuji, Gala, and Red Delicious. Medium sized WAXF1 Fuji apples achieve the largest price premium compared to small sized ones. For those pears that do have size effects, they have a larger price premium from size than that of apples. The large sized pears have a 6 cents price premium over medium sized ones. The large sized Bartlett US#1 pears maximize the price premium at $0.30 over small sized ones.

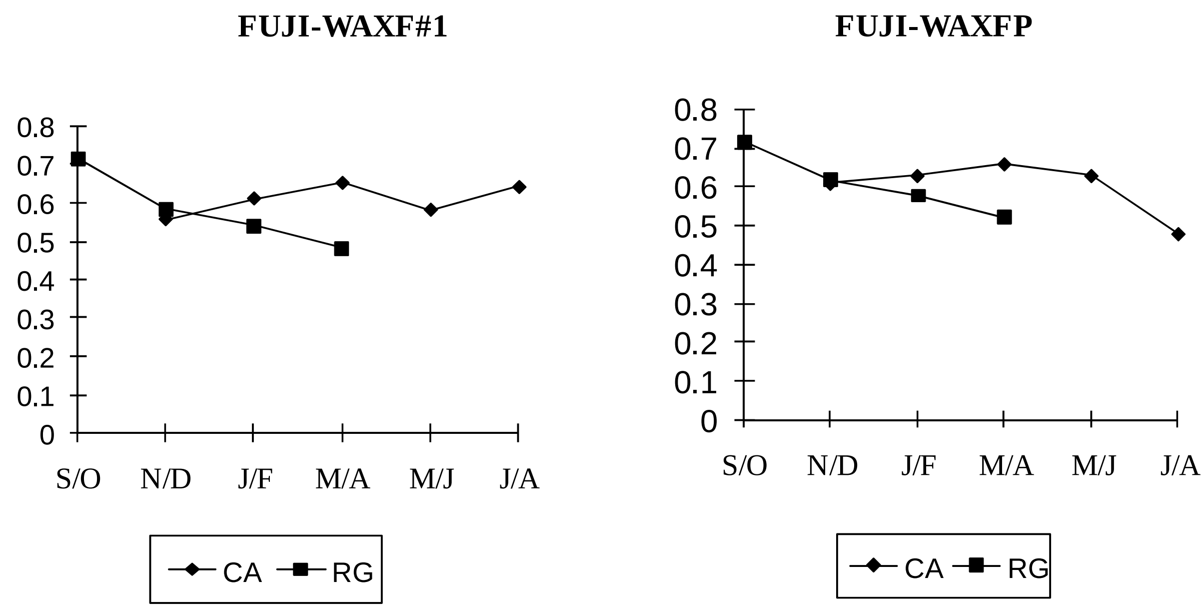
Pack type is also an important factor contributing to the price differentiation. For high grade apples, the Euro packs have a price premium of $0.04 to $0.37 over the regular tray packs, while the two package types have similar prices for low grade apples. On the contrary, most bagged apples have $0.06 to $0.22 lower prices than the corresponding regular tray packed ones.

One recommendation arising from these results is that apple packers, representing growers in most cases, should try to replace their bagged supply by tray packs and promote more use of Euro packs. However, this recommendation does not hold for pears as the Euro pack pears are not necessarily more expensive than regular tray pack counterparts. The WAF D'Anjou price is $0.16 higher for the Euro pack, but US#1 Bosc price is actually $0.08 lower. On the other hand, the bagged price is higher than the tray packed one across all grades except for the WAFs of Bartlett and Bosc. Apparently, pear packers don't need to be as concerned about packages and can go with packing methods.

Seasonal Effects

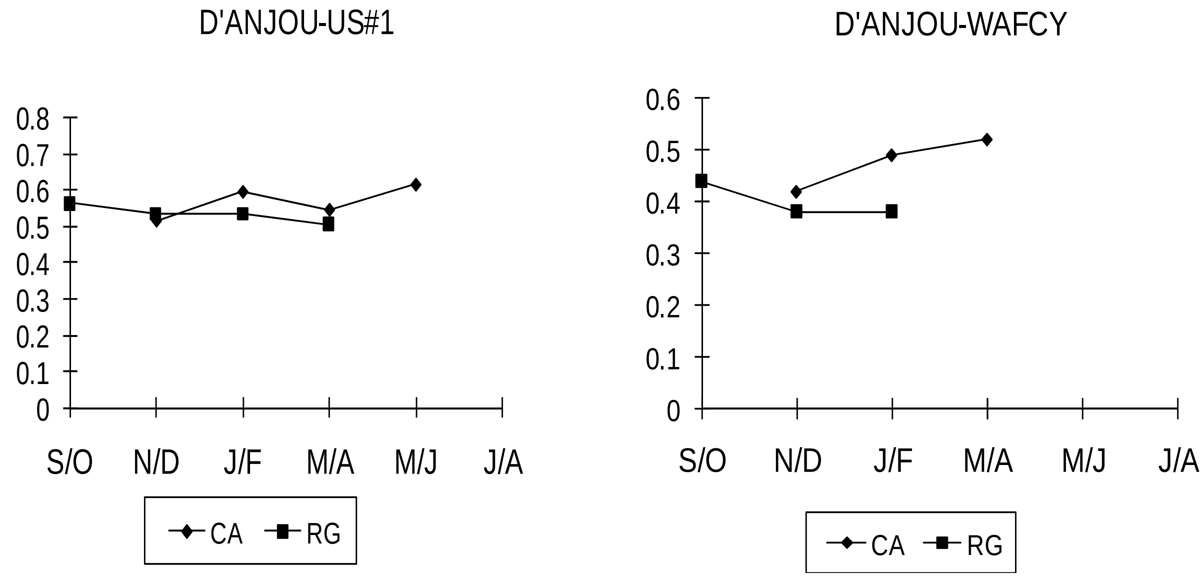
The timing of marketing is very important for organic fruits as their prices are highly seasonal. In general, RG fruits leave the market for several months between May and August. Gala apples and Bartlett pears show an early entry in late August. CA stored fruits normally enter the market no earlier than November. We also observe that the prices of RG fruits tend to decrease later in the season after harvest. To make it easier to understand, we present the seasonal patterns of prices for the top two grades WAXFP and WAXF1 for Fuji apples and WAF and US#1 for D'Anjou pears in Figures 1 and 2.

Figure 1. Fitted prices with seasonal effects for Fuji apples of two top grades.



For each figure, the price curve for RG has a negative slope, implying that the quality of the fruit decreases over time when it is not kept in CA storage. The increasing coefficients for seasonal dummy variables alone indicate the prices for CA storage fruit actually increase slightly caused by the reduction in inventory after early fall. For example, the Fuji WAXFP seasonal dummy coefficients are 0.13, 0.15 and 0.18 for November/December, January/February, and March/April CA price, indicating the prices increase one cent every month after the fall season. The CA curves in the right panel of Figure 1 show this upward slope from November to April. After April, apple prices stagnate or even decrease. The pattern can be slightly different for each variety. For example, the CA prices keep going up until the next harvest for Golden Delicious WAXFP apples. Compared to apples, pears are usually more perishable. As we can see from Figure 2, they usually disappear from the market by June (including those from CA storage), and have a sharp price drop for RG storage.

Figure 2. Fitted prices with seasonal effects for D'Anjou pears.



The crop year 2004/2005 was a bad year for apples as almost all grades exhibit a price at least 4 cents lower than the year before. Prices recovered somewhat in the year 2005/2006. This price trend is also captured by pears in the year 2005/2006 with at least 7 cents price premium over the base year of 2004/2005 except for variety of Bosc which has limited transactions over the two years.

Price Effects

All prices are inelastic with respect to own quantities. One percent increase in the supply of a particular grade causes either no change or less than a one percent decrease of its own price. The most sensitive price is Fuji USXF, which is only 0.19 percent. This negative but inelastic relationship also holds for high grade of Golden Delicious and Granny Smith apples and D'Anjou and Bosc pears.

The quantity of low grade Fuji apples has a negative effect on WAXFP and WAXF1 prices, the two highest priced fruits. Again, the response is inelastic in that a one percent increase in the total supply of low grade apples only causes 0.03 percent fall in WAXFP and WAXF1 prices each. These values suggest that if low grade apples in crop year 2005/2006 are reduced by 10% (which is 440 boxes for the entire crop year), the prices of WAXFP and WAXF1 will increase by $0.0021/lb, and $0.00071/lb. This trade-off converts to a reduction in low grade apple sales of $9,122 (assuming they not sold anywhere), and a sale increase of WAXFP and WAXF1 of $12,050 and $7,650, respectively. It suggests that for Fuji apples, marketing fewer low grade apples will make the whole industry more profitable.

However, for other varieties, there is no clear evidence that lower grade quantities will affect higher grade prices. Reducing low grade crop volume does not help improve the revenue of the industry.

The overall inelastic own and cross price effects also indicate that the market can accept more organic fruits, because an increase in quantities will not significantly impact prices.

Summary

Both good production and feasible marketing strategies are crucial to the profitability. This study is dedicated to providing some useful marketing implications for organic fruit growers. We find that organic apple and pear prices are risky from year to year, and price variation is larger for apples, which may stimulate the application of risk management to fruit production and marketing. Grade is the primary factor that affects prices, and size is another factor. Size sensitivity is different by apple variety, but for pears sensitivity is primarily dependent on grade. Pears also have a larger size price premium than apples. We also find that unlike their apple counterparts, the Euro packs for organic pears are not necessarily sold at higher prices than traditional tray packs, and bags are not necessarily sold at lower prices. This suggests that the industry can try to pack more apples in Euro packs, and doesn't need to devote much effort to sizing apples for some varieties.

Both apple and pear prices are highly seasonal, with those from regular storage having a price decrease and those from controlled atmosphere storage having a price increase in the period up to early summer. Pears have been marketed for a shorter period than apples, although those from CA storage still enjoy a price increase by May/June for D'Anjou. More CA storages of pears are called for the industry.

The crop sizes only have a slightly negative impact on prices. The crop size of the lower grade apples has a negative impact on the price of higher grade apples for Fuji only. However, if all the lower grade apples were removed from the market, without considering the value of this fruit being sold to processors, the sales gain would be quite small. On the other hand, an increase in supply will not harm the prices greatly and can increase the total revenue of the industry.

Although each variety of different fruits has its own price pattern, the overall conclusion from this empirical analysis suggests that to achieve higher prices, growers and packers should focus more on the quality (grade), package type, and storage method.

References

Dimitri, C. and C. Greene (2002). *Recent Growth Patterns in the U.S. Organic Foods Market. AIB-777.* Economic Research Service, USDA, Washington, DC.

Estes, E. and V. K. Smith (1996). Price, Quality, and Pesticide-Related Health Risk Considerations in Fruit and Vegetable Purchases: A Hedonic Analysis of Tucson, Arizona Supermarkets. *Journal of Food Distribution Research* 27(3): 8-17.

Gaskell, M., R. Smith, C. Fouche, S.T.Koike, and J. Mitchell (2000). *Organic Certification, Farm Production, Planning, and Marketing*. UC ANR Publication 7247.

Granatstein, D. and E. Kirby (2006). *Estimated Organic Tree Fruit Acreage and Price Trends for Washington State and Beyond – 2006.* Center for Sustaining Agriculture and Natural Resources, Washington State University, Wenatchee, WA.

Greene, C. and A. Kremen (2002). U.S. Organic Farming: A Decade of Expansion. *Agricultural Outlook*. Economic Research Service/USDA: 31-34 (November).

Hanson, C.J., R. Dismukes, W. Chambers, C. Greene, and A. Kremen (2004). *Risk and Risk Management in Organic Agriculture: Views of Organic Farmers*. Department of Agricultural and Resource Economics, The University of Maryland, College Park, MD.

Lancaster, K. (1966). A New Approach to Consumer Theory. *Journal of Political Economy* 74:132-157.

Organic Trade Association (2006). *Manufacturer Survey Overview*. OTA, Greenfield, MA.

Parsons, W. (2005). *Niche Market or An Expanding Industry? Organic Fruit and Vegetable Production in Canada*. Vista on the Agri-Food Industry and the Farm Community, Canada.

Thompson, G., and J. Kidwell (1998). Explaining the Choice of Organic Produce: Cosmetic Defects, Prices, and Consumer Preferences. *American Journal of Agricultural Economics* 80(2):277-278.

The *Western Economics Forum* is an electronic, peer-reviewed publication of the Western Agricultural Economics Association.

Past issues of the *Western Economics Forum* and submission guidelines can be found at:

http://agecon.uwyo.edu/WAEA/waeawef.htm

Information about the Western Agricultural Economics Association can be found at:

http://agecon.uwyo.edu/WAEA/default.htm

WAEA membership is open to all those interested in agricultural and resource management issues in Western North America.

Western Agricultural Economics Association