Agriculture in the Upper Hocking Watershed 1955 and 1960

A Case Study of the Impact of Watershed Development

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AGRICULTURE IN THE UPPER HOCKING WATERSHED, 1955 and 1960
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The Upper Hocking Pilot Watershed Project came into being as a result of a demand for action to prevent reoccurrence of major floods. The project as finally developed is termed a "unified plan" because it combines conservation treatment of the land with structures on the streams.

This report is concerned only with evaluation of the impact or effect of the unified plan on the agriculture within the watershed of the Upper Hocking River and Hunters Run. The development of the project as a Pilot Watershed Project and creation of the Hunters Run Conservancy District to install the project have been described elsewhere.[1/]

The basis for the present evaluation is the collection, tabulation, and analysis of information for 1955 and 1960 from a sample of farms within the watershed area. The original (1955) schedule was drafted and the sample of farms drawn by Frank Carr and Paul Bachman of the Soil Conservation Service, with consultation and assistance from Professor Robert H. Blosser, Dr. Russell O. Olson, and Dr. John H. Sitterley of the Ohio State University and Ohio Agricultural Experiment Station. The 1960 schedule was adapted from the earlier version by Professor Blosser, Dr. Sitterley, and Dr. Robert M. Reeser of Ohio State University and Ohio Agricultural Experiment Station. Field work was done by Soil Conservation Service personnel in Fairfield County. Tabulation and analysis were under the direction of Dr. Reeser.

The original sample of the farms was a randomly selected list of 54 farms, stratified by size of farm, by tenure, and by area within the watershed. This sample represented about 20 per cent of the farms in the watershed area. Only 34 of the

1/ Fogle, Pearl L., "A Case Analysis of the Upper Hocking Watershed Project," paper presented at Interdepartmental Natural Resources Seminar, The Ohio State University April 2, 1962.

schedules were retained for analysis, because of incomplete data for several farms and because of difficulties regarding comparability of some farms in the two time periods. Some bias may have resulted from the use of only 63 per cent of the original sample. The schedules used deviate to considerable extent from the original stratifications by tenure class and by size of farm.

Interviews with operators, or in some cases with landlords, were completed during the winter following the 1955 cropping season. Interviews with the same sample were undertaken during the winter following the 1960 cropping season. However, changes had occurred in the intervening five years. Some of the farms had changed ownership and were now being farmed by the owner instead of a renter, or vice versa. Some of the operations had changed in scale, with additional acreage being rented in or disposed of. These and other changes made comparability between the two periods more difficult.

Data were tabulated from these schedules to show land use, crop yields, fertilizer treatment, lime use, conservation practices installed, livestock, and labor supply for both 1955 and 1960. Land use and rate of fertilizer application were tabulated by size of farm, and land use and conservation practices by tenure of operator. In addition, new investments in machinery and buildings were summarized for those farmers making new investments.

The following discussion seeks to interpret the individual tables resulting from aggregation of these data and to summarize the findings.

Land Use

The use of farm land in the Upper Hocking Watershed does not appear to be greatly different from that of the county as a whole (Table 1). Census data on land use are not available for 1955 and 1960, the years for which survey data were obtained, but in the census years 1954 and 1959 the general pattern is similar. A somewhat higher proportion of the land in the watershed is in corn, slightly more

Table 1: LAND USE: Percentage Distribution of Land by Crops and Use Categories, for Upper Hocking Watershed in 1955 and 1960, and for Fairfield County Ohio in 1954 and 1959

	Upper Hocking Watershed 1/		Fairfield Co. 2/	
	1955	1960	1954	1959
Corn for grain	24.2	27.6	20.8	21.8
Soybeans	.7	1.1	1.1	1.7
Other row crops	.5	1.2	.8	1.0
Total row crops	25.4	29.9	22.7	24.5
Wheat	13.8	9.7	12.4	8.9
Oats	3.2	4.0	2.5	3.8
Other small grain	.9	.4	1.3	.4
Total small grain	17.9	14.1	16.2	13.1
Rotated Meadow	28.9	26.0	31.3	31.3
Idle or conservation reserve	.7	6.2	2.4	4.9
Total rotated cropland	72.9	76.3	72.6	73.8
Permanent pasture	12.0	11.6	9.5	8.7
Woods	8.9	6.7	10.4	10.5
Miscellaneous uses of land	6.2	5.4	7.5	7.0
Total non-rotated land	27.1	23.7	27.4	26.2
Total land in farms	100.0	100.0	100.0	100.0

1/ Based on data from survey of 34 farms

2/ Based on data from Census of Agriculture

in small grains, and a little less in meadow. These apparent deviations in the watershed from the pattern of the county could have arisen from three sources: a real and significant difference may exist between the watershed and the county; or the sample of 34 farms may not be an accurate representation of the watershed; or the data gathered may not be fully accurate with respect to the farms concerned. Recognizing imperfections of these data for refined statistical analysis or tests of statistical significance of differences, it still appears that the data are reasonable and sufficient to permit broad insight into the developments within this project area in the period covered by the appraisal.

In the five years between surveys, the intensity of land use increased. Corn and other row crops increased in the county, but the increase was greater in the watershed. Wheat acreage declined by about the same proportion in both areas. Non-cropland uses of farm land decreased, but the decline was more pronounced in the watershed.

A general impression from these data is that the sample farms represent an area better adapted to intensive commercial farming than the average of the county, and that this advantage was sharpened between 1955 and 1960.

Crop Yields

Crop yields in the Upper Hocking Watershed were higher than the average of Fairfield County in both 1955 and 1960 (Table 2). Yields of the major crops (especially corn and wheat) increased by substantial margins in the county during the intervening years, while the yields in the watershed, as indicated by the 34-farm sample, maintained their lead. Changes in yields on a proportionate basis were less for the sample area (except for soybeans and barley, which were raised by too few farmers to get a true picture), but absolute increases were roughly comparable and in keeping with the diminishing marginal returns concept.

Hay yields for the watershed are so far above county yields as to require comment. It is probable that multiple cuttings, particularly of alfalfa, account for a large share of the differences.

Fertilizer Use

Data collected on use of fertilizer on the 34 farms of this sample included manure applied to cropland or pasture for the 1960 crop year, but this item was not included in the 1955 survey. In order to make the data for the two periods comparable, use of manure in 1960 was ignored in summarizing the data.

Because many different analyses of fertilizer were used, tabulation was on the basis of pounds of nutrient elements as interpreted by fertilizer labelling regulations. For example, an application of 200 pounds of 3-12-12 fertilizer was tabulated as six pounds of Nitrogen (N), 24 pounds of phosphoric acid (P_2O_5), and 24 pounds of potash (K_2O). All of the commercial fertilizer applied was included, whether dry, liquid, or anhydrous, and whether applied before plowing, at time of planting, or at any other time.

Table 2. CROP YIELDS: Per Acre Yields of Selected Crops in the Upper Hocking Watershed and in Fairfield County, 1955 and 1960

	Upper Hocking Watershed[a]		Fairfield County	
	1955	1960	1955[b]	1960[c]
Corn, bu.	75.8	85.7	64	76
Soybeans, bu.	26.5	33.9	22.5	24
Wheat, bu.	30.8	34.1	28	32
Oats, bu.	50.6	51.1	49	55
Rye, bu.	24.4		20[d]	20[d]
Barley, bu.	53.3	51.3	36[d]	29[d]
Alfalfa hay, tons	3.41	3.50	2.22[d]	2.05[d]
Clover-timothy hay, tons	1.93	1.94	1.38[d]	1.58[d]
All hay, tons	2.50	2.58	1.65	1.80

[a] Based on a survey of 34 farms

[b] Source: "Ohio Agricultural Statistics 1955-56," Research Bulletin 795, Ohio Agricultural Experiment Station Wooster (except as noted.)

[c] Source: Ohio Crop Reporting Service, Statistical Reporting Service, USDA (except as noted).

[d] 1954 and 1959 data, computed from U.S. Census of Agriculture for those years.

Corn was the most heavily fertilized crop, as would be expected (Table 3). Per acre applications averaged 16-39-39 (16 pounds N, 39 pounds P_2O_5, and 39 pounds K_2O) in 1955, but increased to 37-54-46 in 1960. Nitrogen applied increased by 134 per cent, while the total application of all elements per acre increased 45 per cent. Fifty-eight per cent of the fertilizer used in 1955 was applied to corn; this proportion increased to 69 per cent in 1961.

Wheat and oats received similar applications and roughly similar increases, with small grains averaging 9-35-35 for 1955 and 14-45-41 for 1960. Small grains received 34 per cent of the fertilizer in 1955 but only 24 per cent in 1960, due to most of the additional fertilizer being used on corn.

Only small applications of fertilizer were made on meadows and pastures, with 5.5 per cent of all fertilizer on 1955 and 5.0 per cent in 1960 being so used. This was predominately P_2O_5 and K_2O.

No satisfactory comparison can be made between Watershed and county fertilizer programs because of the lack of information on fertilizer analysis in the Census data. In 1959 the average rate of fertilization of corn in Fairfield County was 294 pounds but there is no basis for comparing this to the 37-54-46 rate in the watershed. The acreage subject to fertilization in Fairfield County (rotated cropland except idle land or conservation reserve, plus permanent pasture) received an average application of 155 pounds in 1955 and 143 pounds in 1960. This, however, does not necessarily indicate reduction in amount of plant food applied per acre, because higher analysis fertilizers could more than offset this change. Fertilizer application rates from the survey data indicate that per acre of land subject to fertilization, application averaged 47 pounds of nutrient elements in 1955 (7-20-20) and 69 in 1960 (16-28-25).

Lime Use

To smooth out possible annual variation in rate of lime use, data were gathered on the lime application within a 5-year period ending in 1955 and a 3-year period

Table 3. FERTILIZER: Per Acre Application of Fertilizer on Farmland in Upper Hocking Watershed, by Plant Food Elements and by Crops, 1955 and 1960

	1955				1960			
	N	P_2O_5	K_2O	All Elements	N	P_2O_5	K_2O	All Elements
Corn	16	39	39	94	37	54	46	137
Wheat	10	36	35	81	15	45	40	100
Oats	8	32	31	71	13	45	43	101
Small Grain	9	35	35	79	14	45	41	100
Other cultivated crops[a/]	6	25	24	55	9	26	22	57
Meadow crops	0	3	3	6	0	4	3	7
All rotated cropland (except idle)	8	23	23	54	18	32	29	79
Permanent pasture	0	2	1	3	1	4	3	8
All land subject to Fertilization	7	20	20	47	16	28	25	69

[a/] Soybeans, rye, barley, and truck crops

Note: Aggregative figures are weighted averages.

Table 4. Average Annual Per Acre Applications of Lime on Rotated Cropland and Permanent Pasture in the Upper Hocking Watershed, 1955 and 1960, and Fairfield County, Ohio, 1954 and 1959 (Agricultural ground limestone equivalent in tons per acre)

	Upper Hocking Watershed		Fairfield County	
	1955	1960	1954	1959
Rotated cropland	.22	.14	not available	
Permanent pasture	.17	.10	not available	
Weighted average, crop and pasture land	.21	.13	.15	.13

ending in 1960. Average annual applications of lime were expressed in tons of agricultural ground limestone equivalent, using standard conversion ratios.

Use of lime declined over time in both the watershed and the county (Table 4). Rates in the earlier period, ending in 1955, approximated the rates recommended by agronomists, or one ton every 4 years on cropland. Rates in the later period represent only one ton every seven years; this is not enough to maintain desirable calcium content or pH levels of the soil. This decline in lime used to a level inadequate by agronomic standards is substantiated by the Census data.

Conservation Practices

Enumeration of certain conservation practices was attempted in both the 1955 and 1960 surveys. The apparent low level of adoption of these practices indicates either that these practices were not deemed necessary by the farmers or that enumeration was not complete enough to obtain full information. Records of Soil Conservation technicians indicate that for the project area (watershed) as a whole, terraces, diversions, and strip cropping increased moderately between 1955 and 1960. The same technicians point out that on several of the farms in the survey, less intensive cropping of steeper lands reduced need for mechanical conservation measures, even though the reduction of row crops here was more than offset by intensified cropping of relatively level lands.

Contour cultivation of row crops was practiced on only one farm in the 34 farm sample in 1955 but was used on 4 farms in 1960. Contour strips were used on six farms in 1955 but only three in 1960. Diversions or terraces totalling 6,000 feet had been constructed on two farms in 1955; 8,300 feet had been built on five farms in 1960. Less than 300 acres, or only six to seven per cent of rotated cropland, had any of these conservation practices installed.

Management of woodlands was reported as being in effect on 15 per cent of the forest area in 1955 and 60 per cent in 1960. These areas involved 27 per cent in 1955 and 59 per cent in 1960 of the farms having woods. Since the term

"woodland management" was not defined in the schedule and may not mean the same thing to all farmers or even all enumerators, the 4-to-1 increase reported for this practice may be open to question.

Clipping of permanent pastures was a commonly followed management practice, being reported for 95 per cent of the acreage and 89 per cent of the farms in 1955. In 1960 clipping of pastures was reported for 86 per cent of the acreage and 79 per cent of the farms. The farms where this practice was halted or reduced nearly always had a concomitant reduction in forage-consuming livestock, so that the economic importance of clipping was greatly reduced.

Livestock

Livestock was of less importance in the Upper Hocking Watershed than in Fairfield County as a whole. Comparison of survey data for the watershed and Census data for the county indicates that for all classes of livestock except feeder cattle, density of livestock population (number per 100 acres) was less in the watershed (Table 5).

In Fairfield County, density of all classes of livestock except dairy increased over the 5-year period. For the watershed, the pattern of change in density was much less clear cut and was not definitive for forage-consuming, high labor, or purchased feeder types of livestock.

Over the 5-year period of this study, considerable change occurred in the distribution of livestock on the survey farms. More diary cows were kept in 1960, but on fewer farms and in herds twice as large as in 1955. Fewer beef cows were to be found in 1960, but the total of diary and beef cows was almost constant. Sheep were minor in numbers in both periods, although lambs sold increased as the result of lamb feeding enterprises. Sows and gilts decreased; hogs sold decreased proportionately less because of purchases of feeder pigs. More laying hens were kept but on fewer farms and in larger flocks. Broilers very nearly dropped out of the picture.

The changes made in livestock programs were generally compatible with increasing specialization and commercialization which should be expected in this area. Elsewhere, as well as in Fairfield County, milk and egg production are becoming concentrated in the hands of fewer producers. Increasing specialization in one phase of production is illustrated by purchase of feeder cattle, lambs, and hogs. Decreased emphasis on enterprises without pronounced advantage accounts for the decline in ewes and broilers. Generally, increases in size of project were made to increase efficiency in use of available labor or facilities, while decreases were adjustments to advancing age or to other demands on labor, such as taking a non-farm job, increasing another livestock project, or increasing scale and intensity of cash crop farming.

Labor Supply

Survey data on farm labor supply were incomplete for several farms in each period, with the result that only 29 schedules were usable for analysis of labor supply.

The operators of these farms did not consider all of their own time to be "farm labor." Labor supply from the operator averaged 247 days in 1955, and 226 days in 1960 (Table 6). In 1955, five of these operators worked off the farm; their jobs required an average of 106 days per year. In 1960, 11 operators were employed off farm an average of 175 days per year.

The tendency for adjustments in the farm labor supply to compensate for an off-farm job is illustrated in Table 6. Total farm labor supply, including hired and family labor, was reduced by 53 days per year from 1955 to 1960, while off-farm work was increased by 48 days per year. These are not the same 29 operators, of course, but merely a group of men operating the same 29 farms. The average age of the group was 48 years in 1955 but had dropped to 46 five years later because of replacement of aged retirees.

Table 5. LIVESTOCK: Farms Reporting Total and Average Number of Animals and Density of Livestock Population in Upper Hocking Watershed, 1955 and 1960 and Fairfield County, 1954 and 1959

	Upper Hocking Watershed (Based on survey of 34 farms)								Fairfield County (Based on Census Date)					
	1955				1960				1954			1959		
	Farms reporting (%)	No. Animals	Average size of project	Density (No. per 100 a.)	Farms reporting (%)	No. Animals	Average size of project	Density (No. per 100 a.)	Farms reporting (%)	Average size of project	Density (No. per 100 a.)	Farms reporting (%)	Average size of project	Density (No. per 100 a.)
Dairy Cows	53	162	9	3.0	32	199	18	3.6	60	8	4.3	44	11	3.7
Beef Cows	38	170	13	3.1	26	127	14	2.3	a/	a/	2.5	a/	a/	2.5
Cattle Sold	62	965	30	11.8	76	851	33	15.3	55	10	4.7	60	14	6.4
Ewes	9	83	28	1.5	9	47	16	.8	22	21	4.1	25	22	4.3
Lambs Sold	6	26	13	.5	15	277	55	5.0	a/	a/	a/	a/	a/	a/
Sows & Gilts	56	186	10	3.4	35	137	11	2.5	49	16	6.9	50	22	8.4
Fat Hogs & Pigs Sold	59	2268	113	41.9	56	1887	99	34.0	53	53	25.3	53	94	38.6
Laying Hens	35	1300	108	24.0	29	1842	184	33.2	66	97	58.1	38	129	58.4
Broilers	12	335	84	6.2	3	50	50	.9	a/	a/	a/	a/	a/	a/
Other L'stock	18	----	---	----	6	----	---	----	--	--	----	---	---	----

a/ Not available

Table 6. Average Labor Supply and Off Farm Work per Farm in Upper Hocking Watershed, 1955 and 1960
(In days of labor)

	1955	1960
Operators labor	248	226
Hired by the month	45	55
Hired by the day	28	28
Family labor (man equivalent)	65	21
Custom work hired	a/	3
Total farm labor supply	386	333
Operators with off farm jobs	5	11
Off farm labor: Ave. for those with jobs	106	175
Off farm labor: Ave. for 29 farms	18	66
Average age of operator in years	48	46

a/ Not enumerated in 1955

Other Tabulations

Land use was tabulated by size of farm for 3 size classes, to show whether the intensity of land use or the distribution of uses varied with acreage in the farm. Percentage distributions of land use for three size classes are shown in Table 7.

An increase in the proportion of cropland and a decline in miscellaneous uses of land as farm size increases would be expected. The varying proportion of woods, however, is much more likely to be a random or chance variation than a result of size differences. The restricted acreage of wheat on small farms may be a result of government programs, but is hardly as expected. There is no obvious reason why farms of 110-199 acres should raise substantially more meadow or participate less in the Conservation Reserve, but the total of these two figures shows a rather stable proportion of about 1/3 of the farm "in grass."

Table 7. Percentage Distribution of Land by Crops and Land Use Categories for Three Size of Farm Clesses, Upper Hocking Watershed, 1960

	12 farms 30-109 acres	12 farms 110-199 acres	10 farms 200 acres and up
Corn for grain	25.4	24.2	30.1
Soybeans	1.6	0.0	1.7
Other row crops	2.5	0.2	1.5
Total row crops	29.5	25.4	33.3
Wheat	5.0	10.1	10.7
Oats	4.1	4.0	4.1
Other small grain	0.0	1.1	0.0
Total small grain	9.1	15.2	14.8
Rotated meadow	24.6	30.9	22.9
Idle or conservation reserve	9.6	1.5	8.7
Total Rotated Cropland	72.8	73.0	79.7
Permanent pasture	11.3	10.3	12.6
Woods	6.6	10.2	4.2
Miscellaneous uses of land	9.3	6.5	3.5
Total Non-Rotated Land	27.2	27.0	20.3
Total land in farms	100.0	100.0	100.0

Fertilizer use was tabulated for the same three size-of-farm classes (Table 8). Both aggregatively and for most individual crops, fertilizer applications were heavier for the larger farms. Meadow crops and some assorted cultivated crops were the only exception to this tendency. The ten largest farms in this sample used about half again as much fertilizer per acre as the 12 smallest farms.

A tabulation of land use for farms operated by tenants and by owners (Table 9) showed a higher proportion of rotated cropland on the tenant operated farms. This was largely due to the lower proportion of land in woods. Owners had more land

idle or in the Conservation Reserve. But for the cropland in use, the pattern was almost identical, with 41-44 per cent in row crops, 19-21 per cent in small grains and 37-38 per cent in meadow. Based on this sample, it appears that tenants in this watershed are not "exploiting" their land resources any more than owners. Conservation farming, as measured by land use, is being done as well by tenants as by owners.

Between 1955 and 1960, new capital investments were made by 11 farms. These were cases of increasing or expanding capital on the farm, rather than merely replacing or repairing existing items.

Seven farms added investment in different, additional, or larger machinery, with an average increment of $1,670 per farm. These farms were the same size (202 acres) in 1960 as in 1955 but their average cropland acreage had increased from 150 to 168 acres. At the same time, the labor supply per farm shrank from 510 man days per year to 404, and off-farm work by the operator increased from 29 days to 134 days per year. This appears to be a simple case of substitution of machinery for labor. Most of the machinery added was either hay machinery such as hay conditioners which permit more regular scheduling of field work, or larger equipment to speed up operations.

Nine farms added an average of $2,900 to their investment in buildings, by erecting new structures, or enlarging or remodeling existing buildings. Size of farms measured in acreage increased only moderately for this group, with total acreage going from 214 to 233 acres and rotated cropland from 162 to 178 acres. Labor supply changed very little (429 to 434 man days per year). Off-farm work by the operator doubled (43 to 90 days per year) but the 1960 level was far less than that for the group previously discussed. The major change in these farms was in livestock kept. The labor required to care for the animals on these farms, if ordinary methods and equipment had been used, increased from 1,651 hours per farm to 2,693 or 206 eight-hour days to 341. Yet this increase of almost two-

Table 8. Fertilizer Applications Per Acre on Farmland in Upper Hocking Watershed, by Plant Food Elements and by Crops, for Three Sizes of Famrs, 1960

	12 farms 30-109 acres				12 Farms 110-199 acres				10 Farms 200 a. & up			
	N	P_2O_5	K_2O	All Elements	N	P_2O_5	K_2O	All Elements	N	P_2O_5	K_2O	All Elements
Corn	11	40	39	90	36	49	47	132	44	60	47	151
Wheat	9	33	27	69	14	43	35	92	16	48	46	110
Oats	8	26	24	58	16	58	55	129	12	41	41	94
Small Grain	8	30	26	64	15	48	40	103	15	45	45	105
Other cultivated crops [a]	22	57	56	135	7	34	13	54	00	00	00	00
Meadow crops	3	7	7	17	00	6	5	11	00	00	1	1
All rotated cropland (except idle)	8	27	26	61	16	30	27	73	22	37	30	89
Permanent pasture	0	2	1	3	1	7	7	15	1	2	2	5
All land subject to fertilization	7	23	22	52	14	27	25	66	19	31	26	76

[a] Soybeans, rye, barley, and truck crops

Note: Aggregative figures are weighted averages.

thirds in livestock handled was accommodated with essentially the same labor supply--due at least in part to the addition of buildings to facilitate their care and handling. This also appears to be a case of the substitution of capital for labor.

Table 9. Percentage Distribution of Land by Crops and Use Categories for Tenure Classes, Upper Hocking Watershed, 1960

	18 Tenants	16 Owners
Corn for grain	29	26
Soybeans	2	00
Other row crops	00	2
Total row crops	31	28
Wheat	12	6
Oats	3	6
Other small grain	1	0
Total small grain	16	12
Rotated meadow	28	24
Idle or Conservation Reserve	4	8
Total rotated cropland	79	72
Permanent pasture	12	12
Woods	3	11
Miscellaneous uses of land	6	5
Total non-rotated land	21	28
Total land in farms	100	100
Average size of farm	171 acres	154 acres

CONCLUSIONS

The changes in farming between 1955 and 1960 in the 34-farm sample in the Upper Hocking Watershed were substantially those which were: (a) paralleled by farms in other parts of Fairfield County and other areas of Ohio, (b) induced by a combination of factors including economic and social circumstances, and (c) limited by immobility and inertia, capital rationing and lack of knowledge on the part of

both these farmers and their neighbors. Some differences were observed between the watershed or survey area and the county as a whole. It cannot be safely concluded that the differences observed were due to the impact of the watershed project. Natural and normal variation from one farm to another and the small sample of farms analyzed could have resulted in apparent differences as large as those observed.

In order to more accurately appraise the impact of the watershed project on the agriculture in the affected area, more complete data on a larger sample of farms should have been secured in 1955. At the same time, a sample of comparable size drawn from farms outside the watershed area should have been studied. This would have served as a check, indicating which changes were due to factors other than the impact to watershed development.