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Minnesota Farm Business Notes

Economic Research on Pesticide Use

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Because chemicals generally are more effective and economical than other control methods, farmers make widespread use of them for controlling insects, plant diseases, nematodes, weeds, and other pests. Discontinued use of pesticides could result in about a 25-percent reduction in livestock production and about a 30-percent reduction in crop production in the 1st year. Unless effective alternative pest control methods were employed, these losses would increase in succeeding years as the pest population multiplied.

Despite an extensive pest control program, current production losses remain high. For example, livestock losses (evaluated at current prices) directly attributable to insects and ticks are estimated to exceed $300 million annually. Physical crop losses due to weeds, insects, and diseases are even more extensive but their value is difficult to determine because of current surpluses of some crops.

Use of chemical pesticides is also essential to maintenance of high quality production, particularly of fruits and vegetables. Production costs are reduced by eliminating tillage operations in weed control and by using cost-lowering technologies such as chemical defoliation of crops before harvest. The latter procedure, particularly with cotton, also permits mechanization of harvesting.

Therefore, although expenditures for chemical pesticides are not a major part of total production costs, they do play an increasingly important role in agricultural production.

RAPID GROWTH IN USE

Development and use of chemical pesticides have increased dramatically since the selective herbicidal action of phenoxyacetic acids (e.g., 2-4D) was discovered in 1944. The development of DDT followed in 1945. Research continues to produce new and effective chemicals. Over 57,000 different formulations are now registered by the U. S. Department of Agriculture under the Federal Insecticide, Fungicide, and Rodenticide Act.

About 90 percent of farm use of

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Specialization In Dairy Farming

Boyd M. Buxton*

A current trend in Minnesota dairying is towards fewer and larger herds. On farms where herd size is expanding, the dairy enterprise often requires an increased proportion of productive resources used on the farm.

New technology and methods have encouraged larger dairy herds by reducing labor requirements and allowing expansion and specialization. Changes from stanchion arrangements to parlor systems are frequently accompanied by additional cows in the dairy herd; smaller herds utilize new housing and feeding and milking facilities less efficiently than do larger herds.

Most Minnesota dairy farms produce crops for sale as well as the bulk of the feed requirements for the dairy herd. Therefore, most dairies are equipped with the necessary field equipment for producing a variety of field crops.

This study's objective was to estimate effects of specializing in dairy production on "one-man" farms. Results indicate that this specialization can reduce the maximum level of gross income potential as well as returns to the operator's labor and management.

PROCEDURES

This study's concern was the effects of different size dairy herds relative to other enterprises within the farm organization. Therefore, a representative one-man dairy farm using a double-4 herringbone milking parlor and loose housing was assembled into a complete unit from its component parts. Increased specialization in dairying was approximated by increasing the proportion of total farm output generated by the dairy enterprise.

The farm also was equipped with adequate field equipment for producing corn silage, corn grain, oats, alfalfa hay, and soybeans. Alternative enterprises available to the farm, from which products could be sold directly for cash, included dairy, corn, soybeans, and hogs.[1]

Labor

Adjustments were made in the amount of labor which the single operator could contribute directly to crop and livestock enterprises. His duties also included miscellaneous jobs of buying and selling, building and equipment maintenance, etc. The operator could work up to 300 hours in any 1 month but not over 2,500 hours in 1 year.

Up to 1,250 hours of seasonal labor also could be hired as needed. Family labor was treated as hired labor and was valued the same as nonfamily seasonal labor.

Land, Buildings, and Capital

The study allowed most longrun farm adjustments. Cropland acreages, housing, and feeding facilities were provided to fit the exact needs of the farm and dairy herd. This method insured that costs were calculated on the basis of full capacity utilization of these resources. Three resources—labor, the double-4 herringbone parlor, and field equipment—were fixed in amount and size and could be underutilized on relatively small farms.

Production

Because several possible enterprises were considered, farm output was

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For a more detailed description of this study and basic assumptions, see Boyd M. Buxton, "Economies of Size in Dairy Farming," *Farm Business Notes*, November 1964.

[1] The hog enterprise was never profitable enough at assumed prices to be included in the farm organization even though it was always considered an alternative.

Dairy Farming . . .

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measured in terms of a common denominator, gross income. Costs, in turn, were computed per $1 of gross income.

The major product prices listed below were used in this study. Results of the analysis reflect these price relationships:

Product	Unit	Price
Milk	Cwt.	$ 3.44
Corn Grain	Bu.	1.01
Soybeans	Bu.	2.19
Hogs	Cwt.	15.10

Minimum cost farm organizations were determined with the dairy enterprise producing both 60 and 85 percent of several levels of total gross income.[2] Increasing the proportion of gross income produced by dairy from 60 to 85 percent also increased the dairy herd size relative to the total farm organization. Costs and returns were then compared under both situations.

Summary of farm organizations when dairy produces 60 and 85 percent of total gross income

Gross income (dollars)	Cows (head)	Land used for: Dairy feed (acres)	Land used for: Cash crops (acres)	Labor used: Operator labor (hours)	Labor used: Hired labor (hours)	Variable cost (dollars)	Fixed cost (dollars)	Net returns (dollars)	Cost per $1 gross income (dollars)
60 percent of the following levels of gross income generated by the dairy enterprises:									
14,000	20	45	62	1,877	187	8,578	5,858	—437	1.031
18,000	26	59	79	2,220	241	11,029	5,858	1,112	0.938
22,000	31	72	97	2,500*	372	13,576	5,858	2,564	0.883
26,000	37	85	114	2,500*	854	16,562	5,858	3,578	0.862
30,000	43	97	144	2,500*	1,250†	19,615	5,858	4,526	0.849
85 percent of the following levels of gross income generated by the dairy enterprise:									
14,000	28	65	23	2,138	226	8,951	5,858	—811	1.058
18,000	36	83	30	2,500*	360	11,595	5,858	545	0.970
22,000	44	107	36	2,500*	946	14,804	5,858	1,336	0.939

* Operator's labor fully utilized.
† Hired or family labor fully utilized.

RESULTS

A summary of results is shown in the table. Under this study's framework, two important points are apparent:

- Costs per $1 of gross income are higher for all levels of gross income on the more specialized dairy farm than on the less specialized dairy farm.
- With a limited labor supply, the total level of gross income that can be generated is lower on the more specialized dairy farm than on the less specialized dairy farm.

These results are due primarily to the high labor requirements in dairying. For example, about three times as much labor is required to generate $1 of gross income with the dairy enterprise as with corn.[3] Therefore, when dairy represents a relatively large proportion of the total farm organization, available labor is exhausted at lower levels of gross income. Because more hired labor is required to produce each level of gross income, cost per unit tends to increase on the more specialized dairy farms.

When the dairy enterprise generates 60 percent of the gross income, the operator's labor is fully utilized at about $22,000 gross income. By increasing the proportion of gross income from dairy to 85 percent, the operator's labor is fully utilized at only $18,000 gross income.

By changing from 60 to 85 percent and using about the same total labor, the number of cows increases from 31 to 36 while acres of cash crops decline from 97 to 30. Returns to the operator's labor and management fall from about $2,500 to $550; cost per $1 of gross income increases from $0.88 to $0.97.

An important effect of dairy specialization is that total crop acres must decrease when labor is diverted to the dairy enterprise. With fixed amounts of labor, larger herds better utilize improved dairy facilities but field equipment is then often operated at a less efficient level. Because total output is limited by specializing in dairy, fixed costs are still a large proportion of total costs and unit costs are higher.

IMPLICATIONS

This study has greater application for organizing and building dairy farms from scratch than for analyzing effects of expanding an existing farm organization which is, in part, already fixed. Critical assumptions are that the farm's labor supply is quite limited and that cropland acreage can be varied according to needs. Important implications of the study are:

- Labor plays an increasingly critical role as the dairy enterprise becomes a larger part of total farm organization. Total farm labor requirements are much higher when the dairy enterprise is large relative to other enterprises. Furthermore, the operator's labor is exhausted at lower levels of gross income. Fixed costs spread over a smaller output tend to make higher unit costs.

Because more hired labor is required to achieve specified levels of gross income, costs per $1 of gross income tend to be higher and returns to the operator lower on the more specialized dairy farm than on the less specialized farm.

- On more specialized dairy farms, field equipment and tractors are used fewer hours. This fact results in poorer utilization of this equipment and tends to offset the better utilization of dairy facilities. Moreover, per unit returns to a limited labor supply are larger in crop than in dairy production.
- Some laborsaving alternatives, such as purchasing part of the concentrate feed requirement, have little to offer since the amount of additional labor made available allows only small additions to the dairy herd. Effects of buying all feed and eliminating the costs of maintaining this field equipment are not considered in this article. Minnesota farmers have shown little interest in this type of one-man dairy farm organization, at least in part because of the lack of well established and reliable supplies of good quality forage. ■

[2] Some studies showed that more specialized dairy farms received 85 percent or more of their income from dairy; 60 percent was selected to represent less specialized dairy farms.

[3] Based on assumed prices, approximate labor requirements in the loose housing double-4 herringbone are 55 hours per cow per year for a 43 cow herd of 0.129 hours per $1 gross income. For corn, labor requirements are about 4.3 hours per acre or 0.047 hours per $1 gross income.

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chemical pesticides is on planted crops; livestock applications and other agricultural uses are relatively small. Farmers spent an estimated $436 million for pesticides in 1963, compared to $310 million in 1961. These figures are for pesticide materials only and do not include application costs.

When the economic consequences of pesticides are considered along with the many groups affected, the economic importance of agricultural pesticides in Minnesota and the United States appears substantial. Some of these affected groups are: (1) farmers, via increased crop yields and/or reduced per unit production costs, (2) consumers, via cheaper foods, (3) chemical manufacturers, (4) pesticide application equipment manufacturers, and (5) retailers of these chemicals and equipment.

RESEARCH NEEDS

The current need for extensive research on pesticides, particularly on the economics of their use, arises largely because:

- Chemical pesticides represent a rapidly growing resource input in commercial agriculture and their use affects many people.
- Important questions are being raised that require comprehensive factual information on potential benefits and consequences of using chemical pesticides on a mass scale. To date, alternative nonchemical pest control measures, when they exist, have often not been fully appraised.

Methods of pest control employed by farmers, and policies affecting their employment, are important to all of the groups mentioned, particularly to individual farm producers. Of significance to farmers are answers to the following questions:

How would new or different methods and policies of pest control affect individual farmers?

Would changed pest control methods mean that growing certain crops would no longer be possible or profitable? Would the effect be the same in all production regions?

What are the costs and returns to farmers who adopt new or different methods of pest control?

What adjustments to these changing conditions would help farmers maintain or increase their income?

Recognizing these informational needs, the Federal Congress in the Agricultural Appropriations Act for 1965 provided funds and directives for research on several important aspects of pesticide use.

NEW RESEARCH

Congress made appropriations specifically for the following five categories of research:

1. Increased studies on control of plant diseases and pests and animal parasites by biological and sterility methods, by attractants or repellants, and by development of resistant varieties through plant genetic and breeding research.

2. Basic research on biology, ecology, physiology, pathology, metabolism, and nutrition of insects, plants, and animals. The ultimate objective of such research is improved pest control methods.

3. Research on more specific and less persistent conventional pesticides and improved methods of application. Simultaneous work was proposed for determining residues in processing and marketing agricultural commodities in order to alleviate any potential problems of food contamination.

4. Research on toxicological and pathological effects of pesticides and other chemicals in livestock, effects of residues in soils and in crop and farmstead water supplies, and effects of trace levels of pesticides currently occurring in food and feed supplies.

5. Economic research on uses of pesticides.

The Congress and research administrators hope that these five areas of research can be so integrated as to provide policymakers with critical information for developing recommendations concerning safe and economic control of agricultural pests. The remainder of this article is concerned with the fifth category, economic research.

ECONOMIC STUDY

Economic studies planned by the Economic Research Service fall into a general three-phase program:

1. A biennial nationwide survey of a sample of farms. Data obtained would concern: practices of farmers to control plant and animal pests by using toxic chemicals and the cost of these practices.

2. Analysis of selected alternative methods of pest control with emphasis on comparative costs and returns in selected areas.

3. Analysis of economic implications of alternative methods of pest control, both for the individual farm and for agriculture as a whole.

Nationwide Survey

The first biennial nationwide pesticide survey was recently completed. About 15,000 farmers were interviewed nationally; about 850 of these were in 18 randomly selected Minnesota counties. Data from this survey will provide the first benchmark inventory of chemical pesticide use in U. S. agriculture.

Data currently available on a nationwide basis are acreages of crops treated by general types of pesticides. Estimates of manufactured quantities of pesticides are published annually. However, gross assumptions must be made about how much and where these chemicals are actually used in agricultural production.

The survey should provide data related to key management and policy questions. Estimates will be made of the total volume of chemicals used in agriculture and expenditures made for each crop and kind of livestock. Identity of types of chemicals used will be preserved but not of brand names. Inventories will be made of equipment purchased by farmers for pesticides and of the extent to which farmers rely on purchased services to apply pesticides.

Other Economic Studies

Other economic studies will concentrate specifically on detailed costs and returns and evaluation of effectiveness of alternative pest controls on individual crop and livestock enterprises. In these investigations, close control and/or observation are required. Most investigations will be conducted in cooperation with State Agricultural Experiment Stations.

Within the North Central Region (including Minnesota), this analysis will center on (1) weed and insect control in crop production on Corn-Belt type farms and (2) assessment of pest control alternatives on farms producing dairy products.

This coordinated program of research on pesticides will provide needed information. Moreover, it should point up some critical areas of additional research needs. It will permit the conducting of economic analysis which recognizes the interests of farmers, consumers, industry, and business alike in resolving many important questions relating to safe and economical control of agricultural pests. ■

the outlook corner

J. C. Chai and Harold C. Pederson

Early March planting intentions indicate a record acreage of soybeans this year. For feed grains, planting estimates are down from a year ago. These predictions are based on a sample survey released by the Crop and Livestock Reporting Service.

The intended soybean acreage for the United States is 8 percent above the acreage planted in 1964. This 1965 amount is a record. Soybeans lead all major crops in expected total acreage expansion (see table 1).

For Minnesota, the intended soybean acreage is 12 percent above 1964. Soybean acreage has increased markedly in Minnesota in recent years but at a rate somewhat less than for the United States as a whole.

Based on average yields per harvested acre, the intended acreage would produce 829 million bushels, a record high. The U. S. production in 1964 was estimated at 700 million bushels.

Total feed grain acreages for the United States and Minnesota have trended downward between 1955 and 1965. In 1965 they should decline from 1964 amounts by 2 percent for the United States and 1 percent for Minnesota.

Both expected U. S. and Minnesota corn acreages are down by 1 percent from last year. Minnesota corn acreages stabilized at 6 to 7 million acres during the last 10 years, compared with a downward trend for the United States.

The expected U. S. production of corn, based on average yields, should be 4 billion bushels. The 1-percent decrease in intended acreage would still result in a 15-percent increase from the 1964 production of 3.5 billion bushels.

Acreages of oats are expected to be down 6 percent from 1964 for the United States and 2 percent for Minnesota. About 865 million bushels of oats are predicted in the United States this year. The 1964 production was estimated at 882 million bushels.

The intended barley acreage is expected to be down 12 percent for the United States but actually up 4 percent for Minnesota. The 1965 production of barley for the United States is estimated at 339 million bushels. Such a crop would be 16 percent below last year's production (403 million bushels).

The intended sorghum acreage in the United States is up 4 percent (0.6 million acres) from last year. Little sorghum is grown in Minnesota. U. S. sorghum production this year is estimated at 580 million bushels. This amount is an 18-percent increase from last year's production of 490 million bushels.

Actual planted acreages may vary substantially from the intentions reported due to weather conditions, government programs (production payments under the feed grain program, etc.), and unexpected developments. However, the most important factors affecting plant acreages of soybeans and feed grains are the prices received by the farmer.

In table 2 the relationship of soybean prices to corn prices and the relationship of soybean acreage to corn acreage are shown. The average price of soybeans in the United States was 1.61 times the corn price in 1955 and increased to 2.36 by 1964. Over the same period the soybean-corn acreage ratio nearly doubled.

The price ratio of a given year is almost always accompanied by a corresponding change in the acreage ratio of the following year. For example, when the price ratio increased 8 points between 1955 and 1956, the acreage ratio increased about 2 points between 1956 and 1957.

Not all variations in acreage ratios can be explained by variations in price ratios of the previous year. Other influences previously indicated may affect planted acreage. On the basis of this study, nearly 87 percent of the variation in the soybean-corn acreage ratio apparently was associated with the variation in the soybean-price ratio of the previous year.

Favorable prices for soybeans probably would further stimulate the total expansion of soybean acres. However, soybeans are a cash crop, while much of the corn crop is fed to livestock on the farm. Many farmers decide on their corn acreage on the basis of their prospective needs for feed. Therefore, feed grains are less responsive to price than are soybeans; a point may be reached where feed grain acreage becomes relatively stable. ■

Table 1. Soybeans and feed grains: indicated acreages, Minnesota and United States, 1965

Crop	Actual acreage, 1964		Indicated acreage, 1965		1965 acreage as percent of 1964	
	Minn.	U. S.	Minn.	U. S.	Minn.	U. S.
	million acres				percent	
Soybeans, all	2.88	31.7	3.22	34.3	112	108
Corn, all	5.84	67.4	5.79	66.9	99	99
Oats	3.30	26.6	3.24	25.1	98	94
Barley	0.62	12.2	0.65	10.8	104	88
Sorghum, all	.....	16.9	.....	17.5	.....	104

Source: *Crop Production*, CRB, SRS, USDA, March 19, 1965.

Table 2. Soybean-corn price ratio and soybean-corn acreage ratio, United States and Minnesota, 1955-64

Year	Acreage ratio (soybeans-corn)		Price ratio (soybeans-corn)	
	U. S.	Minn.	U. S.	Minn.
1955	0.24	0.39	1.61	1.64
1956	0.28	0.35	1.69	1.14
1957	0.30	0.45	1.86	2.20
1958	0.34	0.54	1.79	1.96
1959	0.28	0.32	1.88	2.05
1960	0.30	0.31	2.13	2.44
1961	0.42	0.41	2.11	2.21
1962	0.43	0.40	2.13	2.25
1963	0.42	0.40	2.30	2.36
1964	0.47	0.49	2.36	2.41

Source: Derived from: *Minn. Agr. Stat.*, March 1964; FdS-236, Nov. 1964; FOS-226, Jan. 1965.

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