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Farm Programs and the Environment:

The Case for a Limited Land Payment

by

Willis L. Peterson

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UNIVERSITY OF MINNESOTA

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THE CASE FOR A LIMITED LAND PAYMENT

Willis Peterson, Professor

Department of Agricultural and Applied Economics

University of Minnesota

St. Paul, MN 55108

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FARM PROGRAMS AND THE ENVIRONMENT:

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Abstract

The results of estimating reduced form supply and input demand functions suggest that farm programs have increased the area planted to corn and soybeans in the corn belt by about 12 percent, and increased fertilizer and chemical use per acre by about 18 percent. It is argued that a limited land payment (LLP) program would be neutral in its effect on the environment while helping to preserve family farms and rural communities.

It seems safe to say that environmental issues will loom large in the debate over the 1995 and future farm bills. Environmental criticisms of past and present farm programs generally include the following: 1. There has been a shift towards a less diversified, mono-crop agriculture because of the incentive to grow program crops, 2. The increase in weed and disease problems resulting from less diversification has in turn required higher inputs of chemicals, 3. The loss of soil fertility resulting from less diversification has been offset by heavier applications of commercial fertilizers, and 4. The acreage restriction feature of the programs has been an incentive for farmers to substitute fertilizer and chemicals for land.

To the extent that farm programs have had any effect, they will have increased relative prices of program commodities. Unless the elasticity of supply of these products is zero, which is unlikely, the programs will have changed the output mix. Moreover, restrictions on the amount of land devoted to program crops will have caused a substitution of chemicals and fertilizer for land unless the elasticity of substitution among these inputs is zero, which is unlikely as well. Therefore, the direction of influence of farm programs on the output and input mix in agriculture is not open to question: the only question is, what has been the magnitude of the effects?

This paper reports the results of a study aimed at measuring the impact of farm programs on cropping patterns and fertilizer/chemical use in the corn belt. The results suggest that the price support/cropland diversion programs have been detrimental to the environment. It is argued that a limited land payment (LLP) program would be

neutral in its effect on the environment while helping to preserve family farms and rural communities.

Historical Evidence

In the corn belt, incentives that encourage the shift towards a mono-crop agriculture means a greater reliance on continuous corn, or a corn-soybean rotation. Since both are row crops, there is a concern over soil erosion especially with soybeans. Corn is also a heavy user of chemicals and fertilizer which pose a threat to water quality.

Let us consider first, the major cropping pattern changes over the past four decades. During most of this period some form of price support for specified crops and acreage restrictions were in effect. Limiting the discussion to the corn belt, ten states are considered: IL, IN, IA, MI, MN, MO, NE, OH, SD and WI. As shown in Table 1, acreage devoted to both corn and soybeans increased from the beginning to the end of the period. Small grains and hay all decreased over the period. The flex acreage provisions of the 1990 farm bill allowed farmers greater freedom to move towards land-conserving crop rotations. However, as shown in Table 1, corn and soybean acreage increased in 1991 from 1989-90, while total area devoted to small grains and hay decreased. The percent of corn and soybeans in total land devoted to field crops was the highest in 1991 of any of the years shown. One would not expect flex provisions to have much impact as long as corn and soybeans remain the most profitable crops. The same appears to be true in the wheat belt (Herbel and Williams).

Table 1

Harvested Field Crops (Mil. acres)

Corn Belt, Selected Periods

	1949-51	1969-71	1989-90	1991
Corn for grain	47.2 (33)	46.9 (38)	56.0 (39)	58.3 (41)
Soybeans	10.2 (7)	26.3 (21)	40.2 (28)	42.0 (30)
Wheat	17.4 (12)	9.9 (8)	15.5 (11)	12.8 (9)
Oats	28.8 (20)	12.3 (10)	4.3 (3)	2.9 (2)
Barley and Rye	4.1 (3)	2.0 (2)	1.6 (1)	1.6 (1)
Hay	34.0 (24)	26.4 (21)	24.2 (17)	23.8 (17)
Total	141.7 (100)	123.8 (100)	141.8 (100)	141.4 (100)

Source: Agricultural Statistics, Respective years.

Figures in parentheses are the percentages of the total acres in these crops.

There is no way of knowing what the figures in Table 1 would have been in the absence of the farm programs. One might surmise that similar changes would have taken place. New varieties of corn and soybeans that increased yields and allowed a geographic expansion of these crops, and market driven price changes may have precipitated these changes on their own. Also, lower real prices of fertilizer and chemicals likely increased their use, as well as area planted to corn and soybeans.

While the data presented in Table 1 are consistent with the hypothesis that farm programs have encouraged the shift towards a row crop intensive, less diversified agriculture in this region, the preceding factors also could account for this trend.

Cross Sectional Evidence

According to census data, substantial variation exists in farm program participation among different sizes of farms. As shown in Table 2, large farms ($100,000 annual sales or more) participated more than medium ($99,999 to $10,000 sales) and small farms (less than $10,000 sales). The difference is especially noticeable between the large and the small group (78 versus 20 percent participation).

Government payments averaged 100 times more per farm for large farms than those in the small sales group. On a per crop acre basis, large farms received six dollars for each one dollar received in program payments by the small farms. Part of the difference in per acre payments is due to the difference in the crop mix. Large farms grow more program crops. Also as shown in Table 2, large farms are located on better land and obtain higher yields than small farms. As a result, per acre payments are higher.

Table 2

Farm Size Characteristics
Ten Corn Belt States, 1987

	Large	Medium	Small
Farm Size (Acres)	1362	326	153
Farm Program Participation (%)	78	62	20
Farm Program Payments			
Per farm (1000 $)	32	4.8	.32
Per crop acre ($)	36	21	6
Percent of Harvested cropland in:			
Corn for grain	39	30	18
Soybeans	27	28	16
Wheat	9	9	6
Oats	2	4	5
Barley and rye	1	1	1
Hay	13	23	52
Fertilizer and chemicals per crop acre ($)	36	23	12
Crop Yields			
Corn (bu./acre)	125.8	100.4	85.1
Soybean (bu./acre)	39.0	34.6	27.9
Oats (bu./acre)	58.0	51.1	44.1
Hay (tons/acre)	2.69	2.18	1.61
Percent of all land classified as cropland	79	72	51

Source: Census of Agriculture, Vol. 2, "Government payments and Value of Sales", 1987.

In regard to crop mix, the proportion of harvested cropland in corn and soybeans was nearly double for large farms than small farms. The proportion of wheat in the crop mix also was greater for large farms. For nonprogram crops, the situation between large and small farms is reversed. The percent of oats, barley, rye and hay in harvested acreage totaled 16 percent for large and 58 percent for small farms. These figures suggest that small farms are more diversified and less row crop intensive than large farms. If specialization in row crops poses a greater threat to the environment, small farms, being more diversified and devoting a larger proportion of their land to small grains and hay than large farms, are more in line with an environmentally sound, sustainable agriculture. This view is supported by the difference in application rates of fertilizers and chemicals - - three times greater for large than small farms.

Summing up, both the historical and cross-sectional evidence are consistent with the hypothesis that farm programs have contributed to the shift towards a corn-soybean

mono-culture in the midwest, and to heavier application rates of fertilizers and chemicals.

Environmental Differences

It should be acknowledged, however, that even in the absence of farm programs,

some farms will be larger than others. And large farms might still specialize in corn and soybeans. In the process they would use more chemicals and fertilizer per acre.

The crops produced on a farm depends on several factors. An important one is the physical environment. Farms located on heavy black soils with large level or gently rolling fields, have a comparative advantage in the production of corn and soybeans. Such land also is conducive to the use of large machinery, the machines most utilized by large farms.

Although the census does not provide information on soil type or field size, an indirect measure of these characteristics is available from the census data. As shown by the bottom line in Table 2, the percent of all land classified as cropland is substantially higher for large than small farms. This implies that large and small farms operate in different physical environments.

In areas where cropland makes up a large share of all land in farms, there is a tendency towards heavy, black, prairie soils with large, level or gently rolling fields, at least in these states. This land is conducive to corn and soybean production, and to the use of large machines, a characteristic of large farms.

In areas where cropland makes up a smaller share of all land in farms, woods and wasteland are more common. Soils in these areas tend to be lighter, forest soils; and the topography more rolling, with smaller fields. This land is less conducive to corn and soybeans, and to the use of large machines.

Unless soil fertility, topography, and field size are taken into account, large farms can appear to be more efficient than small ones. But the main point here is that the difference in the physical environment could explain the difference in crop mix and fertilizer and chemical use per acre between large and small farms. Thus, we have two competing, but not necessarily mutually exclusive hypotheses: large farms devote a larger share of their cropland to corn and soybeans: 1. because of the farm programs, or 2. because of their land characteristics.

Statistical Evidence

A. Corn and Soybean Supply

Theory suggests that the supply of corn and soybeans is a function of their own prices, prices of alternative products, input prices, and various exogenous supply shifters. Because the states in this region face similar output and input prices, a reduced form of the supply equation is estimated. The equation contains two exogenous supply shifters: 1. log of government payments per acre, and 2. percent of cropland in all land. The latter is a proxy for soil quality, field size, and topography. The dependent variable is percent of cropland in corn and soybeans. The 1987 census reports nine sales classes, making a total of 90 observations for the 10 states.

The coefficient on the two independent variables reveal how much, if any, these variables shift the supply of corn and soybeans at a given level of output and

input prices. The results of the regression are shown in column (1) of Table 3. Both variables are statistically significant at the .01 level.

The log of government payments coefficient of .072 implies that a one percent change in government payments per acre, results in a .072 of a percentage point change in the percent of cropland in corn and soybeans. The elimination of the payments, a 100 percent change, suggests a decline in corn and soybean acreage of 7.2 percentage points. As shown in Table 2, corn and soybeans comprised 58 percent of cropland in the medium sized farm group. Therefore, according to this estimate the programs increased corn and soybean acreage in the corn belt by about 12 percent (7.2/58 x 100 = 12).

B. Fertilizer and Chemicals Demand

Theory also suggests that quantity demanded of an input is a function of its price, output price, prices of related inputs, and exogenous demand shifters. Because input and output prices do not vary among the observations, a reduced form input demand functions is estimated.

The dependent variable of this demand function is log of dollars of fertilizer and chemicals applied per acre of cropland. The two exogenous shifters are 1. log of government payments per acre, and 2. percent cropland of all land, the same as in the preceding supply function.

As shown in column (2) of Table 3, both input demand shifters are statistically significant at the .01 level. The log of government payments coefficient of .187 implies that a one percent change in government payments per acre results in a .187 of one percent change in fertilizer and chemical use per acre. The elimination of government payments, a 100 percent decrease, suggests a 18.7 percent decrease in fertilizer and chemical use per acre. For medium sized farms this amounts to $4.30 per crop acre (.187 x $23 - $4.30).

Whether these changes are regarded as large or small is a matter of opinion. It does appear, however, that farm programs have contributed to less diversification between field crops and small grains and hay, as well as to heavier applications of fertilizer and chemicals. Granted, farmers have become more conscious of the environment, adopting minimum tillage techniques and exercising greater care in the application of fertilizer and chemicals. Chemical manufacturers also have developed new more environmentally benign products. But further gains could be made by adopting a farm program that was at least environmentally neutral.

Table 3

Estimated Reduced Form Equations

	(1)	(2)
	Corn and Soybean Supply	Fertilizer and Chemical Demand
Government payments	.072 (3.10)	.l87 (3.39)
Percent cropland	.726 (5.55)	2.51 (8.04)
R^2	.658	.773

* Figures in parentheses are t-ratios. A constant term was included but is not shown here.

Farm Program Critique

Over the years, government programs of price supports and cropland diversion have been criticized on several counts. Early on, economists recognized the inefficiencies associated with price and output distortions. Commodities are produced that will not clear the market at the support prices, resulting in surpluses and a reduction in the total value of output to society (Johnson).

The dumping of the surpluses on the world market or in third world countries via the export enhancement and P.L. 480 programs also is long recognized as distorting prices and production world-wide. World market prices are reduced along with prices received by farmers in other exporting countries and in countries receiving or purchasing the subsidized exports. Perhaps the greatest harm here is the retardation of agricultural and economic development of third world countries receiving the free or subsidized food. The resulting low agricultural prices in recipient countries dampens incentives to invest in agriculture (Schultz).

The perverse effect of the farm programs on income distribution also is well known. As shown in Table 2, corn belt farms with 100 thousand dollars of sales or more received on the average 32 thousand dollars of government payments per farm in 1987. Small farms with 10 thousand dollars of sales or less received only $320 per farm on the average -- a 100-fold difference. Since most large farms already have higher incomes than small farms, government programs have contributed to more inequality of the nation’s income distribution.

It appears also that cropland diversion programs have had a significant negative impact on the rural, nonfarm population (Van der Sluis and Peterson). Because of acreage restrictions, business and job opportunities in small towns have declined, hastening out- migration. In the process, their institutions such as schools, churches and health care facilities have been weakened. Finally as reported here, another drawback of the programs has been the incentive to specialize in program crops, and to apply heavier doses of fertilizer and chemicals.

A Limited Land Payment (LLP) Program

In recent years economist's and policy makers have intensified the search for ways to remove these undesirable side-effects from farm programs (see for example, Allen, Cochrane and Runge, Doering, Gardner, Hallberg, Johnson et al, and Sumner).

If society wishes to continue to transfer income to agriculture, it would be desirable to implement a program that does not distort prices and the crop mix, or harm the environment, but does offer more help to small, low income farmers. And in view of the weak economic base of rural America, a program that helped rather than harmed small towns would be desired as well.

A program that met the above objectives would have to be set up such that payments were uncorrelated with prices and production. One possibility would be to base payments on land rather than on specific crops. A per acre payment on a limited number of acres per farm would be consistent with the preceding objectives.

Payments would not depend on the quality of the land, its agricultural or forestry use, or how much each acre produced. As a result there would be no incentive to produce specific crops or to apply more fertilizer or chemicals in order to increase one's payment.

The cost of the program would depend on two factors: 1. the payment per acre and 2. the number of acres covered per farm. Small, low income farms would benefit more from a larger payment per acre but limiting the payment to fewer acres per farm. Most farms have at least 40 acres of land in total. A $100 per acre payment on 40 acres yields $4000 per farm. According to 1987 census data, there were 2,087,759 farms in the country. A $4000 payment per farm would have cost $8.351 billion. Actual farm payments in 1987 were $9.646 billion.

Although a $4000 addition to net income (1994 prices) would not make much difference to the living standard of the largest farmers, it could more than double the net incomes of small farmers on low quality land, or of those that suffered a crop failure. Of course, the $100 per acre and $4000 per farm maximum payments are just examples. Raising the land limit and decreasing the per acre payment would benefit large farms relative to small ones.

It is not the intent of this paper to spell out the details of such a program. But a few consequences and characteristics might be mentioned to initiate discussion. First, the payment limitation feature of the program would create an incentive to spin off smaller, "phantom farms" from larger existing operations. This phenomenon could

be minimized by imposing eligibility requirements. Perhaps, only principal operators of farms that existed at the time the program went into effect would be eligible to receive payments initially. Of course, family members would be free to divide up the payment as they wished. As farms were passed down to younger generations, or sold, application would have to be made to change the principal operator.

In cases where a farm was divided, the new principal operator would have to make application for payment, and show that the spin-off farm was a separate entity by having separate buildings and machinery. Absentee landlords, or absentee tenants, would not qualify. Recipients would have to live on the land receiving the payment. With this system, it is likely that average farm size in the country would decrease.

To ensure that payments went to bonafide farmers, a minimum sales requirement could be imposed to qualify for the program, say $50 per acre of total land or $2000 per farm, the lessor of the two. Exemptions could be made for farms that suffered a crop failure and had little or no sales.

A program of this kind would be largely neutral in its effect on production, land use, and commodity prices. There would be some capitalization of benefits into land values, especially on small farms. But there would be no special incentive to produce specific crops or products, or to apply heavier doses of chemicals or fertilizer. Land could be used for any agricultural or forestry enterprise - - fruits and vegetables, field crops, hay, pasture or tree crops, and qualify for benefits. It is important not to limit payments to cropland only, else there would be an incentive to till land that is

better suited to grass or trees. Also, owners or tenants of low quality land having low yields and a small proportion in tillable acres would not be discriminated against, as they have been.

Rural communities also would benefit from the program because more families would receive payments than with past programs -- about three times the number according to 1987 census data. Also there is evidence to suggest that small livestock farmers spend their money closer to home than the large feedlots (Chism and Levins). With this program, about 50 percent of the total payment would go to small farms with less than $10,000 in annual sales. In 1987, these farms received only 2 percent of government payments.

Prices would be determined by markets, but weather and price risks could be reduced by purchasing crop insurance and hedging in the futures markets. Also the cost of administering the program should be less than is now spent because of its simplicity. It is a program that field office personnel and farmers could understand.

Although the LLP program would be environmentally neutral, it could be combined with a long-term Conservation Reserve Program (CRP) as a means of furthering the conservation objective. Income distribution and conservation objectives are more likely to be attained if targeted by programs specifically designed to accomplish one or the other.

Conclusions

Farm program payments based on total output of specific commodities and/or the amount of land owned favor large farms, while distorting cropping patterns and input use. If society wishes to continue transferring income to agriculture, a limited land payment (LLP) program would not distort prices and production while furthering societal objectives of preserving the environment, family farms, and rural communities.

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