United States
Environmental Protection
Agency

Great Lakes National
Program Office
230 South Dearborn Street
Chicago, Illinois 60604

EPA-905/2-87-001
GLNPO Report No.87-05
April 1987

EPA

Allen County, Ohio Tillage Report

EPA-905/2-87-001
April 1987

WATER QUALITY DEMONSTRATION PROJECT
ALLEN COUNTY, OHIO

(FINAL REPORT)

BY

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(Section 108(a) Demonstration)

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July 1986

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FOREWORD

The U.S. Environmental Protection Agency (USEPA) was created because of increasing public and governmental concern about the dangers of pollution to the health and welfare of the American people. Noxious air, foul water, and spoiled land are tragic testimony to the deterioration of our natural environment.

The Great Lakes National Program Office (GLNPO) of the USEPA was established in Region V, Chicago, Illinois to provide specific focus on the water quality concerns of the Great Lakes. The Section 108(a) Demonstration Grant Program of the Clean Water Act (PL 92-500) is specific to the Great Lakes drainage basin and thus is administered by the Great Lakes National Program Office.

Several sediment erosion-control projects within the Great Lakes drainage basin have been funded as a result of Section 108(a). This report describes one such project supported by this Office to carry out our responsibility to improve water quality in the Great Lakes.

We hope the information and data contained herein will help planners and managers of pollution control agencies to make better decisions in carrying forward their pollution control responsibilities.

Valdas V. Adamkus
Administrator, Region V
National Program Manager for the Great Lakes

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LIST OF ABBREVIATIONS AND SYMBOLS

ABBREVIATIONS

ac.	-- acres
A.C.G.H.D.	-- Allen County General Health District
A.C.P.	-- Agricultural Conservation Program
A.S.C.S.	-- Agricultural Stabilization and Conservation Service
avg.	-- average
B.O.D.	-- biochemical oxygen demand
bu./ac.	-- bushels per acre
C.E.S.	-- Cooperative Extension Service
conc.	-- concentration
C.T.I.C.	-- Conservation Tillage Information Center
D.C.	-- District Conservationist
D.O.	-- dissolved oxygen
F.	-- Fall
F.F.A.	-- Future Farmers of America
F.O.	-- field office
ft	-- feet
G.L.N.P.O.	-- Great Lakes National Program Office
g	-- grams
gal	-- gallons
hr	-- hour
l	-- liters
L.S.D.	-- least significant difference
m3	-- cubic meters
mg	-- milligrams
ml	-- milliliters
N.A.C.D.	-- National Association of Conservation Districts
N.R.I.	-- Natural Resource Inventory
O.A.R.D.C.	-- Ohio Agricultural Research and Development Center
O.A.S.S.	-- Ohio Agricultural Statistics Service
phos.	-- phosphorus
S.	-- Spring
S.C.S.	-- Soil Conservation Service
std. dev.	-- standard deviation
S.W.C.D.	-- Soil and Water Conservation District
tons/ac.	-- tons per acre
U.S.D.A.	-- United States Department of Agriculture
U.S. E.P.A.	-- United States Environmental Protection Agency
vo-ag	-- vocational agriculture

SYMBOLS

%	-- percent

METRIC EQUIVALENTS

1 acre	= 0.404 hectares	1 mile	= 1.609 kilometers
1 ft.	= 0.304 meters	1 inch	= 2.540 centimeters
1 ton	= 0.907 metric tons	1 bushel	= 35.238 liters
1 liter	= 0.264 gallons	1 gram	= 0.035 ounces

ACKNOWLEDGMENTS

Three men, Ralph Christensen, John Lowrey and Carl Wilson who represented the United States Environmental Protection Agency, Region V were instrumental in administering and providing technical assistance to the water quality demonstration project. Locally, the project was administered by Don Vigh and Beth Seibert, District Technicians with the Allen Soil and Water Conservation District and Steve Davis, District Conservationist, United States Department of Agriculture, Soil Conservation Service. Guidance was provided by the Allen Soil and Water Conservation District Board of Supervisors.

The cooperation of the farmers of Allen County is gratefully acknowledged. With the sincere interest in applying conservation tillage on their farms, this project was able to strive forward and achieve its objectives. Perseverance in making conservation tillage succeed is one of the area farmers greatest qualities.

Funding received from the U.S. Environmental Protection Agency greatly accelerated conservation tillage in Allen County. The monies were used to increase the manpower and equipment available to area farmers. A study on rural sewage disposal systems was also initiated from some of these funds.

Technical expertise from the U.S.D.A. - Soil Conservation Service, the Ohio Division of Soil and Water Conservation Districts, and the Cooperative Extension Service - Ohio State University was a great asset to the Project. With their inputs and continual support, the Project was able escalate. Cooperation from area agri-businesses was also appreciated.

SECTION 1

EXECUTIVE SUMMARY

The Allen Soil and Water Conservation District (S.W.C.D.) applied for a grant from the U.S. Environmental Protection Agency (U.S. E.P.A.) at the start of 1980 to demonstrate and evaluate methods for the reduction of sediment and related pollutants in the Maumee River and Lake Erie. The grant was awarded and the Water Quality Demonstration Project got its official start on July 11, 1980. The Project addressed two different areas: conservation tillage, and rural sewage.

CONSERVATION TILLAGE DEMONSTRATION PROJECT

Over its five year span, the Tillage Project demonstrated to farmers throughout the county, on a voluntary basis, the effects and economics of sound conservation. An intensive educational program was executed, equipment made available, and technical assistance provided. These incentives encouraged landowners to test conservation tillage on their own land.

The response to the adoption of these practices was outstanding. Two hundred and thirty two farmers gained hands-on experience as they committed 16,178 acres to 1,308 conservation tillage demonstration plots. At the end of the project a definite growth in the use of conservation tillage practices could be seen. No-till acreage in the county had increased by twenty times and mulch tillage by three. The Soil Conservation Service (S.C.S.) estimates that 64,534 tons of soil were saved as a result of the demonstration project.

RURAL SEWAGE DEMONSTRATION PROJECT

The remaining twenty-four percent of the grant monies was spent on this section of the Water Quality Project. The Allen S.W.C.D. addressed the situation of improving water quality where a high concentration of failed rural, residential sewage systems existed. The area selected was a small watershed with apparent substandard residential sewage disposal systems releasing effluent into the stream that drains the site. The upstream end of the watershed is basically in agricultural production.

Monitoring of the stream for pollutant and sediment loading was performed upstream and downstream of the residential area. The results showed that inputs of sewage effluent were evident in the stream.

Upon evaluation of all sewage disposal systems in the area, any that were unable to meet the parameters of the Home Sewage Disposal Rules of the Ohio Sanitary Code were required to be updated and improved to come into compliance. Monies were available to assist home owners in the installation of the required systems.

Once all substandard systems were improved, additional monitoring of the stream took place. The results show significant reduction of inputs of sewage effluent into the stream system. The export of sewage effluent downstream was also reduced. Any improved stream characteristics within the watershed was not noted due to the lack of any stream flow during the final monitoring periods.

EXECUTIVE SUMMARY CONCLUSION

The Water Quality Project had a very positive impact on Allen County, and was a valuable learning experience for all those involved. The growth in acceptance and usage of conservation tillage practices was outstanding, but most important of all is the fact that conservation tillage methods were proven to yield as well as conventional tillage. The rural sewage portion of the Project reinforced the concern of area health agencies to the need for regulation pertaining to and the monitoring of residential sewage systems.

SECTION 2

INTRODUCTION

The Allen S.W.C.D. began their Water Quality Demonstration Project in July of 1980. The project was funded primarily by a grant from the U.S. E.P.A., Great Lakes National Program Office (G.L.N.P.O.). The Conservation Tillage Demonstration Project developed from the need to reduce the amount of phosphorus entering Lake Erie through the Maumee River Basin. Large inputs of phosphorus were causing the lake quality to degrade. Much of this phosphorus was found attached to the sediment particles that were being eroded from agricultural land. It was estimated that water quality could be improved if the amount of soil loss was reduced. One means of achieving soil erosion control is by using conservation tillage practices that leave a protective cover of residue on and near the soil surface all year round.

Over its five year span, the Project demonstrated to farmers throughout the county, on a voluntary basis, the effects and economics of sound conservation. An intense educational program was executed, equipment made available and technical assistance provided, all as incentives for landowners to test conservation tillage on their own land. The response to the adoption of these practices was outstanding, proving the success of the Project.

A second part of the Water Quality Project was a Rural Sewage Demonstration Project which stemmed from an increasing concern to reduce the amount of contaminants entering Lake Erie. The Allen S.W.C.D. addressed the situation of improving water quality where a high concentration of failed, rural, residential sewage systems existed. The combined Allen County General Health District worked with the residential home owners to correct the deficient septic systems. Water quality monitoring, before and after the renovation process, was conducted of the ditch that the sewage systems drained into.

This report attempts to briefly tell the story of the Conservation Tillage Demonstration Project and Rural Sewage Demonstration Project in Allen County, Ohio and what was learned from the efforts of the Allen S.W.C.D., area farmers, the residential home owners, and all cooperating agencies.

SECTION 3

BACKGROUND

PHYSICAL SETTING

Location

Allen County lies in the northwestern section of Ohio, within the eastern confines of the mid western corn belt. It is in the central lowlands and straddles the till plain and lake plain areas of west central Ohio.

Area

The county has a total land area of about 403 square miles or about 260,500 acres (Table 1). The 1984 population of the county was approximately 112,250, 43 percent (47,830) of which reside in the county seat of Lima. Lima is located near the center of the county and is the largest town. Smaller towns include Delphos, Bluffton, Beaverdam, Cairo, Spencerville, Elida, Lafayette and Harrod.

TABLE 1. ALLEN COUNTY AREA MEASUREMENTS

Nonfederal Land and Small Bodies of Water	258,700 ac.
Federal Land	600
Census Water (Large Bodies of Water)	1,200
Total Surface Area	260,500 ac.

Taken from the S.C.S. county level National Resource Inventory (N.R.I.) data, published 1985.

Natural Resources

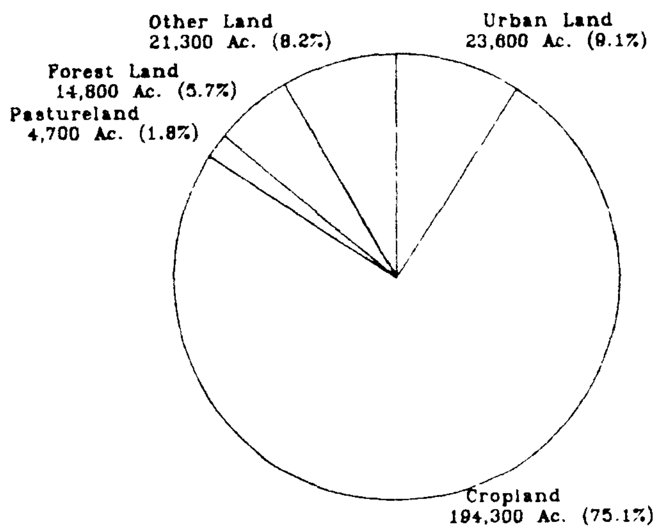
Agricultural Activity--

Agriculture is a major enterprise in Allen County. In a study of the county's economy for the Allen County Commissioners, Woolpert Consultants identified agriculture as a primary industry. The report identified that manufacturing related to agribusiness accounted for 23 percent of Allen County's manufacturing base, as compared to six percent for the State of Ohio as a whole.

A large percentage of the work force is engaged in agriculture related activities. County Business Patterns Data for 1982 provided by the Ohio Cooperative Extension Service (C.E.S.) identified ten areas of employment related to agriculture. These ten areas accounted for approximately 14 percent of the county's civilian work force.

According to the Ohio Crop Reporting Service, 75 percent of the county's land is being used for crop production purposes (Figure 1). The 1982 Census of Agriculture lists 1,202 farms in the county. Ninety-two percent of these farms are classified less than 500 acres in size, and 43 percent are less than 180 acres in size. The census reported 53 percent of the farms are operated by someone whose principal occupation is something other than farming. Forty-seven percent of the operators call farming their principal occupation. Sixty-one percent of the county's farm operators reported some days of work off the farm.

Allen County Land Use [1]



TOTAL NONFEDERAL ACREAGE IN ALLEN COUNTY = 258,700 ACRES

Taken from the S.C.S. county level N.R.I. data, published 1985.

FIGURE 1. Allen County land use.

Sixty-three percent of the county's farm income is generated from the sale of crops (Table 2). Corn and soybean production represents 48 percent of the total farm income for Allen County, which is important to note because according to local S.C.S. calculations, a corn and soybean crop rotation is subject to the most damaging effects from erosion compared to other rotations regardless of the tillage system (Tables 3 and 4). This accentuates the need to apply conservation tillage to the land to leave a residue covering on the soil's surface throughout the year and help reduce the amount of erosion.

TABLE 2. 1984 CASH RECEIPTS FOR FARM COMMODITIES IN ALLEN COUNTY[1]

CROP	RECEIPTS*
Soybeans	$16,836
Corn	8,516
Wheat	3,676
Oats and Hay	1,127
Other Crops	2,903
Livestock	19,592
Total	$52,655

1 Taken from 1984 Ohio Farm Income, Ohio Agricultural research and Development Center (O.A.R.D.C.)
* in thousands of dollars

TABLE 3. MAJOR ALLEN COUNTY CROPS[1]

CROP	1985 ACRES	1985 AVERAGE YIELD*	1984 ACRES	1984 AVERAGE YIELD*	1983 ACRES	1983 AVERAGE YIELD*
Corn	61,800	128.7	60,000	127.0	48,500	65.3
Soybeans	78,300	41.6	74,500	39.0	66,200	28.7
Wheat	20,000	69.8	23,000	48.0	24,800	52.7
Oats	3,100	100.0	3,000	68.2	3,200	75.0
Hay	7,400	3.5	7,000	2.5	6,700	3.0

1 Taken from the 1984 and 1985 editions of the Ohio Agricultural Statistics, Ohio Agricultural Statistics Service (O.A.S.S.)
* All yields expressed in bu./ac. except hay which is in tons/ac.

TABLE 4. RANKING BY CASH RECEIPTS FROM SALES OF THE EIGHT MAJOR FARM COMMODITIES IN ALLEN CO.[1]

RANK	COMMODITY	PERCENT
1	Soybeans	32
2	Corn	16
3	Hogs	15
4	Other Livestock	12
5	Wheat	7
6	Other Crops	6
7	Dairy	5
8	Cattle	5

1 Taken from 1984 Ohio Farm Income, O.A.R.D.C.

Topography--

The county is covered by material left from several glaciers. These glacial deposits range from a few feet to several hundred feet thick and overlie limestone bedrock.

The relief is nearly level to gently sloping (0-6% slope) as mapped by the S.C.S. in the county's soil survey. Steeper areas are found in places along streams and the three end moraines which traverse the county. These end moraines run across the county from east to west, and are among the areas where erosion is most severe. A level area is located in the northwest corner of the county, in an area which is a remnant of the old glacial lake bed.

Stream Characteristics--

Most of the county is part of the Maumee River Basin. However, a small part of the upper Scioto River watershed does extend into the very eastern edge of the county. The streams of the county include the Auglaize River, the Ottawa River, Sugar Creek, Cranberry Creek, and Riley Creek. These all flow north to the Maumee and then to Lake Erie. Besides the natural drainage ways, many miles of manmade channels have been constructed over the years to assist in draining the land.

Relationship to Lake Erie--

Allen County is located in the southeastern portion of the Maumee River Basin which drains into the western basin of Lake Erie (Figure 2). Allen County has three major tributaries which flow northwesterly and eventually outlet into the Maumee River. The Ottawa and Auglaize Rivers join near Kalida toward the western edge of Putnam County. The Auglaize then empties into the Maumee River at Defiance.

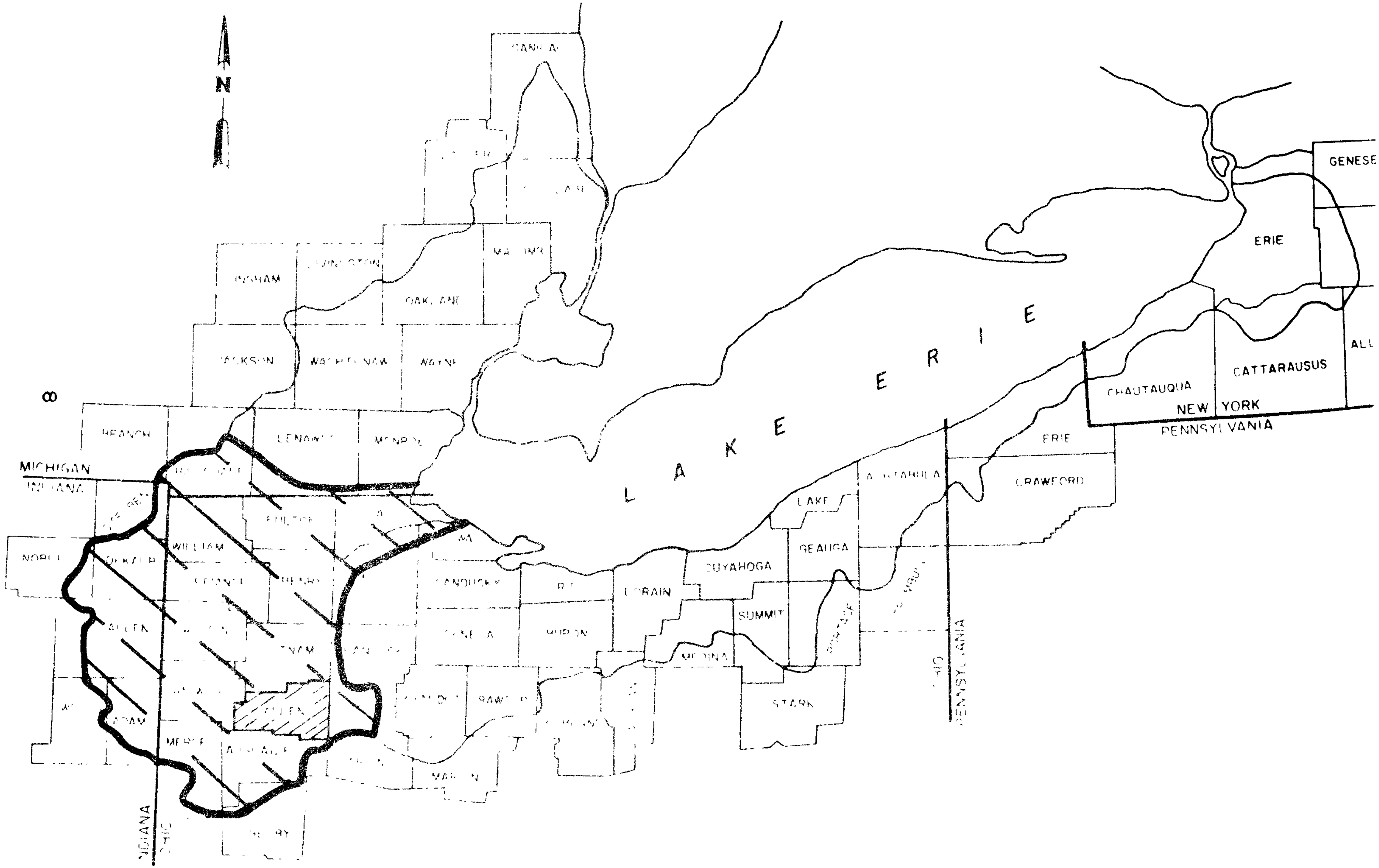


Figure 2. Maumee River Basin

Soils--

Relationship to agricultural production-- 75 percent of the soils in the county are classified as Morley, Blount or Pewamo. Morley is a moderately well drained soil; under good management, conservation tillage will yield as well or better than conventional tillage on this soil type. Conservation tillage in Blount soil will yield nearly equal to conventional under good management, provided that the soil drainage has been improved by surface or random subsurface drainage. Pewamo soil may yield less with conservation tillage since it is naturally very poorly drained. Conservation tillage results will be more favorable if this type of soil is systematically tiled. The soils of the county are deep, fertile and highly productive, but according to local S.C.S. figures, 44 percent of the cropland is eroding at a greater than acceptable rate. The acceptable rate for erosion is defined by the S.C.S. as the maximum rate of soil erosion termed "soil loss tolerance", that will allow a high level of crop production to be sustained economically and indefinitely. These values, commonly known as "T" factors are expressed in terms of tolerable soil loss per acre per year and ranges from 3 to 5 tons/acre/year for soils in Allen County.

Erosion-- Soil erosion is a continuously occurring natural process that loosens and transports soil particles. Erosion occurs slowly on undisturbed forest land and areas with adequate permanent vegetative cover. Soil losses are quite high on sloping cropland that is continually cultivated and left unprotected during several months every year. It is estimated that an average of over 716 thousand tons of topsoil erode from Allen County agricultural land annually. Almost 99 percent of the erosion occurs on cropland. The average soil loss on cropland is 3.6 tons/acre/year. Table 5 depicts erosion amounts and rates for the various rural land uses in the county.

TABLE 5. ANNUAL SOIL EROSION BY AGRICULTURAL LAND USE [1] ON NONFEDERAL LAND

LAND USE		ACRES	TONS	TONS/AC.
Cropland		194,300	707,300	3.6
Pastureland		4,700	800	0.2
Forest Land		14,800	5,300	0.4
Other Rural Land		10,300	3,300	0.3
	TOTAL	224,100	716,700	
			AVERAGE	3.2

1 Taken from S.C.S. county level N.R.I. data, published 1985.

Application to sewage disposal systems-- The soils present in the area of the Rural Sewage Demonstration Project are of the Blount and Morley soil series which represent 52 percent of the soils in Allen County. These soils are characterized as generally not suited for a soil absorption disposal field system.

Unique Characteristics of the Area--

Many interesting aspects involve the formation of Allen County soils. The county was covered by several glaciers, but the Late Wisconsin drift covered all material left by former glaciers. The county is covered by glacial drift, which ranges from a few feet to several hundred feet in thickness. This mantle of glacial drift overlies limestone bedrock throughout the county, and in several places there are outcrops of limestone. Quarries were established at the more prominent outcrops at Bluffton, south of Delphos, and east of Westminster. There is also a large quarry at Lima.

The relief of the county is primarily nearly level to undulating, but areas adjacent to the streams or in the morainic areas are steeper. The major part of the county is a till plain, but there are three end moraines in the county. In the morainic area, the relief is more pronounced and the erosion is more severe than on the plains. The end moraines were formed when the glaciers began to melt and recede, depositing the materials which had been carried. It formed moraines that run as bands across the county from east to west. Areas of sandy and gravelly outwash occur along the base of these moraines and on some of the higher parts of the moraines.

In the northern part of the county the relief is more subdued. The northwestern corner is nearly level (0-2% slope), while the southeastern section is gently sloping to steep (6-25% slope). Prominent beach ridges of sandy or gravelly outwash, formed by wave action, parallel the moraines. After the glacier had receded to a point north of the area that is now Allen County, a large glacial lake was formed that extended from the northernmost parts of the county north and east to Lake Erie. The soils in this former lake bed are generally high in clay content, and relief is nearly level.

Eighty-five percent of the soils in Allen County are somewhat poorly drained to very poorly drained. These soils need artificial drainage if best yields are to be obtained.

CLIMATOLOGICAL DATA/WEATHER PATTERNS

Normal/Average Conditions

The climate of Allen County and northwestern Ohio is characterized as continental, in the sense that the region is subject to wide extremes in temperature. In winter, cold air advancing out of Canada brings occasional periods of zero weather, but in the summer the area comes under the influence of masses of warm, moist air. Temperatures, on rare occasions, exceed 100 degrees Fahrenheit. The largest amount of precipitation falls in

June, and the smallest amount falls in February. A large part of the precipitation in the winter is in the form of rain. The rain often falls on ground that is not frozen. Because Ohio is located on the eastern edge of the interior plains, it is spared the violent fluctuations of wetness and drought that characterize some areas to the west and south. Precipitation is favorably distributed for the production of crops. In spring an ample amount of moisture is usually available for the germination of seed and the growth of plants. The driest season coincides with the harvesting period.

The average annual temperature in Allen County is 51.4 degrees Fahrenheit. Annual rainfall averages 36.6 inches. The average growing season, or that period normally free from temperatures as low as 32 degrees, is 161 days. It extends from May 3 to October 11. The season normally free from temperatures as low as 36 degrees, when light frost can occur, extends from May 16 to September 29. A period from April 19 to October 24, 188 days, is free from temperatures as low as 28 degrees. The growing season is ample for growing such crops as corn and soybeans without having to plant on dates when the risk of a later freeze exceeds 25 percent.

The moisture in the soil also goes through a seasonal cycle, which is generally favorable for crop production. Winter is the normal recharge season, and most soils are saturated with moisture, or nearly so, by the start of the growing season. If rainfall is normal in the spring, current and stored moisture is generally ample until mid-July, but a moderate shortage develops during August and September.

Early in the afternoon, the average relative humidity is about 50 percent in the summer and as high as 70 percent in the winter. It rises into the 80's and 90's at night throughout the year. In summer the sun shines about 70 percent of the possible time as compared with 40 percent or lower in the winter. Tornadoes have occurred on rare occasions in Allen County, usually during the spring months. Damaging hailstorms occur much less frequently than states to the west and south.

Deviations From Normal

The 1981 - 1985 growing seasons all proved that there is no such thing as an "average" year, which is illustrated in Table 6. Figure 3 graphically displays the rainfall measured during the season by year.

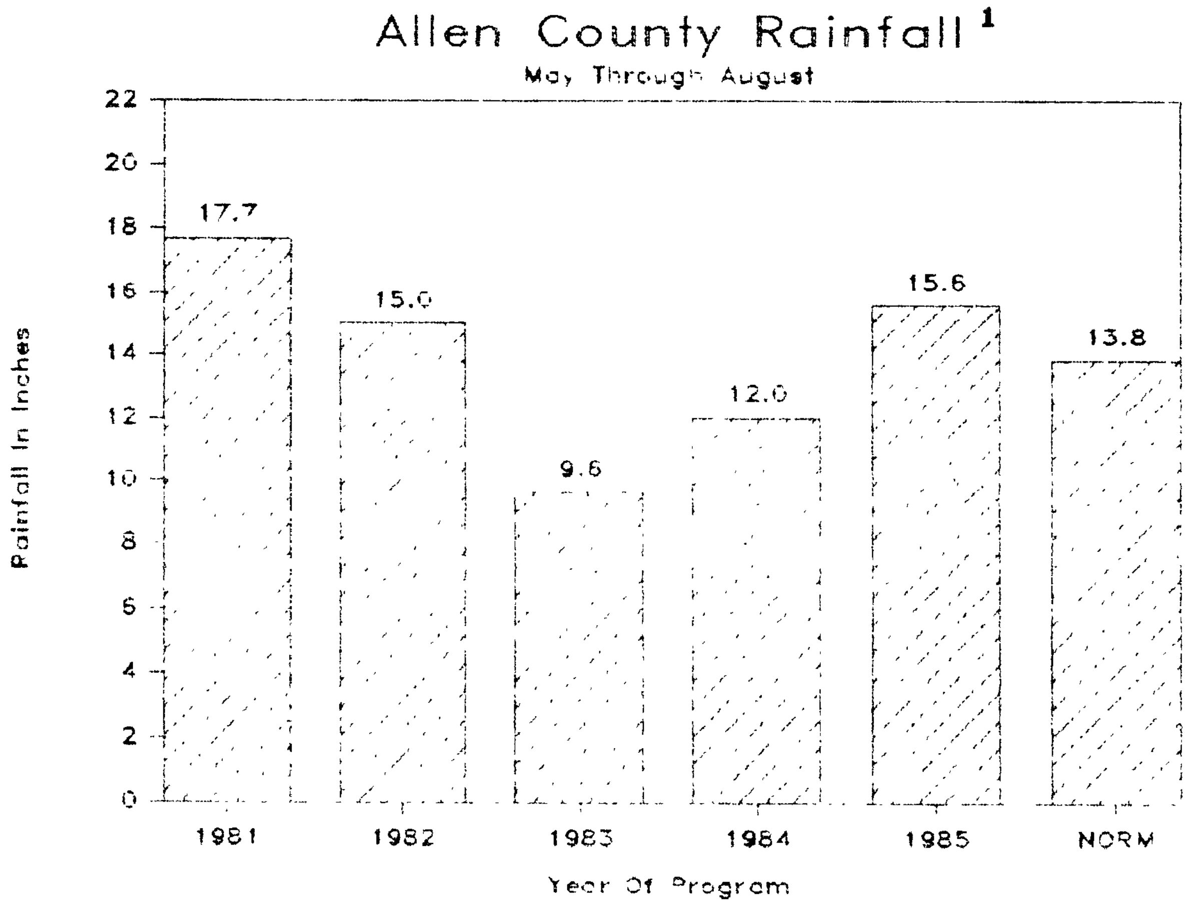
1981 Growing Season--

The 1981 growing season was abnormal, record breaking and discouraging to farmers. The winter of 1980 - 1981 was drier than normal, and March was relatively dry and warmer than usual. In April the rains came and never seemed to stop. April, May and June were among the wettest months on record. The growing season rainfall averaged 30.6 inches compared to the normal 22.4 inches, which was 37 percent above normal. The fall was wet and the first killing frost occurred on October 3rd.

TABLE 6. ALLEN COUNTY RAINFALL DATA 1981-1985 [1]

	Jan-Mar	Apr	May	June	July	Aug	Sept	Oct-Dec	Total	% of Normal
1981	3.9*	4.8	4.9	8.3	2.4	2.1	4.1	8.7	39.3	111%
1982	11.6	1.8	6.0	3.9	2.5	2.6	3.4	10.6	42.4	119%
1983	3.6	3.8	4.0	3.0	1.8	.8	2.2	16.7	35.9	101%
1984	5.3	5.2	3.6	2.6	3.6	2.2	3.1	7.7	33.3	94%
1985	5.6	1.1	4.1	3.7	2.9	4.6	1.1	10.7	33.8	95%
COUNTY NORM	7.8	3.6	3.6	4.0	3.3	2.9	2.9	7.4	35.5	

1 Data collected from the Lima Wastewater Treatment Plant; Vernon Neff, farmer; and Ray Burkholder, weather observer.
* Data listed in inches



1 Data collected from the Lima Wastewater Treatment Plant; Vernon Neff, farmer; and Ray Burkholder, weather observer.

Figure 3. Allen County rainfall.

1982 Growing Season--

The 1982 cropping season began with a wetter than normal winter. Most of this rainfall occurred in March. April and early May were quite dry, but heavy rains did come the last part of May and early June. Rainfall during the remaining months was adequate. Fall harvest was interrupted frequently by rain and occasional cool periods. The first killing frost occurred very late in the season.

1983 Growing Season--

Most of the county was plagued with a severe drought during the 1983 growing season. The winter of 1982/1983 was very dry but replenishing rains fell in April and May. Rainfall started to diminish toward the end of June. Little or no rainfall was reported across the county for most of July and all of August. October and November experienced more than twice as much rainfall as normal.

1984 Growing Season--

The winter of 1983/1984 was drier than usual, but the April rainfall made up for it. Adequate precipitation fell in May and early June. A brief dry spell was encountered near the end of June. Rain throughout the rest of the season was relatively timely. A couple of brief, high temperature, low moisture stress periods occurred primarily at the end of July and again at the end of August. Early fall had extensive wet periods.

1985 Growing Season--

Less precipitation than normal was measured during the winter of 1984/1985. Dry weather and warm temperatures allowed farmers to start Spring field work in mid-April. Considerable rainfall occurred in the later part of April and was followed by a brief cool period. Field work resumed the beginning of May. Moisture was adequate and timely throughout the growing season for the most part. Harvest was interrupted by rain from time to time. Some crops still required harvesting in December due to excessive rainfall in mid-November.

Effects on Conservation Tillage Project Operation--

Weather had a major influence on the operation of the Project, particularly wet conditions. A lot of rain in the spring would limit the number of days suitable for planting. In such cases, the Allen S.W.C.D. staff had to make sure that the equipment was circulating around the county constantly in order to meet the demand of the program's sign-up. It was not unusual under such circumstances to have to return to a particular area because a certain field or fields were not ready to plant due to rain. This created more road travel and added wear on the equipment.

The same thing would happen with the mulch tillage tools if wet weather persisted in the fall. There would be less time to accomplish the planned work load and therefore the pressure to complete the work would be greatly increased. Consequently, in some cases less attention was paid to detail.

Effects on Attainment of Conservation Tillage Project Goals--

Of the five growing seasons during the project period, none were alike. One year was droughty, another was quite a bit wetter than normal, and each one of the other three was different yet. But instead of a hindrance to the Project, the varied seasons were most likely a benefit. It enabled conservation tillage to be tested in literally all weather conditions. The demonstration plots were subject to longer growing seasons, shorter growing seasons, a drought, an extremely wet growing season, wet springs, dry springs, wet harvests and dry harvests. Conservation tillage practices did hold their own against conventional methods in all types of weather.

Effects on the Rural Sewage Project Operation--

The weather experienced during the period of the Rural Sewage Project had little effect on it's operation. During one sampling period, heavy rains washed a water sampling station downstream resulting in the loss of information at this site for several hours until it was replaced.

The installation of sewage systems was affected very little by any adverse weather. Most systems were put in on a timely manner working around any inclement weather conditions.

Effects on Attainment of Rural Sewage Project Goals--

An exceptionally dry period experienced during the two final monitoring periods resulted in very low flow conditions in the stream. More rainfall would have provided additional stream flow, and provided more data on the effectiveness of the systems.

SECTION 4a

CONSERVATION TILLAGE DEMONSTRATION PROJECT

PURPOSE

The Conservation Tillage Demonstration Project developed from the need to reduce the amount of phosphorus entering Lake Erie through the Maumee River Basin. Much of this phosphorus was found attached to the sediment particles that were being eroded from agricultural land. It was estimated that water quality could be improved if the amount of soil loss was reduced. One means of achieving soil erosion control is by using conservation tillage practices. Conservation tillage is any tillage system that creates a suitable environment for a growing crop while leaving a protective cover of residue on or near the soil surface throughout the year.

The actual purpose of the Project was to accelerate the adoption of conservation tillage practices in the Maumee River Basin. The strategy was to demonstrate the effects and economics of sound conservation to farmers through "hands on" experience in hopes that they would voluntarily and more readily adopt the use of conservation tillage in their own farming operations. It was thought that if intensive educational training was offered, equipment made available and technical assistance provided, the general acceptance of the practices would occur much sooner.

GOALS

Seven objectives were established at the beginning of the Project, and achievement of each was deemed necessary for its successful completion. They are as follows:

1. To demonstrate that conservation tillage systems are a profitable and reliable alternative to conventional tillage systems on soil types which comprise a large portion of the Maumee Basin.

2. To demonstrate how to get farmers to readily adopt conservation tillage on a voluntary basis.

3. To demonstrate a program which could serve as a model for treatment of other critical areas within the Lake Erie Basin.

4. To demonstrate several types of alternative conservation tillage systems and to evaluate the degree of erosion protection afforded by each system. To demonstrate which of these systems provide acceptable erosion control benefits and which provide preferred erosion control benefits.

5. To obtain information on the changes in insect and weed pressures and pesticide uses when there is a high concentration of conservation tillage in an individual area.

6. To obtain other technical and economic information which will improve existing water quality, and aid other agencies in their current programs that address agricultural sediment reduction.

7. To bridge the gap between planning for reductions in agricultural sediment loadings and actually seeing it happen on the land.

SCOPE

The original project proposal limited the project size to two particular areas in the county which included a total of 10,240 acres. The areas were identified as critically eroding, and together they represented 3.9 percent of the total land area in the county.

This was amended before the Project got started. The amendment expanded the boundaries to include the entire county. This was done in order to get more farmers involved and to increase the Project's visibility. Participation in the Project was then opened up to any interested farmer in the entire county.

GRANT APPLICATION

Seventy-four percent of the grant monies ($497,880) was allocated to the operation of the conservation tillage demonstration project. The funds were available to cover costs for seven categories, including personnel, fringe benefits, travel, equipment purchases, office supplies, contractual obligations and other. The "other" category involved such items as office space rental, purchase of tools, equipment rental, equipment operating expenses, displays, test result publications, and tours, field days and educational meetings.

ORGANIZATION

Agency Roles and Responsibilities

The Allen S.W.C.D. was the sponsor and administrative agency for the Project. The Allen S.W.C.D. Board of Supervisors guided the Project through the establishment of project goals and procedural guidelines, approval of financial expenditures and the evaluation of periodic progress reports. The Board of Supervisors hired a Project Coordinator to direct the project operation within the policy and procedural agreement established by the Board. Assistance was also utilized from the existing Soil and Water Conservation District staff in carrying out the project activities during peak workload periods.

The local S.C.S. staff, specifically the District Conservationist (D.C.), provided technical guidance and planning expertise to the Project Coordinator, S.W.C.D. Board of Supervisors and the other agencies.

The Allen County C.E.S. contributed educational assistance, encouraged the use of conservation tillage throughout the county, and helped carry out various educational activities, tours and field days.

The county Agricultural Stabilization and Conservation Service (A.S.C.S.) encouraged farmers to participate in the Conservation Tillage Demonstration Project. Since the Allen S.W.C.D. did not charge for the use of the equipment, the Allen County A.S.C.S. County Committee did not offer any cost-sharing incentives over and above their regular Agricultural Conservation Program (A.C.P.).

Local agribusinesses contributed valuable assistance to the Allen S.W.C.D. in securing equipment, helping execute special hybrid and herbicide test plots, and providing other services needed to help make conservation tillage a success in Allen County. many also contributed financially to field day, meal expenses.

Funding Mechanisms

The U.S. E.P.A., G.L.N.P.O. provided 74 percent of the funds for the total project budget while the Allen S.W.C.D. furnished the balance of the resources to carry out the Project. No income, as such, was generated from the project operation. Equipment was available to the farmers at no cost unless the use went beyond the guidelines that were established each year. There was also a charge for pest scouting services outside the demonstration plots. The money generated from these two items, however, was a very meager amount.

Labor or equipment which a farmer or another party contributed to help establish and promote the Project was considered "in-kind" contribution and the value was credited to the project. Rates were established at the start of the project as to the value of each type of service or operation performed as part of the local "in-kind" match.

Accountability

On a quarterly basis, the Project Coordinator prepared a Standard Form 270, Request for Advance or Reimbursement and submitted the form to the U.S. E.P.A. The form included total program outlays to date, estimated outlays for the next quarter, funds already requested, and funds being requested for the next quarter. Payments from the U.S. E.P.A. were based on the information on this form.

All grant monies received by the Allen S.W.C.D. from the U.S. E.P.A., G.L.N.P.O. were deposited into an account with the county which was administered by the Allen County Auditor. After the Allen S.W.C.D. Board of Supervisors approved payment of all acquired bills at their monthly meeting, said bills were submitted to the Auditor's office for payment.

The Allen S.W.C.D. kept a complete record of all project receipts and expenditures. Each month the Auditor prepared a report of the account status and sent it to the Allen S.W.C.D. The entire process provided for [illegible]er of checks and balances on the system.

SECTION 4b

OPERATING PROCEDURES

PROJECT ADMINISTRATION

Relationship to Existing Programs

The Conservation Tillage Demonstration Project complemented the Allen S.W.C.D.'s existing programs very well. Erosion control had always been a high priority with the Allen S.W.C.D. Three years prior to the award of the U.S. E.P.A. grant, the Allen S.W.C.D. began a conservation tillage promotion program addressing agricultural sediment pollution. The program relied on voluntary cooperation and farmer owned equipment, and was operated with limited resources. Primarily, encouragement, individual assistance and educational meetings were used in the promotion.

The U.S. E.P.A. grant allowed for an expansion of that program and provided the means to involve more people. Many farmers, who would not have otherwise, participated in the Project. The Allen S.W.C.D. secured 59 new cooperators who had never had any association with the District before. Many of these people, once acquainted with the Allen S.W.C.D., requested assistance with other problems, such as the installation of sod waterways.

Selection of Project Coordinator

A member of the Allen S.W.C.D. staff accepted the duties of the Project Coordinator, which were to direct the project operation within the policy and procedural guidelines established by the Allen S.W.C.D. Board. This individual was responsible for contacting the landowners, setting up the demonstrations, and providing technical assistance to the participants. The Project Coordinator also obtained and maintained the conservation tillage equipment and coordinated its use, collected and summarized project data, conducted educational meetings and tours, and reported progress to the Allen S.W.C.D. Board. Much of this was accomplished with the help of other S.W.C.D. employees.

Additional Project Staff

After the start of the Project, the Allen S.W.C.D. hired an additional employee. A major portion of this person's time was devoted to assisting with the Water Quality Project. He performed such duties as moving and setting up equipment, weighing crops at harvest and collecting data as needed. The rest of his time was spent on other Allen S.W.C.D. programs.

The other existing Allen S.W.C.D. staff members lent assistance to the Project as needed. The Allen S.W.C.D. secretary performed the Project's secretarial duties.

The S.C.S. D.C. assisted in the operation of the Project and provided valuable technical expertise. Soil Conservation trainees assigned to the Lima, Ohio Field Office worked with the Project as part of their learning experience.

Additional employees were hired during the growing season as pest scouts to regularly check for weed and insect problems and chart the progress of the plots.

Fund (Grant) Management

Quarterly, the Allen S.W.C.D. submitted a request for advancement of funds from the U.S. E.P.A. The request form indicated the amount of money that the District desired each month. Upon receiving a check from the U.S. E.P.A., the Project Coordinator deposited it into a special account established with the Allen County Auditor.

The Allen S.W.C.D. Board approved all project expenditures. The Project Coordinator submitted any bills and a request for payment to the Auditor monthly. Then upon his approval, the bills were paid from his office.

The Project Coordinator kept a record of all receipts and expenditures which was checked against a monthly statement from the Auditor's office for any discrepancies.

All major purchases were approved by the U.S. E.P.A., G.L.N.P.O. Project Officer. A biennial budget was also submitted to him for approval, indicating the Allen S.W.C.D.'s spending intentions for the two-year period.

Equipment Purchase or Lease and Management

Early in the Project, more leasing of equipment was done because of the need for improved performance on many pieces. Purchases were made once the equipment performed satisfactorily in the field. Tractors were leased each Spring to operate the Allen S.W.C.D.'s no-till planters, and in the Fall to pull the offset disc, coulter chisel plows, and any other pieces of mulch tillage equipment. The leasing of tractors was a very big expense to the Project, but it made a big difference in getting work done quickly and in a timely manner. However, it was often found that purchasing tillage and planting equipment was more economical than leasing.

At various times during the life of the Project, pieces of equipment, such as planters, weigh wagons, and mulch-tillage tools were purchased and/or sold. The procedure followed in the procurement of equipment was according to guidelines set by the State of Ohio. For any purchase or lease that was expected to exceed $2,000 in value, it was necessary to advertise for sealed bids. Two legal notices were placed in the local newspapers at least fifteen days apart prior to opening of bids. Invitations to bid, specifications and bid sheets were sent to farm implement dealers in the area who might be able to supply the needed equipment. On the date specified in the legal notices, the bids were publicly opened and read aloud by the chairman of the Board of Supervisors. In the purchase of equipment, generally the lowest bid submitted was awarded the sale. However, in some cases, proximity of the dealership to the Project area, specifications for the equipment, and farmer acceptance were considered. The successful bidder was notified in writing within fifteen days of the opening of the bids and usually was given six to eight weeks for delivery. When submitting a bid, each bidder was required to accompany the bid with a certified check or bid bond in the amount of five percent of the bid so that a contract could be entered into and performance thereof secured.

The disposal of equipment followed the same basic procedure. Legal notices indicating farm equipment for sale were published. Announcements were also sent to area farm implement dealers and various farmers. Sealed bids were received and opened on the specified date and the item was generally sold to the highest bidder.

Where procuring and disposing of equipment was concerned, the Allen S.W.C.D. did reserve the right to reject any or all bids and to waive any discrepancies in favor of the District.

Selection of Project

The Allen S.W.C.D. recognized the tremendous potential of conservation tillage. Research by the C.E.S. showed that 70 percent of Allen County soils would produce at existing or greater yield levels under reduced tillage methods. The reduction in soil erosion that conservation tillage provides as compared to conventional methods was very impressive. Savings in time and labor have also been substantiated.

All indications were that conservation tillage would be successful in Allen County. The benefits of these methods needed to be proven in order to be accepted by the area farmers who were comfortable with their current, traditional tillage methods. In securing the U.S. E.P.A. grant, the Allen S.W.C.D. took the lead in demonstrating to farmers in the county that conservation tillage is an economically sound practice.

Guidelines for Project Participation

Cooperators were encouraged to apply early for participation, demonstrate two or more tillage practices in the same field, keep accurate records, take yield checks, permit possible tours of fields, and allow publication of data and yields collected on the demonstration plots. A project participant who did not comply with the requirements, risked being ineligible for future involvement in the Project.

At the start of the Project the guidelines were more relaxed in order to build participation. However, many problems were encountered and it became necessary to establish more stringent guidelines each year.

A few farmers abused the Project. It became merely a convenience for some who were only interested in the use of free equipment. There were others who wanted to use the equipment as a last resort if they were behind schedule in either getting their crops planted or tillage work done, or if it was inconvenient for them to transport their own equipment to a particular field. Many of these people were involved as project participants year after year. Because of this abuse, a gradual tightening of the guidelines occurred each year.

As a result, quite a few of these people were lost in the final year of the Project because use of the equipment was limited to first and second year participants in order to involve more new people. A participant definition was also created to exclude family operations who were signing up more than one member. Acreage limits were hard to enforce but were necessary for maximum service to all project cooperators.

Side-by-side comparisons were very important in determining the success of conservation tillage practices, but many did not want to take the time and work part of a field differently if they could just go in with one tool. In several cases the comparisons between tillage systems in the same field were not treated equally due to differences like previous crop, hybrid planted, or rates of fertilizer, chemicals or seeding to name a few. Therefore, the results from such plots could not really be directly compared. A few years into the Project, the District allowed farmers to establish conservation tillage plots without comparisons, but after some time it was felt that little was being proven without a direct comparison. Therefore, in the last year, comparisons were required and full compliance by the participants was given.

The Allen S.W.C.D. planted some double-crop no-till soybeans in wheat stubble the first few years of the Project. The District soon stopped because it caused added wear on the planters. The practice was not promoted after that because it was used more as a convenience than for erosion control. Land is rarely worked after wheat is harvested in this area just to plant soybeans. Generally, double crop soybeans are planted using a no-till method. Replanting was performed only in no-till fields planted the first time with project equipment.

TECHNICAL ASSISTANCE

Lake Erie Tillage Task Force

The Lake Erie Tillage Task Force was developed as a means of providing uniformity and continuity among the many conservation tillage demonstration projects initiated in the Maumee Basin. They developed standard definitions, interpretations and criteria which assisted in guiding the various conservation tillage demonstration projects. Their meetings served to coordinate between agency representatives and project staff, and provided for the interchange of ideas in achieving the ultimate goal of improving water quality in Lake Erie.

Since the Allen County, Ohio Project was one of the earliest initiated, the Task Force provided a limited amount of direction. Some of the ideas presented could be incorporated into the Project, but in many cases, project goals and objectives had already been established and were difficult to change at the later stages of the program without causing problems. Also, the relationships between the staff and cooperators were different for each county, therefore, making it difficult to adopt a universal set of guidelines for the entire Basin.

A common data sheet was used for each plot in the Lake Erie Basin. This was an excellent means of obtaining a broad data base from all the demonstrations projects, even though every item on the sheet did not apply to every plot, it provided a uniform means of reporting data.

Eligibility Requirements for Technical Assistance

Any Allen County farmer interested in demonstrating conservation tillage on his land was eligible to participate in the Project. The only requirement was compliance with the guidelines established by the Allen S.W.C.D. Board of Supervisors. If a farmer indicated interest and agreed to follow the guidelines, technical assistance was provided.

Technical Assistance Provided

District employees attempted to follow a definite procedure with each farmer. After it was determined that the farmer wanted to try conservation tillage, contact was made with him by the SWCD staff. The test site was selected and evaluated for site suitability and chances for success and then the herbicide, fertility and variety programs were planned. The staff and farmer monitored the field in the Spring to determine when it was ready to plant. When conditions were favorable for planting, an SWCD employee delivered the planter, which was pulled by a tractor leased by the District, adjusted and set it up for the farmer and made sure it was operating properly before leaving the field. The farmer was required to operate the equipment himself. The District staff kept the equipment working properly and moving constantly from one participant's farm to the next. The equipment was provided to the farmers at no cost, but they were required to replace the fuel that they used.

In the case of the mulch-tillage tools that were used in the fall, the process was essentially the same. The District employees would help the farmer select the site and advise him on which direction the field should be tilled. The staff would deliver and adjust the equipment, which was also furnished with a tractor, when he was ready to use it. Since the ground had been tilled, these plots could be conventionally planted, and the farmers used their normal planting practices.

Field office staff members and pest scouts followed up by regularly checking the demonstration plots throughout the season for emergence, weed control, insect pressure and other problems that might affect the normal growth of the crops. Weigh wagons were made available to the farmers at harvest. A District employee assisted in weighing the grain and determining the yield. Supplied with the cultural data from each field, the District staff estimated the net return for the crop. The results and observations from the entire project were then published each year. These reports titled, "Conservation Tillage Test Results - Allen County, Ohio", were published annually from 1981 through 1985.

INFORMATION AND EDUCATION

Information and Education Program Design

Mass exposure was a primary project approach which was attained through an intensive education and information program. Two audiences were targeted, one being landowners in the county and the other the general public. The object was to increase awareness and spark concern over erosion, and then offer conservation tillage, augmented by available equipment and assistance, as a solution.

News Media--

The program was also designed to inform and update people in the county as to the progress of the demonstration plots. Area radio and television stations were utilized along with newspapers to effectively "spread the word". Several tours and field days received local television coverage. Radio stations and newspapers were also very cooperative, especially when personally contacted about the nature and importance of news releases and activities.

The Allen S.W.C.D. published a newsletter four to six times a year, which was mailed to approximately 1,300 cooperators. Every issue contained information updating the District cooperators on the status of the Project. A listing of guidelines and an application for participation in the demonstration project was included at least once each year. A special harvest issue was prepared late in the fall or early in the winter listing individual yield results for all the plots.

Meeting and Tours--

Meetings and tours were held throughout the year to update those interested in the progress of conservation tillage in the county. These were also effective tools in developing higher farm management skills required to make the systems successful. The first meetings of the year were held midway through the winter. Results and observations from the previous year's demonstration plots were reviewed as well as the guidelines established for the coming season. A meal, sponsored by area chemical representatives was included with this meeting. Promotions of this nature generally contributed to higher attendance for any activity.

A series of workshops were conducted late in the winter to review the results from the past year and offer selected management tips. A field day was held in early summer which featured no-till herbicide, variety and hybrid plots. A charcoal grilled, steak dinner was provided, compliments of the area chemical representatives. This activity was usually held twice each year, once on the east side of the county and then again on the west side.

Early in September the Allen S.W.C.D. hosted an Agronomy Tour in cooperation with the Allen County C.E.S. The group would either travel in buses to the designated tour stops or caravan in their own vehicles. Highlights of the tour would include comparisons in tillage methods, herbicide applications, hybrids, varieties, residue and fertilization. The tour was followed by a meal, sponsored by the area chemical representatives.

Management Guides--

Several Management aids, including a farmer checklist for successful no-till management, were prepared and printed by the District or reproduced from other sources. New participants especially, benefited from this type of material. Many farmers reported feeling more comfortable with the conservation tillage method or methods they had chosen to demonstrate.

Scouting Program--

The scouting program taught farmers and agency personnel much about insect and weed pressure related to conservation tillage. It was certainly worth the time and money invested. During the project period, 6,892 reports were left with farmers. The data collected convinced the Allen S.W.C.D. and the Allen County C.E.S. that scouting of no-till fields is important. Farmers and agency personnel were able to learn what pests to look for at different times during the growing season.

Fair Display and Other Promotions--

The Allen S.W.C.D. attempted to make the Conservation Tillage Demonstration Project as visible as possible. The District had been setting up a display at the county fair for many years. After the start of the Project, conservation tillage became the focal point of the District's display at the county fair. The tillage equipment and no-till planters were on hand for viewing and a pictorial narrative exhibit explained the use of the equipment. Applications for participation in the coming year's demonstrations were available. One year a model farm was constructed that showed various tillage methods and other conservation practices. Soil loss from different tillage methods was depicted with actual piles of soil two years.

"Allen S.W.C.D. Conservation Tillage Demonstration Project" was painted in bold, attractive lettering on the weigh wagons. Another promotional tool was plot signs that the District had professionally made. The signs were posted in the demonstration plots making them highly visible to passersby.

Staff Commitment to Information and Education

In 1980, the onset of the Project saw much skepticism from some Allen County farmers. The staff and other agency personnel realized the great importance of a strong and effective information and education program. The combination of demonstration and education was much more successful than demonstration alone would have been. Publicity brought awareness to conservation tillage methods. Without such a commitment from the staff, the Project might not have enjoyed the acceptance that it did.

INCENTIVES FOR PARTICIPANTS

Incentives Available

A voluntary approach was utilized in getting conservation tillage practices accepted in Allen County. An intensive educational program and technical assistance provided together with available equipment, offered at no cost, were the only incentives used. Another bonus was the chance for farmers to test a new system that could save them fuel, time and manpower. During the course of the Project many farmers had to evaluate their current operations for inefficiencies due to the poor farm economy.

Eligibility Requirements for Incentives

There were no special eligibility requirements for incentives. A participant had to agree to follow the standard guidelines established by the Allen S.W.C.D. Board each year. Those farmers who purchased their own conservation tillage equipment were still eligible for technical assistance if they requested it.

Procedure for Providing Assistance to Project Participants

In order for a participant to receive technical assistance and the use of project equipment, he had to sign up as a District cooperator, if he wasn't already one. He also had to farm land in Allen County and make application for participation in the Conservation Tillage Project.

Special Plots--

Throughout the Project, several farmers were asked by the Allen S.W.C.D. and the Allen County C.E.S. to put out hybrid and variety plots. These plots were located throughout the county and particular farmers were selected due to management abilities, the site characteristics, and locale in the county. Seed for the plots was donated by area seed dealers.

One or two separate herbicide comparison plots were put out each year. If two were established they were normally placed in different areas of the county. Area chemical representatives donated the chemicals for these demonstrations. Farmers were chosen primarily for their management ability, but the site that a farmer had to offer was an important factor as well.

REPORTING SYSTEM

Data Compilation

The Project Coordinator strived for accuracy in the collection and reporting of data from the demonstration plots. The Conservation Tillage Information Center (C.T.I.C), located in Fort Wayne, Indiana, provided all the Districts in the Maumee River Basin with field data sheets for compilation of data. The C.T.I.C. is a clearinghouse for information on conservation tillage, established as a special project of the National Association of Conservation Districts (N.A.C.D.) and administered in cooperation with agricultural industry, governmental agencies (including U.S.D.A. and U.S. E.P.A.), private foundations, organizations and farmers.

The Allen S.W.C.D. collected the necessary information to complete the data sheets and then returned them to C.T.I.C. The C.T.I.C. used the information to evaluate the activity in the entire Basin, and the District used the same form for their own records.

To collect the data, pest scouts and other District staff would obtain a population, or stand count, in a growing crop at 3 to 8 weeks after planting. At the same time, a measurement of residue cover was taken. After spring planting was completed, the Project Coordinator filled out a form for each plot with as much information as he could. Then, the form was sent to the farmer, who added the rest of the needed data and returned it to the Allen S.W.C.D.

After harvest, yields were collected and the net returns were calculated for each plot. A copy was made of the completed data sheets for the project files and the originals were sent to C.T.I.C.

Quarterly Progress Reports

Two reports were compiled and sent to the U.S. E.P.A., G.L.N.P.O. Project Officer quarterly. The first was a narrative account of project activities for the quarter. New developments were listed, along with a progress report. Meetings, tours and other landowner gatherings for the Project were reported as to their nature and attendance.

The second report was a request for advance of grant monies. It listed total program outlays to date and also the amount being requested. Each report had to be approved by the Project Officer.

Field Reviews by Project Officer

As time and travel permitted, the Project Officer would meet with the Allen S.W.C.D. staff and discuss progress, procedures and other activities of the Project. This was an excellent opportunity to discuss any problems in the operation of the Project and to keep all parties up to date. Letters, reports and telephone conversations are not nearly as informative and clarifying as personal visits.

Annual Reports

Each year a booklet was compiled and published to show the results of the conservation tillage demonstration plots. General information pertaining to the Project, the type of growing season for the year and its effect, soil erosion and its relation to water quality, economic comparison guidelines and the conditions for technical assistance and use of equipment were all included.

Plot results were listed by crop. Selected cultural data for each demonstration plot was listed along with the yield, value and net return. At the end of each crop section were tables, summarizing the data. An additional table contained the average yield and return for each tillage method demonstrated for all the years of the Project. No-till yields in relation to residue cover were also compared for each year of the Project. Other tables summarized tillage production costs, and time and fuel amounts used for each tillage type. Observations on yield and economic data followed the tables.

Final Report

The publication of this final report by the Allen S.W.C.D. was included in the conditions of the grant. It is to thoroughly review the project program, background of the county, project operating procedures and accomplishments, conclusions and recommendations. In short, it was to tell the story of the Allen S.W.C.D. Water Quality Project. The annual reports were primary sources of information in the compilation of this report.

SECTION 4c

PROJECT ACCOMPLISHMENTS

NUMBER OF PROJECT PARTICIPANTS

The Project attracted 232 different Allen County farmers to participate during its five year course. Figure 4 represents the total number of farmers who participated in the Project by year, and the percentage of those who were new participants. The graph reflects a sizeable number of farmers participating the first year. In 1982, participation was up due to the interest created by the first year, and fifty-nine percent of the total number of those farmers were new to the project that year. The third and fourth years show successive declines in the total participants. New people continued to set up demonstrations, but compared to total involvement, the rate was much lower. The final year reflects a considerable decrease in total participation but a significant increase in the percentage of new cooperators. The District had evaluated the project direction and revised the guidelines to allow maximum opportunity for new cooperators to participate and to eliminate those farmers who had been using the project as a convenience. The result was a more manageable project year with emphasis on quality instead of quantity.

CONSERVATION TILLAGE TYPES

Four tillage types were compared in the demonstration plots. They were no-till, chisel plowing, offset disking, and conventional methods. No-till, chisel plowing and offset disking represent conservation tillage practices. Conventional methods used in the plots were for comparative purposes and included fall moldboard plowing, spring moldboard plowing, tandem disking, and field cultivation, or any other method that disturbed the soil enough to result in less that 30 percent residue cover.

Acreages in the Demonstration Plots

Tables 7 and 8 list acreages for the demonstration plots by crop and tillage type respectively. Annual acreages are listed along with the totals for the entire project period. A grand total of 16,178 acres were involved over the five years of the Project. The total project budget ($672,880) includes both the federal and nonfederal shares of outlays, and amounts to a total cost of $41.59 per acre.

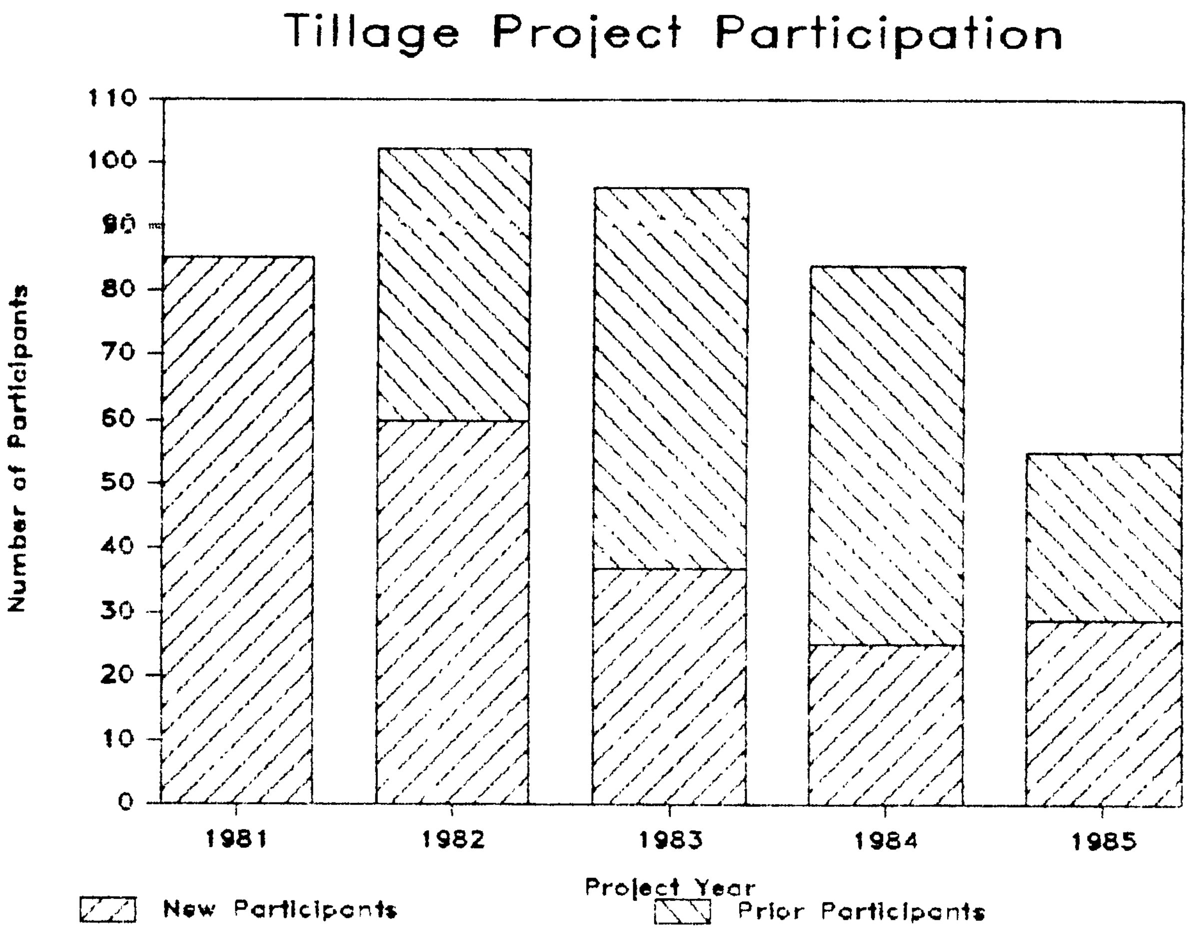


Figure 4. Total project participation as compared to new participants

TABLE 7. DEMONSTRATION PLOT ACREAGES BY CROP

Year	Corn	Soybeans	Wheat	Total
1981	2,195	1,943	99	4,327
1982	1,924	1,308	0	3,232
1983	1,662	1,331	298	3,291
1984	1,105	1,227	160	2,492
1985	1,450	1,476	0	2,926
Totals	8,336	7,285	557	16,178

TABLE 8. DEMONSTRATION PLOT ACREAGES BY TILLAGE TYPE

Year	No-Till	Chisel Plow	Offset Disc	Conventional Comparison	Total
1981	839	781	454	2,163	4,237
1982	640	617	277	1,698	3,232
1983	652	469	284	1,886	3,291
1984	263	147	136	1,946	2,492
1985	554	619	215	1,538	2,926
Totals	2,948	2,633	1,366	9,231	16,178

INFORMATION AND EDUCATION

Meetings and Training Seminars

Over the project period, ten meetings and seminars were held. The purpose of these gatherings was to update the farmers on the results obtained from the plots to date and to inform them of the latest conservation tillage management techniques. Local farmers, area equipment dealers, Ohio C.E.S. specialists, and S.C.S. representatives were called upon for presentations at these meetings and seminars.

Field Tours

Field days and tours were an ideal way for farmers to get a closer look at the demonstration plots. A total of eleven were held for the Project. Various resource people were called upon to discuss such topics as variety and hybrid selection, fertility, herbicide programs, equipment, and insect pressure.

Newsletters

The Allen S.W.C.D. publishes four to six newsletters each year. The mailing list included anyone who was signed up as a District cooperator and others who specifically requested to be on the list. Twenty newsletters published during the project period included information on the demonstration plots.

Young Farmer Presentations

Five local school districts sponsor adult education classes for farmers. They meet weekly, in the evenings, from December to April. The S.W.C.D. and S.C.S. staff members gave thirteen presentations to the various Young Farmer chapters over the five years of the Project. As a result, many new participants were acquired.

Vocational Agriculture Plots

The District made the project equipment available to all vocational agriculture (vo-ag) departments in the county. Four departments participated during the Project and put out a grand total of 313 acres. The farmland involved was either owned by the school or the township. The vo-ag departments were either given the land to farm and maintain or they rented it. Operating expenses came from their Future Farmers of America (F.F.A.) chapter treasury. All profits were used to support chapter activities.

The demonstration plots established on these lands were used to teach the vo-ag students about conservation tillage practices. Approximately 253 high school vocational agriculture students were exposed to these particular plots.

SECTION 4d

CONCLUSIONS

PROJECT IMPACTS

The Conservation Tillage Demonstration Project had quite a positive impact on agriculture in Allen County and the agencies directly involved with the demonstrations.

<u>Agency Programs</u>

Allen Soil and Water Conservation District--

The biggest impact that the Project had on the Allen S.W.C.D. was the number of new cooperators it attracted. Sixty-nine of the farmers (29.7%) participating in the demonstrations had never had any prior contact with the Allen S.W.C.D. As a result of their involvement in the tillage plots, many requested further assistance from the District for other conservation practices.

The funds from the grant paid for the basic needs of much of the program. The District responded in kind with increases in staff and equipment to accommodate the Project operations. An additional employee was hired, two vehicles were purchased, and more office space and equipment was procured. These acquisitions were retained after the completion of the Project for use in continuing the conservation tillage efforts and other District programs.

The Project also resulted in a close working relationship between the District and area agribusinesses. Very little interaction had taken place prior to 1980.

Early in 1985, as the Project came to an end, the District leased approximately 170 acres of farmland from the Allen County Commissioners. The purpose of the new venture was to demonstrate conservation farming on a long term basis. The farm equipment that remained from the Project, along with the considerable knowledge and experience that had been obtained, enabled the District to operate this county land as a Demonstration Farm.

Soil Conservation Service--

The Project provided valuable field experience for S.C.S. trainees. Four trainees received considerable first-hand knowledge of conservation tillage while stationed in Allen County, and others gained experience through short training details. Compared to the other counties in the Lake Erie Basin, with the exception of Defiance County, the Allen S.W.C.D. Water Quality Project was a bit unique, especially considering the amount of equipment involved.

Allen County Cooperative Extension Service--

The agriculture agent initiated the pest scouting program, which brought about the awareness that no-till crops, require regular scouting visits. Through the Project, the Extension Service expanded their corn hybrid plots to include no-till trials. The C.E.S. also increased their educational efforts in the area of conservation tillage. Speakers and resource people from the Ohio State University were secured for various meetings, workshops and field days that were held in cooperation with the Allen S.W.C.D. Literature as well as crop planning assistance were made available to the farmers . Field visits were also made to view problems and check the progress of the crops.

Allen County Agricultural Stabilization and Conservation Service--

The A.S.C.S. was making one-time payments to farmers trying no-till for the first time. Farmers could receive ten dollars per acre on a maximum of ten acres. This program was discontinued after the start of the Allen S.W.C.D.'s Conservation Tillage Demonstration Project. Since the District was offering the use of no-till planters and other conservation tillage tools at no charge to any interested farmer, the A.S.C.S. committee decided not to offer any A.C.P. cost share for conservation tillage. As a result, additional A.C.P. monies were freed for cost-sharing of related conservation projects.

Agribusiness--

Most agribusiness firms benefited from the Conservation Tillage Demonstration Project with increased business and sales. Conservation tillage brought about increased chemical sales. According to the C.T.I.C. in Fort Wayne, Indiana, farmers spent four to twelve additional dollars per acre in no-till for the application of a contact herbicide. Most farmers who did their own chemical spraying had the contact herbicide custom applied on no-till fields.

Opportunity arose for more custom work such as planting. Implement dealers and individuals performing custom planting usually had all the business than they could handle, if not more. Rental of conservation tillage tools was also in demand. Few farmers were willing to go out and buy such equipment without first trying it for a season or two.

The demonstration plots provided a place for the area chemical representatives to put out herbicide test plots. Direct comparisons were made from one brand to another. Application timing was also compared.

As the Project progressed, area weed, seed and feed dealers expanded and updated their equipment to meet the needs of the conservation tillage farmer. Like the participating farmers and S.W.C.D. staff, the agribusinessmen learned much about the application of conservation tillage in Allen County.

Inter-agency Cooperation

The agencies worked well together, and were always willing to offer assistance or other input. The Project benefited significantly from this existing inter-agency cooperation. For many of the agencies, the Project served as an introduction to each other and several of the associations that were established have continued through other programs.

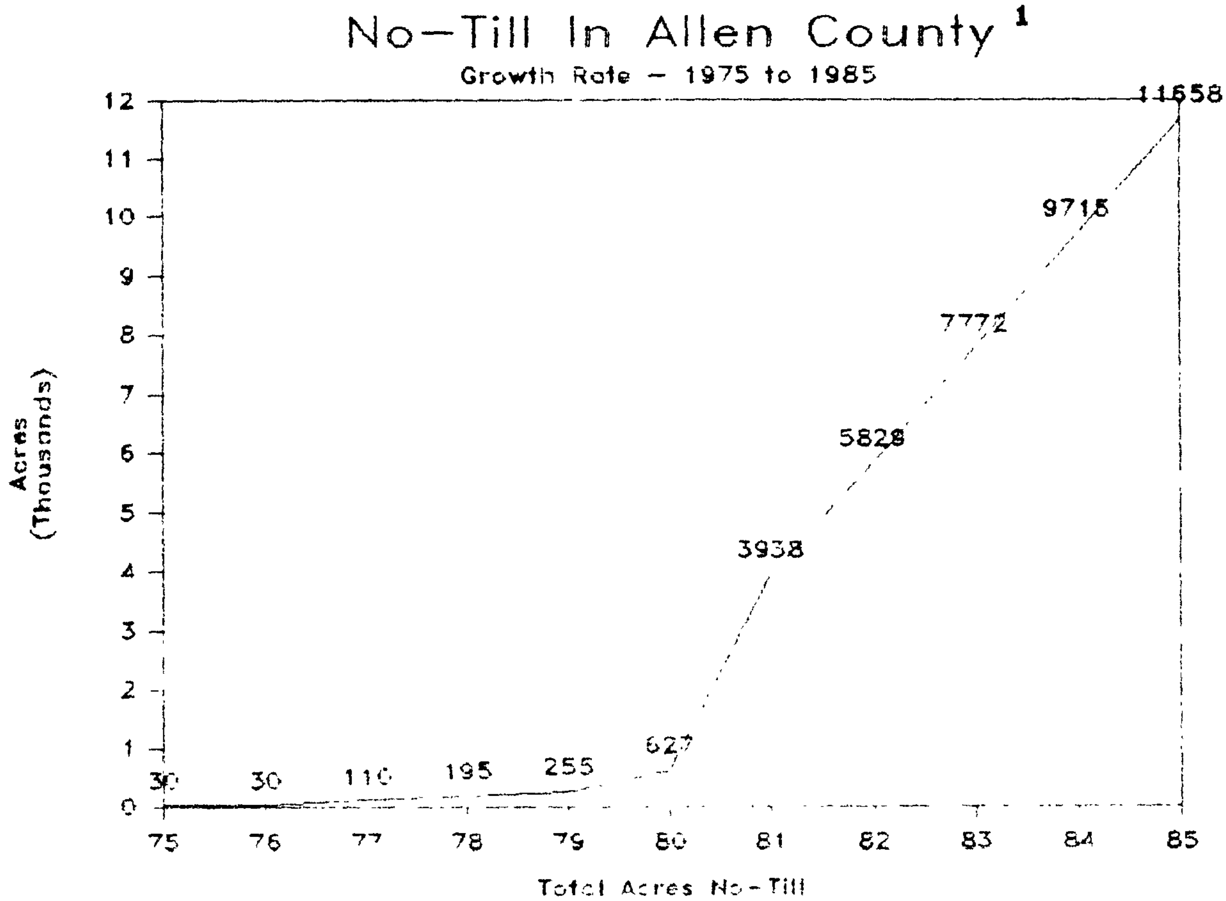
Implementation of Conservation Tillage

The project saw a definite growth in the acceptance of conservation tillage practices over the years. The adoption of no-till, in particular, was influenced the most by the demonstration project. From 1980 to 1985, no-till acres in the county increased from 0.3 percent to 6 percent of the farmland in the county (Figure 5). Mulch tillage increased from 10 to 30 percent of the total acres of farmland in Allen County (Figure 6).

Since 1980, the sales of mulch-tillage equipment, such as chisel plows and offset discs have skyrocketed. Much of this is due to the fact that in comparison to a moldboard plow, the operation of these tools requires less fuel, and often decreases time spent in the field. Even though they will also significantly aid in the reduction of erosion under proper management, the key factor in their sales has been the savings the farmers realize in fuel and time. Considering the number of mulch-tillage tools throughout the county though, the total number of acres under conservation tillage should be much higher than it is. One problem is that the farmers tend to work the ground "one extra pass" and to bury more of the residue before planting. For reduced-tillage practices to effectively reduce erosion and even be considered as conservation tillage, there must be a minimum of 30% residue cover left on the soil surface at planting. In many cases, residue at planting falls short of this. Our challenge is to convince the farmer to leave the minimum 30 percent residue cover required for erosion control.

No-till is so much more clearly defined than mulch-tillage, so measuring the amount of acres under this practice in the county is easier. In the past few years we have seen a steady increase in the number of no-till acres in production. Figure 5 illustrates the growth of no-till in Allen County over the past eleven years. It is obvious from the chart that the most growth occurred the year the demonstration project began planting no-till (1981). In the 1984 and 1985 especially, many no-till planters were sold in the area and almost as many farmers adapted their own planters for no-till use. Table 9 indicates the number of no-till farmers in the county and whether or not they participated in the Project. In 1985, each no-till farmer planted an average of 56 acres. Sixty-eight percent of the farmers who no-tilled in 1985 were involved in the Project at some time during its course.

Figure 6 shows the growth in reduced tillage applied to Allen County farmland over the past eight years. Sixty-five percent of the farmers in the county now use mulch tillage tools in their farming operation. On the average, each operator farms 118 acres by reduced tillage methods. Only 38 percent of those 781 farmers were involved in the Conservation Tillage Demonstration Project. It is clear to see that the demonstration project influenced the adoption of no-till more than mulch tillage.

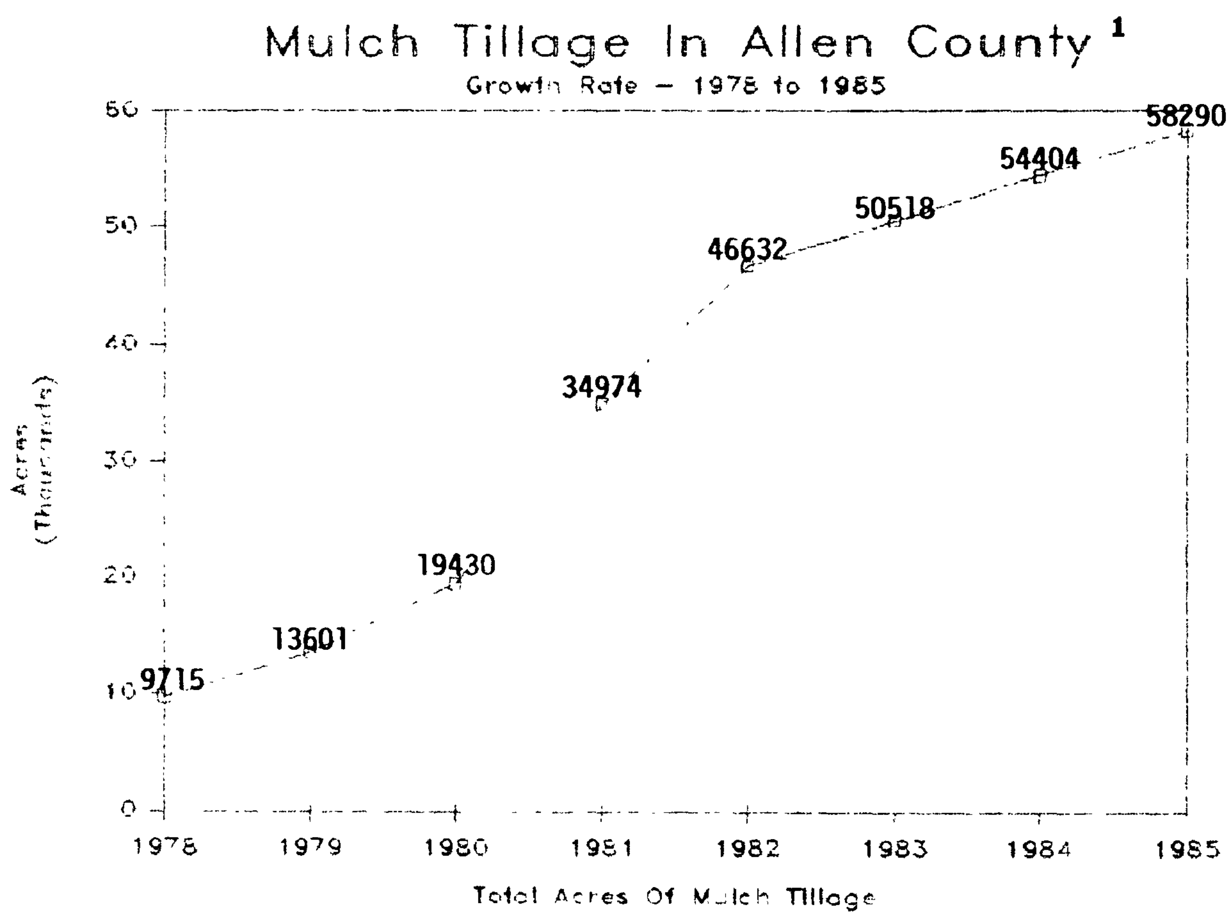


1 Developed from records maintained by Allen S.W.C.D. staff.

Figure 5. Growth of no-till in Allen County.

TABLE 9. NO-TILL FARMERS

	TOTAL # OF FARMERS NO-TILLING IN ALLEN CO.	% OF THOSE HAVING DIRECTLY PARTICIPATED IN THE PROJECT	% OF THOSE WHO DID NOT DIRECTLY PARTICIPATE IN THE PROJECT
1981	98	87%	13%
1982	139	82%	18%
1983	175	73%	27%
1984	206	73%	27%
1985	236	68%	32%



1 Developed from records maintained by Allen S.W.C.D. staff.

Figure 6. Growth of mulch tillage in Allen County.

Conservation tillage practices have proven themselves in Allen County and their acceptance is obvious through the increasing number of acres being managed under these methods and equipment purchases earh year. No-till, at this time represents 6% of the cropland in production in Allen County, and the mulch-tillage acreage stands at approximately 30 percent. Therefore, 36 percent of the farmlanc is currently being maintained under conservation tillage practices. The S.C.S. estimates that 64,534 total tons of Allen County soil have been saved on the conservation tillage demonstration plots as a result of the Project.

Negative farmer attitude was the biggest barrier when the Project was initiated. Conventional tillage has been a tradition in this area. There's just something about a well-tilled field that leaves a sense of satisfaction with most farmers. Some would tell you, "I've been doing it this way for years..." in response to any suggestion to change. Others couldn't bear the sight of a no-till field from the time it was planted until the crop canopies over the residue because it "went against their grain". However, the most significant effect the project had was its ability to break this barrier and begin to change the thinking of many farmers in the county. Many farmers are simply comfortable with their current operation and considering the fact that the average age of the area farmer is 50, it is not realistic to expect a mass change from a method they have been practicing for over 30 years. We believe that more conservation tillage practices will be applied to the land in the future, especially as equipment wears out and must be replaced. The current farm economy demands that farmers increase their efficiency. Many will change over as they search for new ways to cut costs and improve productivity. Eventually we will see attitudes changing, but it will take time.

PHYSICAL APPLICATION OF CONSERVATION TILLAGE TO THE AREA

After conducting 1,308 individual demonstration plots, the Allen S.W.C.D. concludes that conservation tillage practices can successfully be applied to Allen County soils. The tests have shown that in both corn and soybean production, chisel plowing, offset disking and no-till will yield competitively with fall and spring moldboard plowing.

The District was very pleased with the results from the demonstrations as a whole, but it is important to note that this was a **demonstration** project of farmer proven techniques, not a research project with controlled conditions. For the purpose of this report and for our own use, we have drawn some conclusions from the data obtained over the Project's existence. We suggest that those reviewing this final report should thoroughly evaluate its contents and then draw their own unbiased conclusions.

Influencing Factors

Weather influenced the project results more than anything else, but that was beyond anyone's control. Where farmers were concerned, their personal farm management ability had the most effect on the success of conservation tillage practices demonstrated on their own land.

For example, farmers no-tilling for the first time were encouraged to try planting corn into soybean stubble or soybeans into cornstalks, because an inexperienced no-tiller would most likely have better luck with one of these situations. No-till corn planted into wheat stubble, on the average, has not proven to yield as well as the same crop planted into soybean stubble. But a good manager, who considers all factors involved when planning a crop, and then proceeds accordingly, can get an excellent yield from a no-till corn crop planted into wheat stubble.

Figure 7 compares the yields of one such Allen County farmer (Farmer X) who planted no-till corn into wheat stubble on the same farm for seven consecutive years, to the county's average yields for the same condition and the average yields of all no-till corn crops from the demonstration plots. The illustration shows that this particular farmer's yields were well above the others in each of the seven years. Therefore, we believe that management ability has a lot to do with the continued success of no-till.

Many variable factors influenced the success, or failure, of the test plots besides differences in management ability from farm to farm. Soil type, drainage, seed variety or hybrid, fertilization, herbicide programs, and planting and harvest dates varied quite a bit. This too should be taken into consideration when evaluating the results.

Significant Difference and Success Rate

Two terms are used in the following text: significant difference and success rate. The expression, significant difference is used by the Allen S.W.C.D. when evaluating yields and returns. When comparing two numbers, it denotes a difference of greater than five percent. Significant difference, as the Allen S.W.C.D. uses it, is not a true calculated least significant difference (L.S.D.) figure, but an arbitrary five percent figure that they selected as being representative in view of the way the demonstrations were carried out. Considering the large number of variables involved, a difference of five percent or less is deemed trivial by the District. Success rate is defined as: the number of times a system was equal to or surpassed its comparison, relative to the total number of times that it was tested.

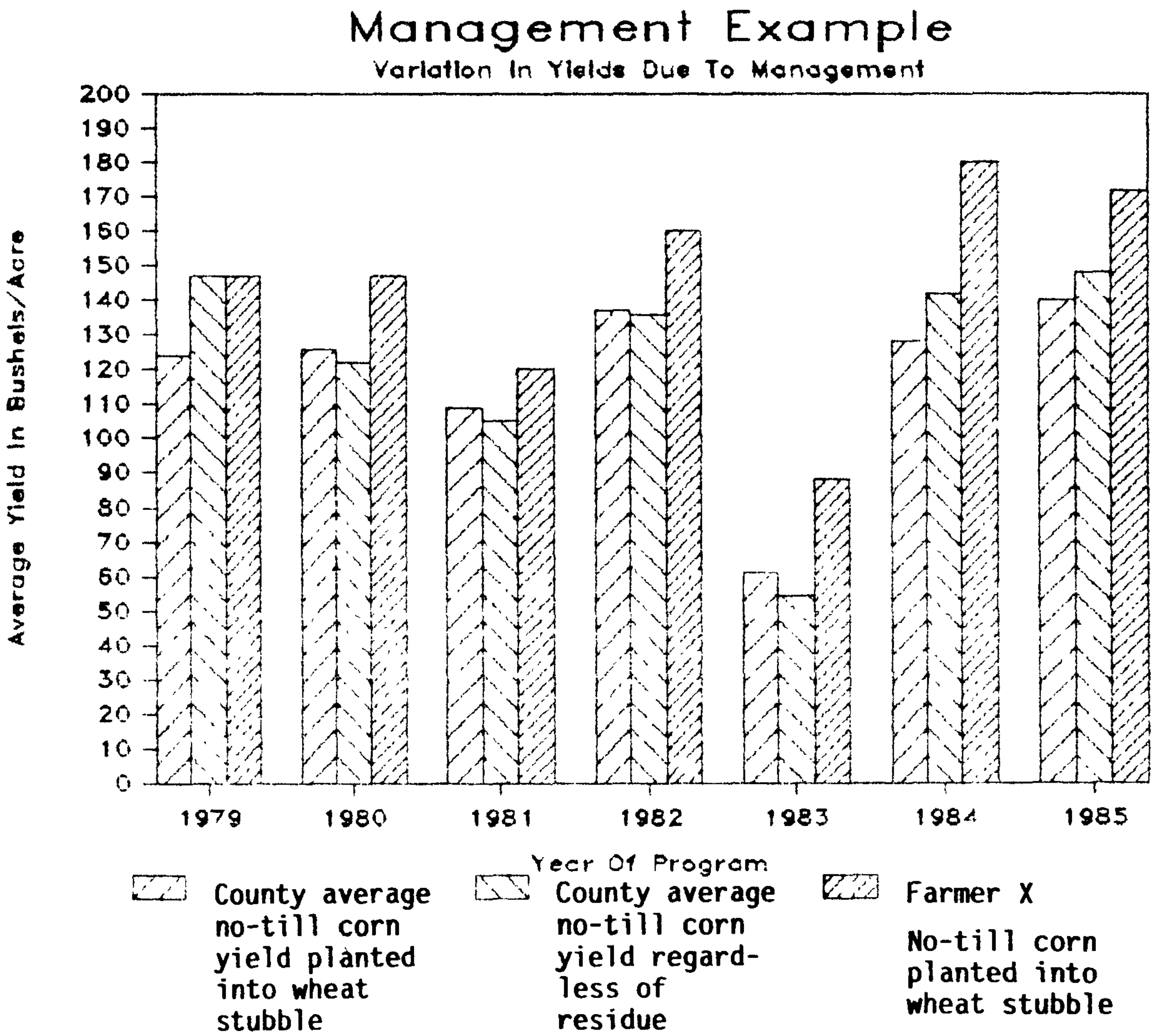


Figure 7. No-till management example.

Corn Production

Table 10 compares the average corn yields by tillage system for each year of the Project. It also gives the average corn yield for the county as reported by the Ohio Crop Reporting Service. Figures 8 and 9 show the five year averages of corn yields and success rates respectively by tillage type.

Fall plowing and chisel plowing resulted in the highest average yielding system of the five that were compared during the Project (Table 10 and Figure 8). They yielded significantly higher than the other three systems.

As seen in Figure 9, spring plowing had the highest success rate, but it should be noted that it was only tested 19 times (Table 10). There was a significant difference between it and second ranked chisel plowing. With the exception of no-till, which had a 48 percent success rate, all four of the other systems were successful over half the time.

Each type of tillage tested, with the exception of offset disc, provided the highest average yield in at least two of the five Project years (Figure 10). With the exception of four systems in 1983, which was a drought year, and the no-till yield in 1984, the average yearly corn yield for the county was lower than the average yield of any of the tillage systems tested (Table 10). A total of 868 different corn plots were established during the Project.

TABLE 10. COMPARISON OF CORN PLOT YIELDS BY TILLAGE SYSTEM

	NO-TILL	FALL PLOW	SPRING PLOW	OFFSET DISC	COULTER CHISEL	COUNTY AVG.*
1985 Avg.	137+(7)	151(5)	141(6)	140(5)	146(5)	129
1984 Avg.	122(4)	158(3)	--	137(4)	156(3)	127
1983 Avg.	66(12)	49(9)	25(1)	48(10)	49(15)	65
1982 Avg.	144(17)	137(14)	142(6)	136(8)	148(13)	129
1981 Avg.	109(22)	136(17)	139(6)	119(11)	123(15)	101
Project Average	116(62)	126(48)	112(19)	116(38)	124(51)	
Success Rate	30/62	35/48	16/19	20/38	40/51	

* as reported by the Ohio Crop Reporting Service
\+ yields reported in bushels/acre
( ) number of tests

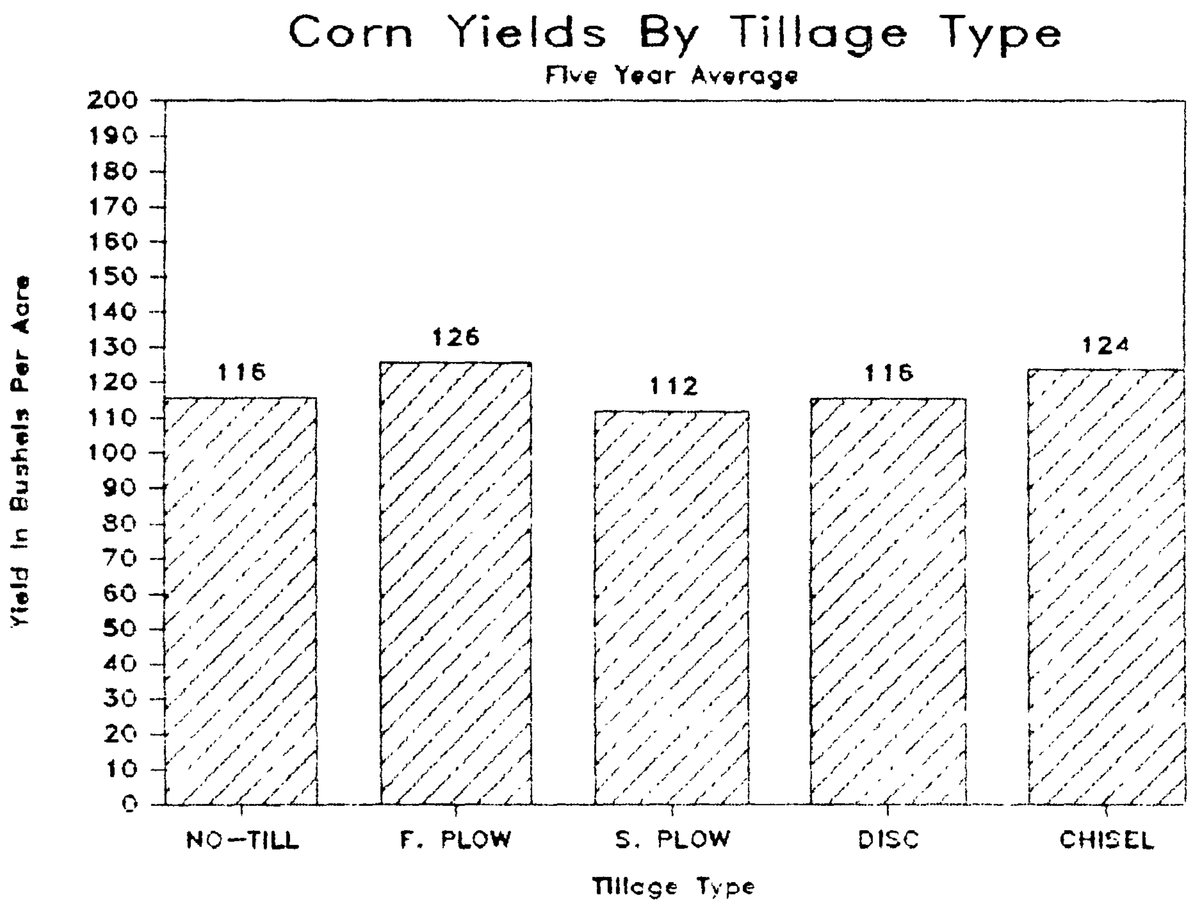


Figure 8. Five year average of corn yields by tillage type.

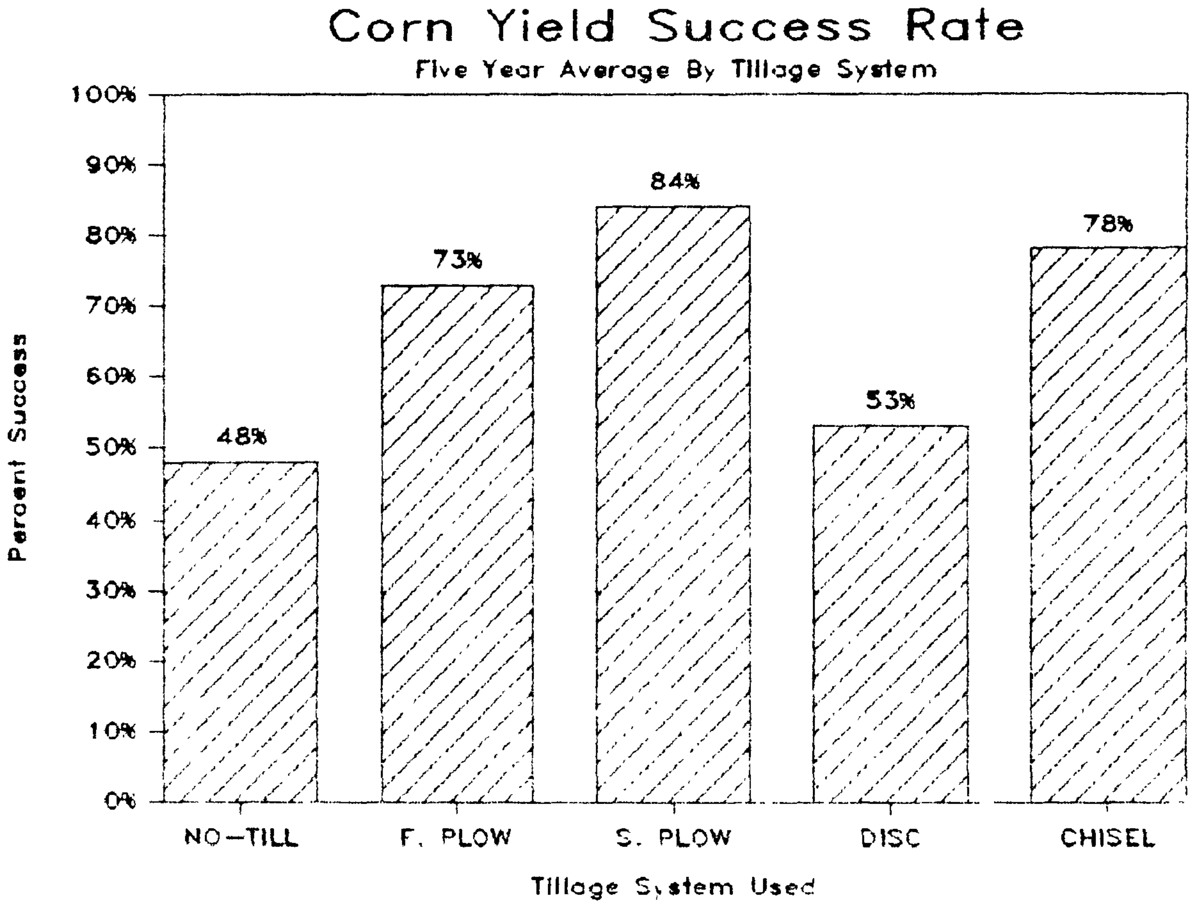


Figure 9. Corn yield success rate by tillage type.

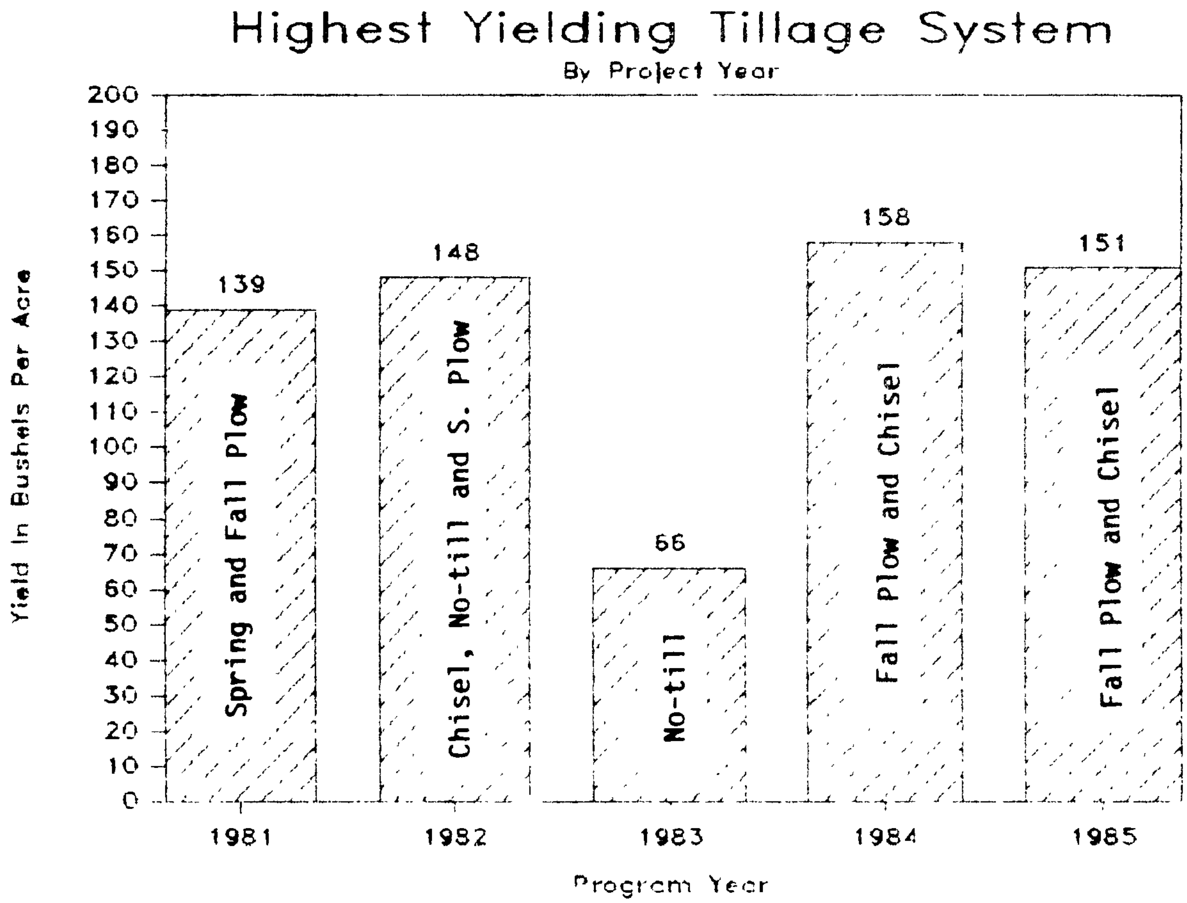


Figure 10. Highest yielding tillage system, on the average, by project year.

No-till--

Much more emphasis was placed on no-till in this Project than on mulch tillage. This was because mulch tillage does not differ significantly from conventional methods, whereas no-till represents a drastic change. Mulch tillage was already considered a successful practice in the county, but it needed to be promoted to increase its usage and adoption. It was estimated that mulch tillage was being applied to ten percent of Allen County farmland in 1980. No-till, on the other hand, was only being applied to 0.3 percent (0.0032) of the farmland. The District decided that no-till crop production merited more of their time and effort.

The average no-till corn yields compare quite favorably to the county's average yield, as Figure 11 indicates. Figure 12 compares the average no-till yield to the highest yielding system's average. There was not a significant difference between the two in 1982 or in 1985. No-till was the highest yielding system in 1983, a drought year, and in 1985.

Residue cover-- Residue cover has been shown to have an affect on no-till success, and this can be seen in Table 11 and Figure 13. No-till corn was most successful when planted into soybean residue. Very high and very low yields were experienced with no-till corn crops planted into wheat stubble. The District found that planting no-till corn was least successful when planting into cornstalks.

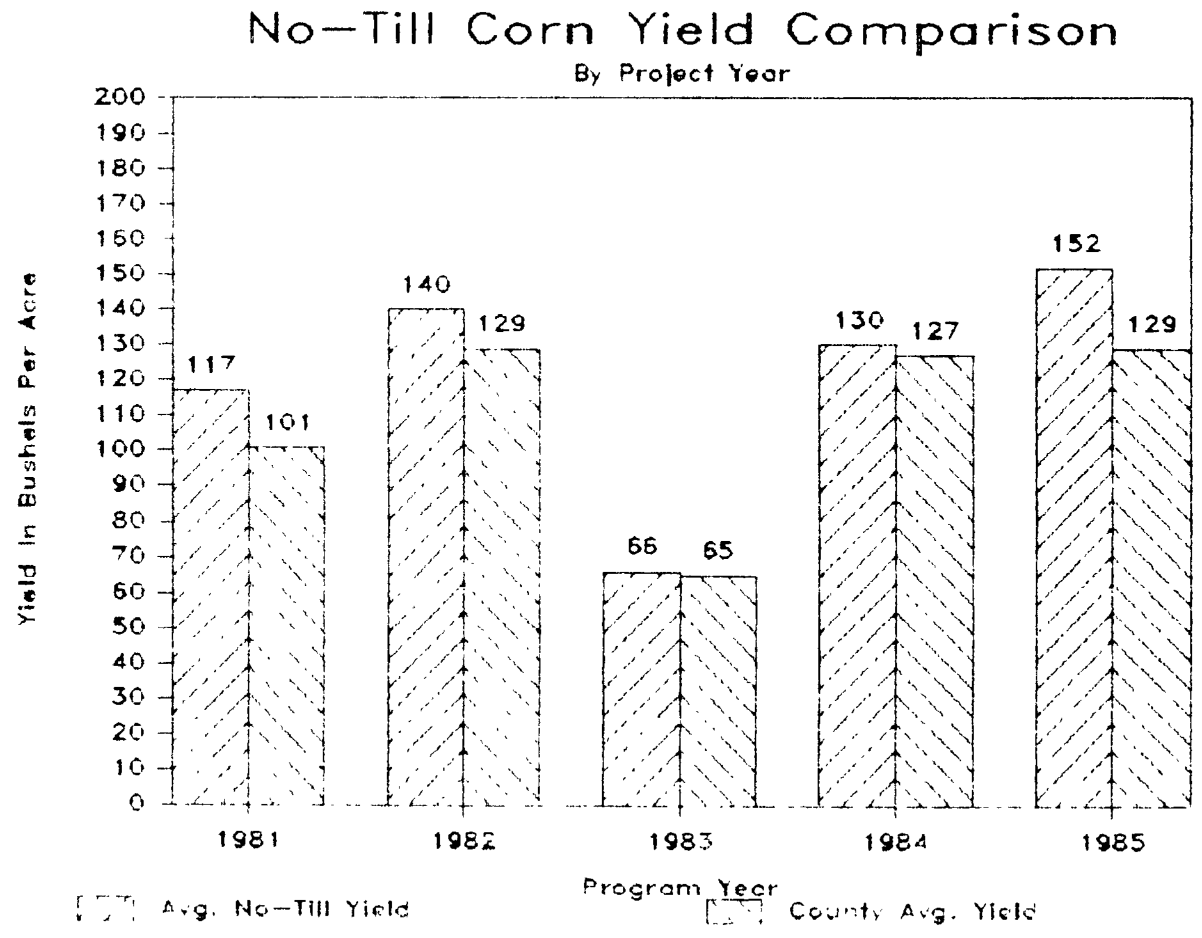


Figure 11. No-till corn yield comparison with the county average yield.

Soybean stubble was clearly in the lead in 1981 while there was not a significant difference between the wheat stubble and cornstalk residue yields. The same held true in 1983, and a similarity was also observed in 1982 and 1984. There was not a significant difference between top yielding soybean stubble and wheat stubble, while cornstalks yielded approximately eight to fifteen percent lower. The corn planted into cornstalk residue yielded the highest in 1985, but the fact that this is from only one test needs to be taken into consideration. Wheat stubble residue was second with four tests and was significantly higher than the average of the 20 plots planted into soybean stubble.

When comparing the Project's average for each type of cover though, soybean stubble is slightly in the lead over the other two types (Table 11).

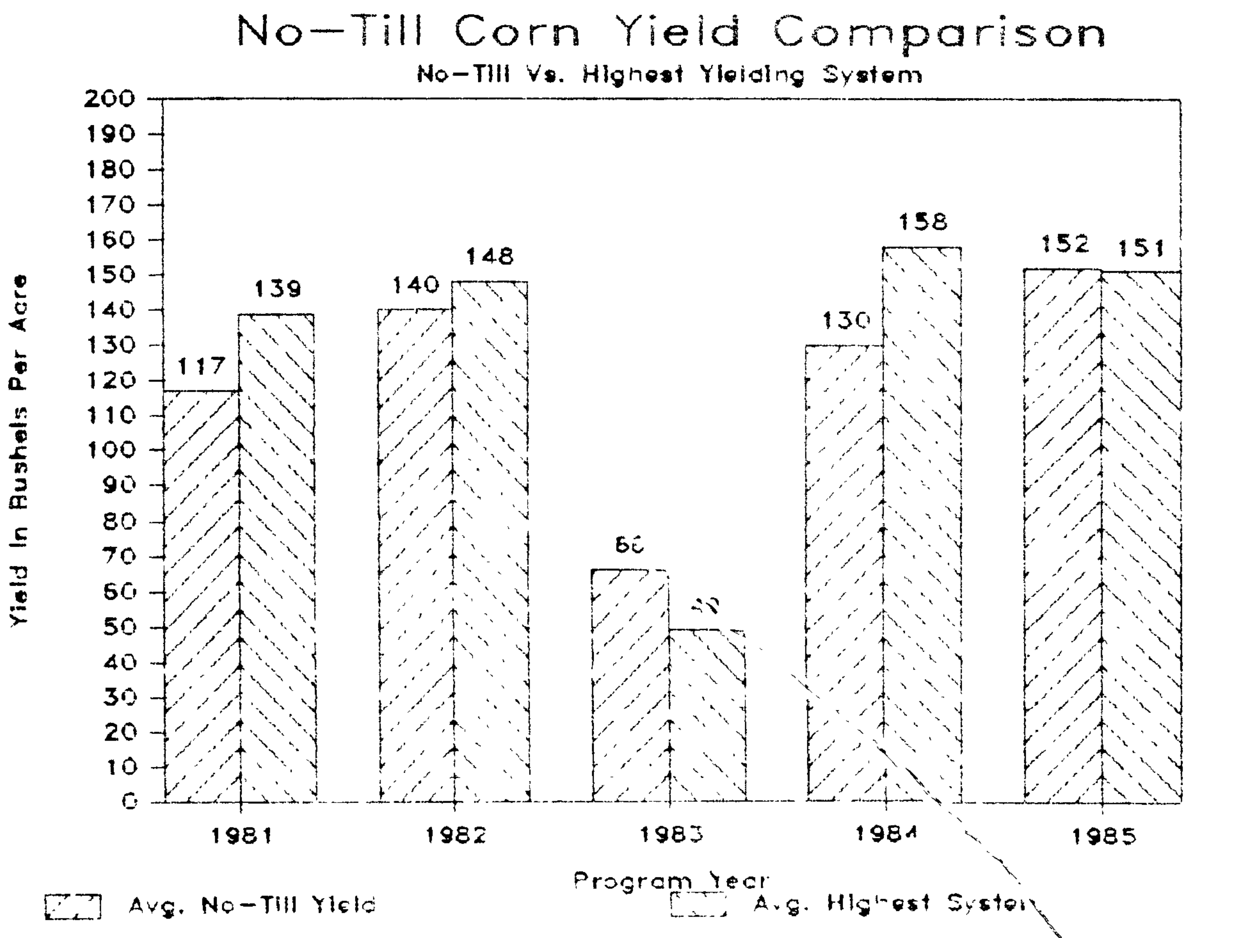


Figure 12. No-till corn yield comparison with the highest system.

TABLE 11. COMPARISON OF NO-TILL CORN YIELDS BY RESIDUE COVER

YEAR	CORN STALKS	WHEAT STUBBLE	SOYBEAN STUBBLE
1985	180+ (1)	148 (4)	139 (20)
1984	121 (11)	142 (10)	139 (18)
1983	56 (11)	54 (16)	72 (16)
1982	125 (6)	136 (25)	143 (19)
1981	101 (7)	105 (19)	128 (5)
AVERAGE	117 (36)	117 (74)	124 (78)

\+ yields reported in bushels/acre
( ) indicates number of tests

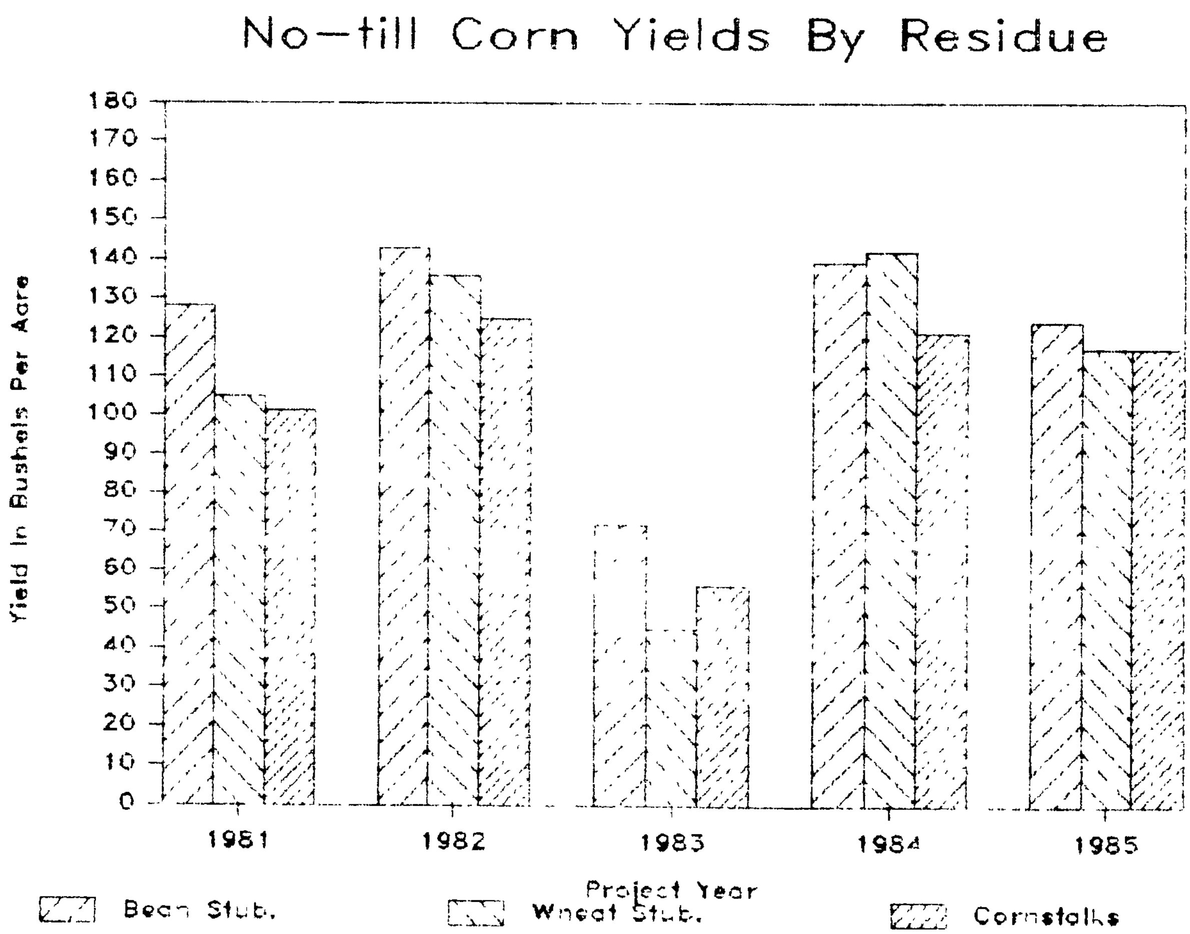


Figure 13. Average yearly no-till corn yields related to residue cover.

Soybean Production

Four hundred and forty different soybean plots were operated over the course of the Project. Table 12 compares the average soybean yields by tillage system for each year of the Project. It also gives the average soybean yields for the county as reported by the Ohio Crop Reporting Service. Figures 14 and 15 show the five year averages of soybean yields and success rates respectively by tillage type.

We are inclined to believe that soybeans are insensitive to tillage. Five years of tests indicate little difference in yield by tillage type. On the average, no-till, fall plow and chisel plow showed the highest yield, but offset disc was not significantly lower. Spring plow followed behind with a seven percent difference compared to the three top ranked systems. Each tillage system tested provided the highest yield on the average in at least one of the five Project years (Table 12). This includes those systems that did not show a significant difference in yield.

Fall plow had by far the highest success rate. All five of the systems were successful well over half the time. The average yearly county soybean yields were lower than any of the five tillage system averages except for 1983, which was a drought year (Table 12).

TABLE 12. COMPARISON OF SOYBEAN PLOT YIELDS BY TILLAGE SYSTEM

	NO-TILL	FALL PLOW	SPRING PLOW	OFFSET DISC	COULTER CHISEL	COUNTY AVG.*
1985 Avg.	44+(4)	52(7)	44(3)	43(4)	47(12)	42
1984 Avg.	47(8)	45(8)	41(3)	45(7)	44(7)	39
1983 Avg.	34(13)	34(14)	23(1)	27(17)	29(11)	29
1982 Avg.	41(12)	41(7)	46(7)	45(13)	47(12)	39
1981 Avg.	39(9)	34(7)	36(2)	39(9)	36(8)	29
Project Average	41(46)	41(43)	38(16)	40(50)	41(50)	
Success Rate	29/46	34/43	10/16	33/50	31/50	

* as reported by the Ohio Crop Reporting Service
\+ yields reported in bushels/acre
( ) indicates number of tests

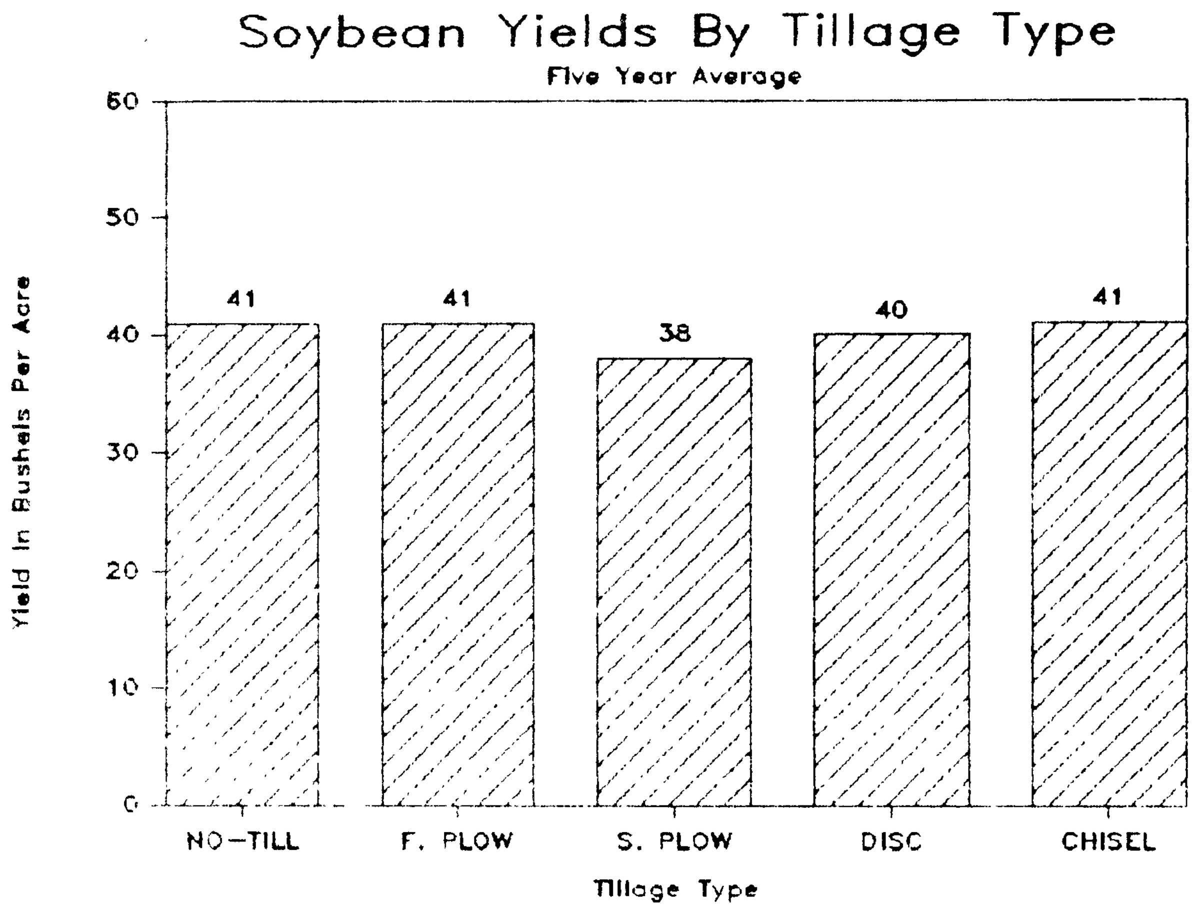


Figure 14. Five year average of soybean yields by tillage type.

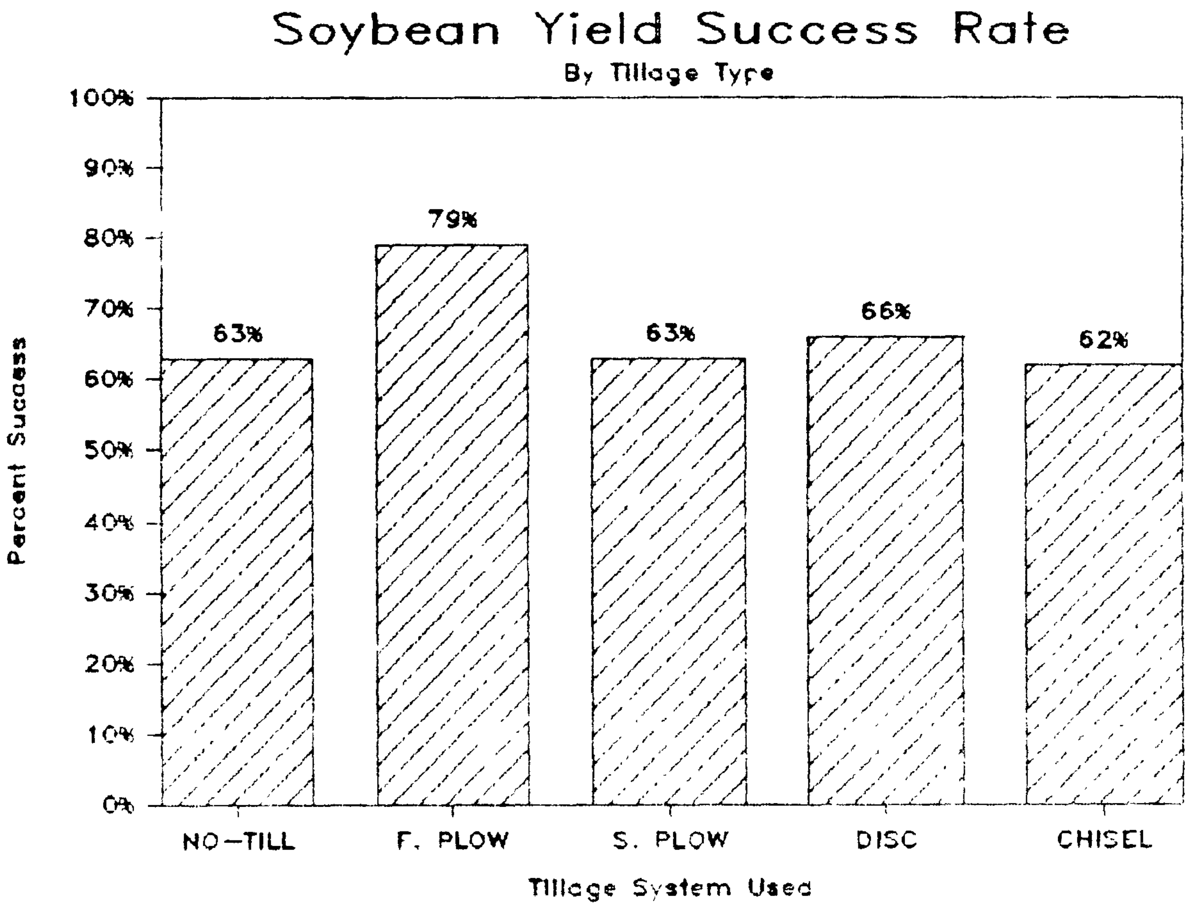


Figure 15. Soybean yield success rate by tillage type.

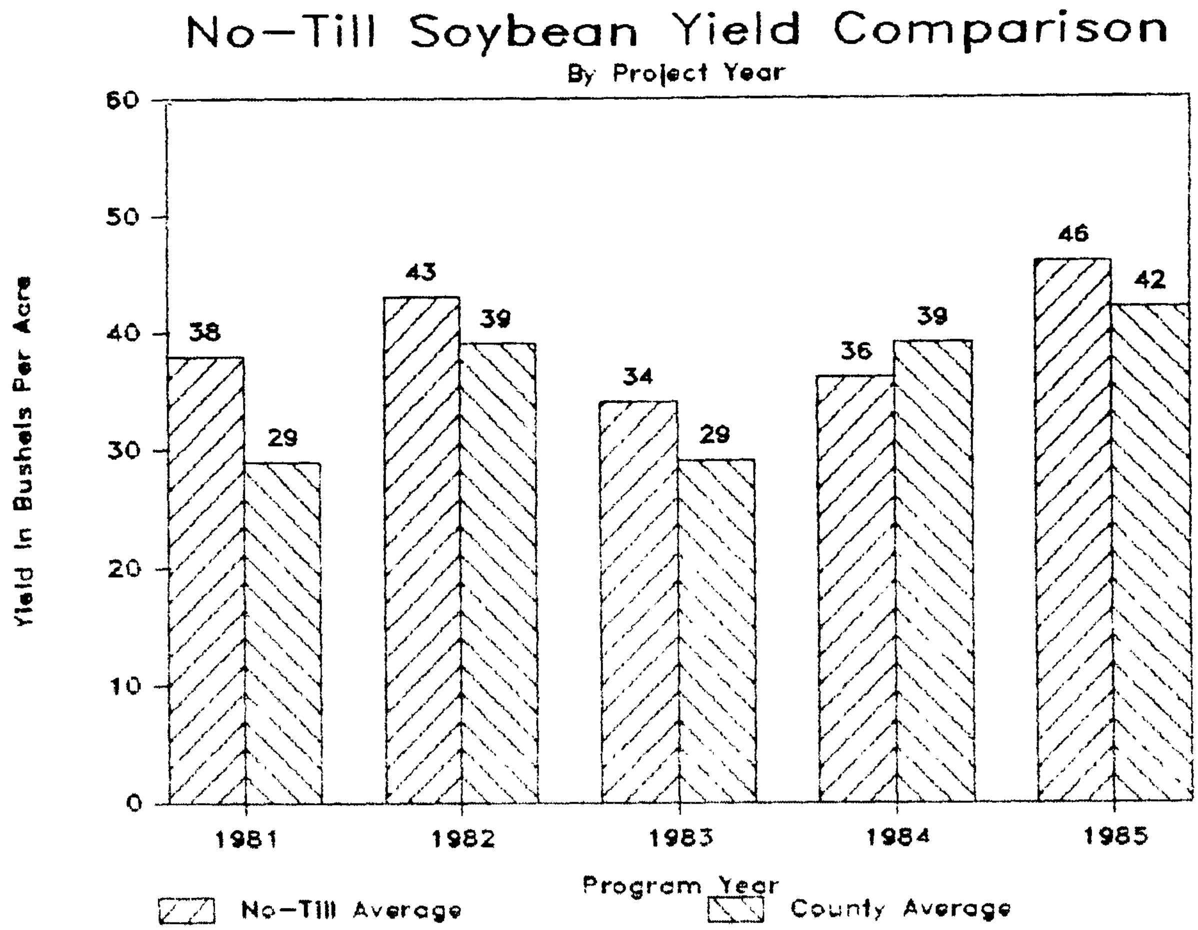


Figure 16. No-till soybean yield comparison with the county average yield.

No-till--

Figure 16 depicts a significant difference, in favor of no-till, between the average no-till yield and the county's average yield in each of the Project years, with the exception of 1984 when the county average yield exceeded the no-till yield by three bushels.

Residue cover-- Table 13 compares the average yields from the three most common types of residue cover (Figure 17). Soybeans planted into cornstalks has the highest average yield. In fact, it was the highest yielding in all five of the years concerned including 1981, when there was no significant difference between it and the top yielding soybean stubble residue. Soybean stubble and wheat stubble follow cornstalks respectively. It should be noted that cornstalks had five to seven times the total number of tests than the other two did.

TABLE 13. COMPARISON OF NO-TILL BEAN YIELDS BY RESIDUE COVER

YEAR	WHEAT STUBBLE	SOYBEAN STUBBLE	CORN STALKS
1985	--	39+(7)	50 (9)
1984	26 (5)	34 (10)	40 (29)
1983	12 (4)	27 (3)	29 (37)
1982	33 (4)	38 (2)	45 (31)
1981	32 (3)	40 (6)	38 (18)
AVERAGE	26 (16)	36 (28)	40(124)

+ yields reported in bushels/acre
( ) indicates number of tests

Weed-control-- We did learn that good weed control is crucial when producing no-till soybeans. Considerable experience and knowledge is still needed in this area.

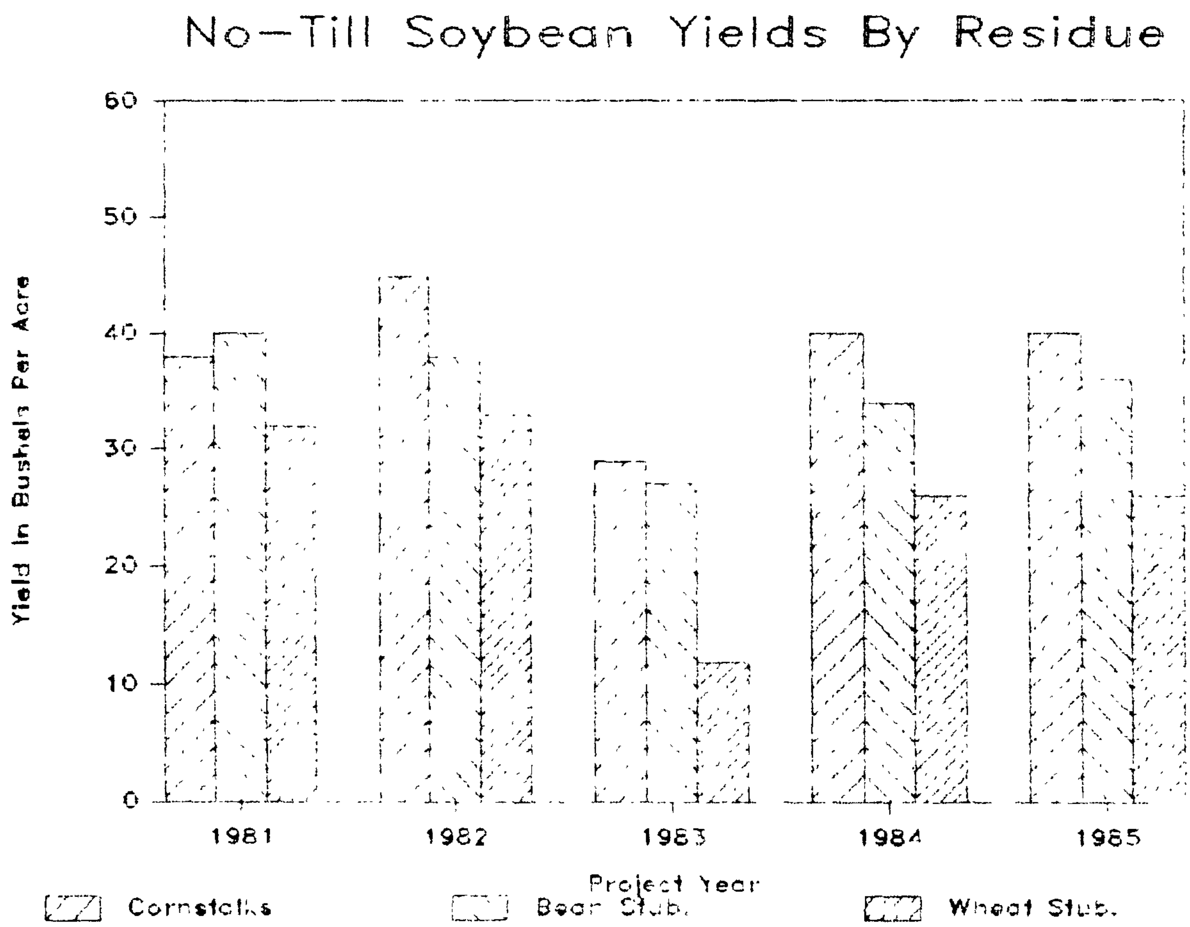


Figure 17. No-till soybean yields related to residue cover.

ECONOMIC APPLICATION OF CONSERVATION TILLAGE TO THE AREA

All of our tests indicate that the conservation tillage practices being applied to Allen County soils are economically feasible and the increase in usage of these practices is a direct reflection of that fact. Farmers today are looking toward efficiency and sound economics to survive in production agriculture. The following text takes a look at costs and net returns. The figures were developed on a per acre basis. Costs included all crop inputs such as seed, fertilizer, tillage, fuel drying, trucking, harvesting, etc...

Costs for the plots reflect an average of all the plots for a given year. A mean average was derived from the total of all five years. The farmers reported to the District the products and procedures and the rates applied to their plots. With the help of area agribusinesses and the C.E.S., an average value was established for each unit. Therefore, the cost figures used in this and other reports by the District, were determined by the Project staff.

In establishing the net return for a plot, the District multiplies the dry yield per acre by an average price per bushel for the county. This price is determined with the help of area grain elevators, and is an average price during harvest season. The production cost per acre is subtracted from the value and the result is net return. This figure represents what was left for land, labor and profit.

Corn Production

Costs--

Figures 18, 19 and 20 show the average fertilizer, herbicide and tillage costs for each tillage system. The total costs, by tillage type, are illustrated in Figure 21. An additional category, not graphically pictured, is included in the total cost figures. This miscellaneous grouping includes a nominal charge for seed interest and land. It also includes fixed costs for planting, harvesting, trucking, insecticide, and anything else not included in the other three categories. These fixed costs are based on tillage type, yield and possible residue cover.

Chisel plow had the lowest fertilizer cost (Figure 18). No-till and offset disc reflect considerably higher fertilizer costs. It is possible that farmers increased their fertilizer usage in their no-till plots, especially that, which was broadcast. The only explanation that we can offer for the difference between chisel plow and offset disc is that it is due to management levels and other factors that vary from participant to participant rather than requirements or differences due to tillage.

No-till had a higher herbicide cost than the other systems by about eight to ten dollars per acre (Figure 19). The application of a contact herbicide accounts for most of the increase. Offset disc had the lowest cost, but chisel plow and moldboard plow were only two dollars/acre higher.

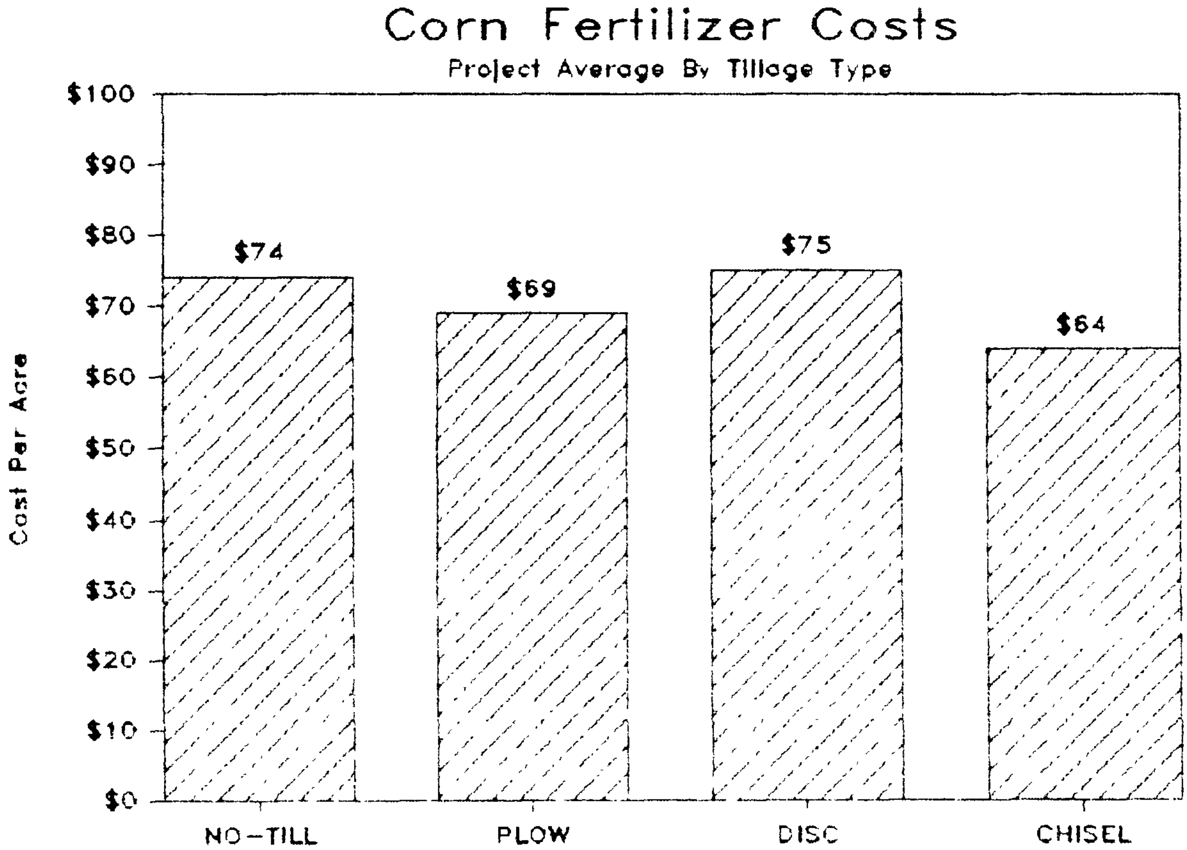


Figure 18. Corn fertilizer costs per acre by tillage system.

With respect to tillage costs, no-till was considered to have no charge (Figure 20). Moldboard plow had the highest cost, and offset disc and chisel plow were equal. They had lower tillage costs than moldboard plow primarily because it costs approximately $1.50 to $1.75 an acre less to operate a chisel or disc than a plow.

The miscellaneous category was fairly consistent, with the following average costs by tillage type: no-till, $85/acre; plow, $82/acre; disc, $81/acre; chisel, $82/acre.

There was no significant difference between the totals for each system (Figure 21). No-till showed the lowest total cost, while plow and disc had the highest, with a difference of nine dollars. The District considers these cost differences as being insignificant.

Net Returns--

The yearly net returns are listed according to tillage type in Table 14. Quite a bit of variance can be seen between years and tillage systems. All of the systems but offset disc were the highest returning in at least one of the five Project years.

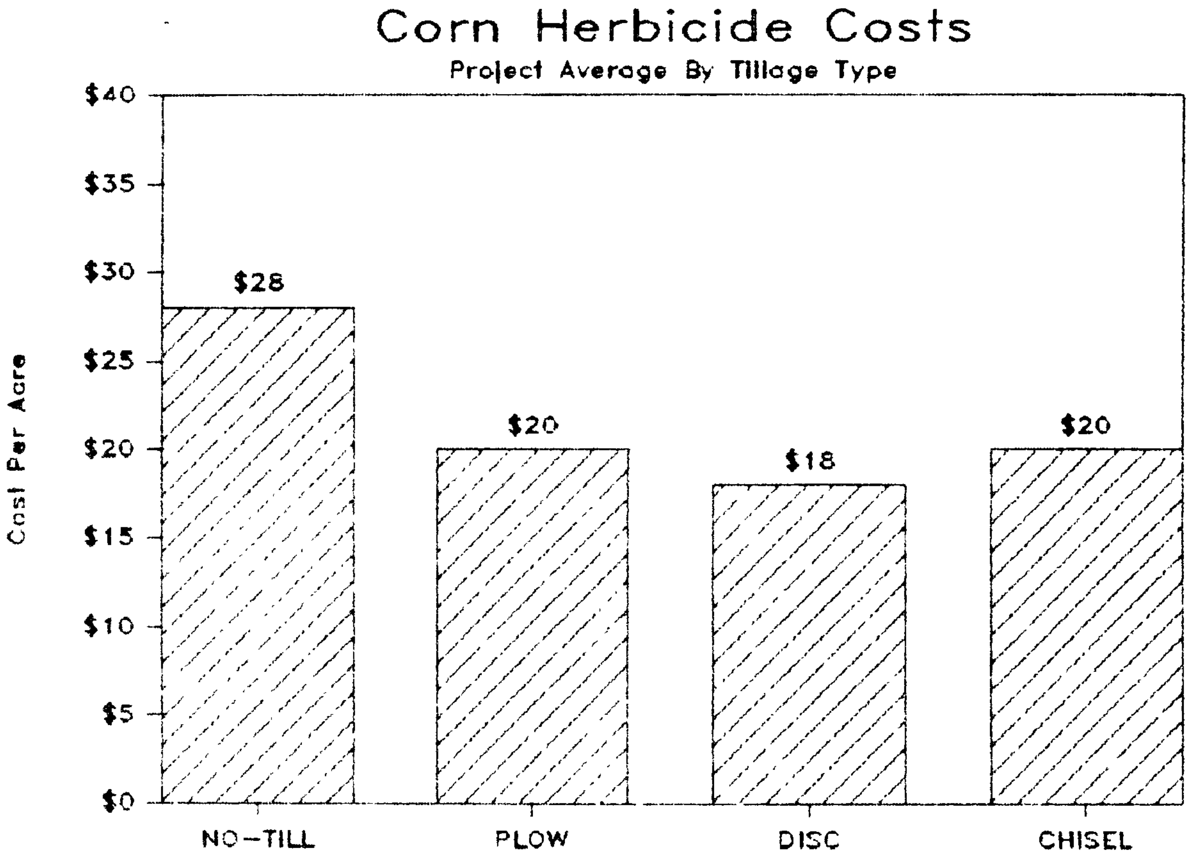


Figure 19. Corn herbicide costs per acre by tillage system.

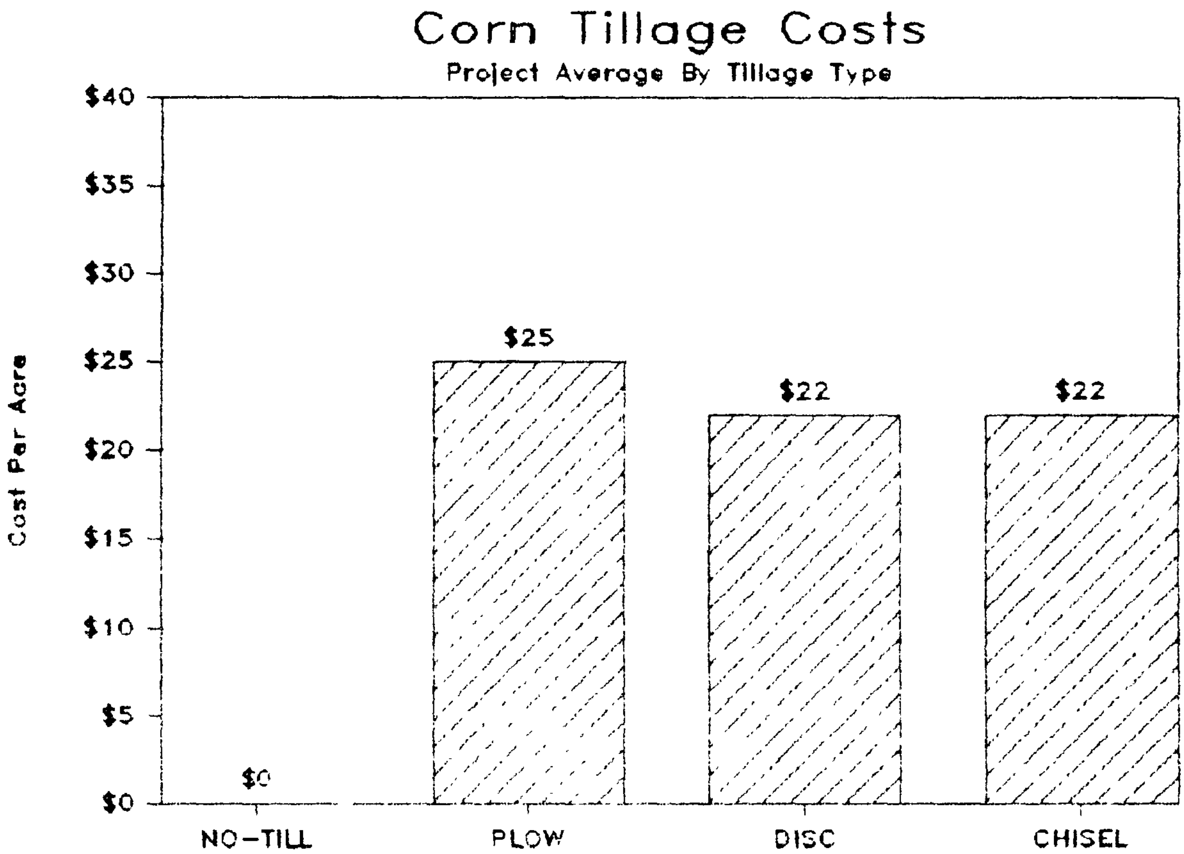


Figure 20. Corn tillage costs per acre by tillage system.

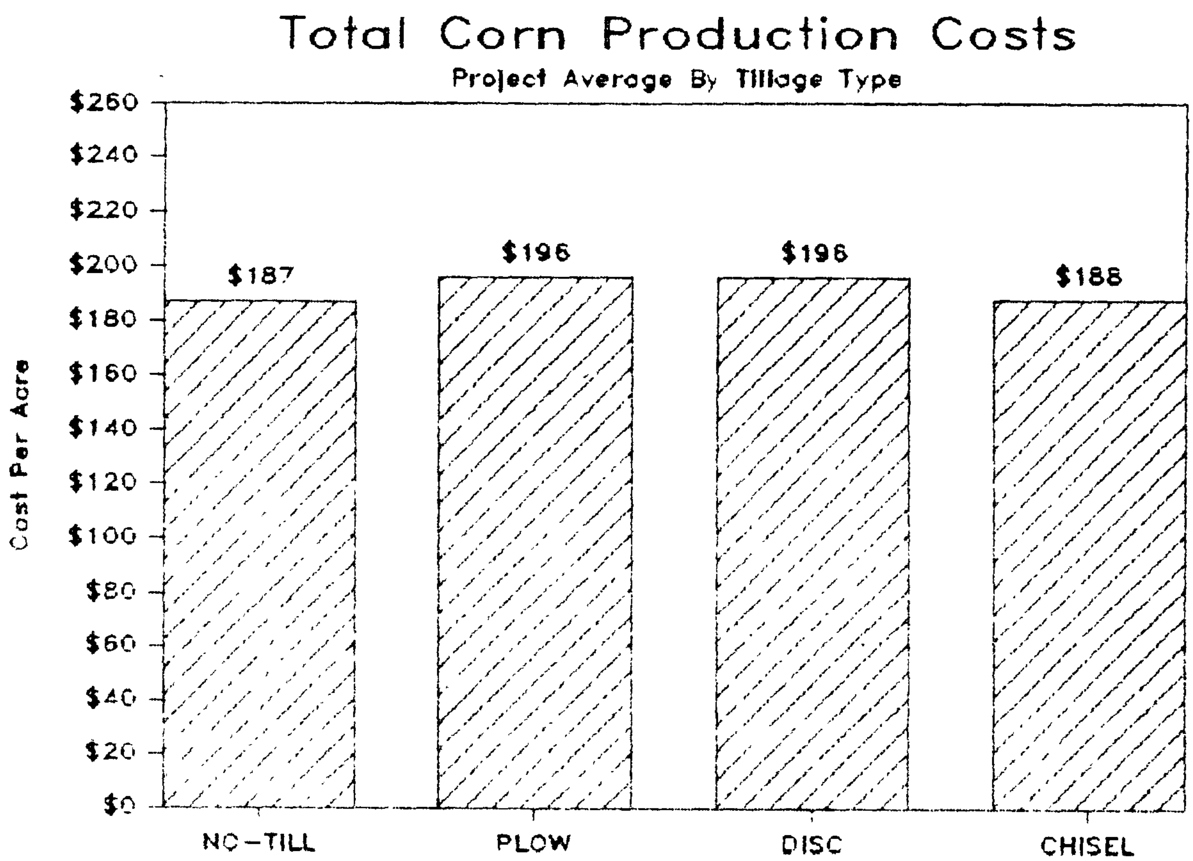


Figure 21. Total corn production costs per acre by tillage type.

TABLE 14. COMPARISON OF CORN PLOT RETURNS BY TILLAGE SYSTEM

	NO-TILL	FALL PLOW	SPRING PLOW	OFFSET DISC	COULTER CHISEL
1985 Avg.	$109£ (7)	$114 (5)	$ 84 (6)	$ 94 (5)	$124 (5)
1984 Avg.	120 (4)	181 (3)	--	152 (4)	206 (3)
1983 Avg.	41 (12)	-4 (9)	-92 (1)	-15 (10)	-20 (15)
1982 Avg.	39 (17)	28 (14)	47 (6)	13 (8)	37 (13)
1981 Avg.	9 (22)	73 (17)	66 (6)	23 (11)	54 (15)
Project Average	$ 64 (62)	$ 78 (48)	$ 26 (19)	$ 53 (38)	$ 80 (51)
Success Rate	28/62	27/48	7/19	15/38	28/51

£ returns reported in dollars/acre
( ) indicates number of tests

Table 14 also gives the average return for each tillage type for the entire Project period. Coulter chisel produced the highest average return. Fall plow was second highest with no significant difference between it and chisel plow. The no-till, offset disc and spring plow returns followed respectively. Spring plow may have fared a little better if it had been tested in 1984, since that was the highest returning year for all of the other systems. Figure 22 portrays this same data in graphic form.

Success rate is illustrated in both Table 14 and Figure 23. The net return success rates were a little more consistent than the yield success rates. Fall plow and chisel provided the highest net returns slightly more than half the time when evaluated with their direct comparisons.

Soybean Production

Costs--

Figures 24 through 26 show the trends of the soybean production costs. Overall, no-till had a significantly lower total production cost (Figure 27). There was no significant difference between the other three systems.

No-till and plow had the lowest average fertilizer cost (Figure 24). Chisel and disc, with $8 per acre, reflect the higher fertilizer cost.

Each system had significantly different tillage costs (Figure 25). No-till, having no tillage, was the lowest while plow reflected the highest average cost per acre.

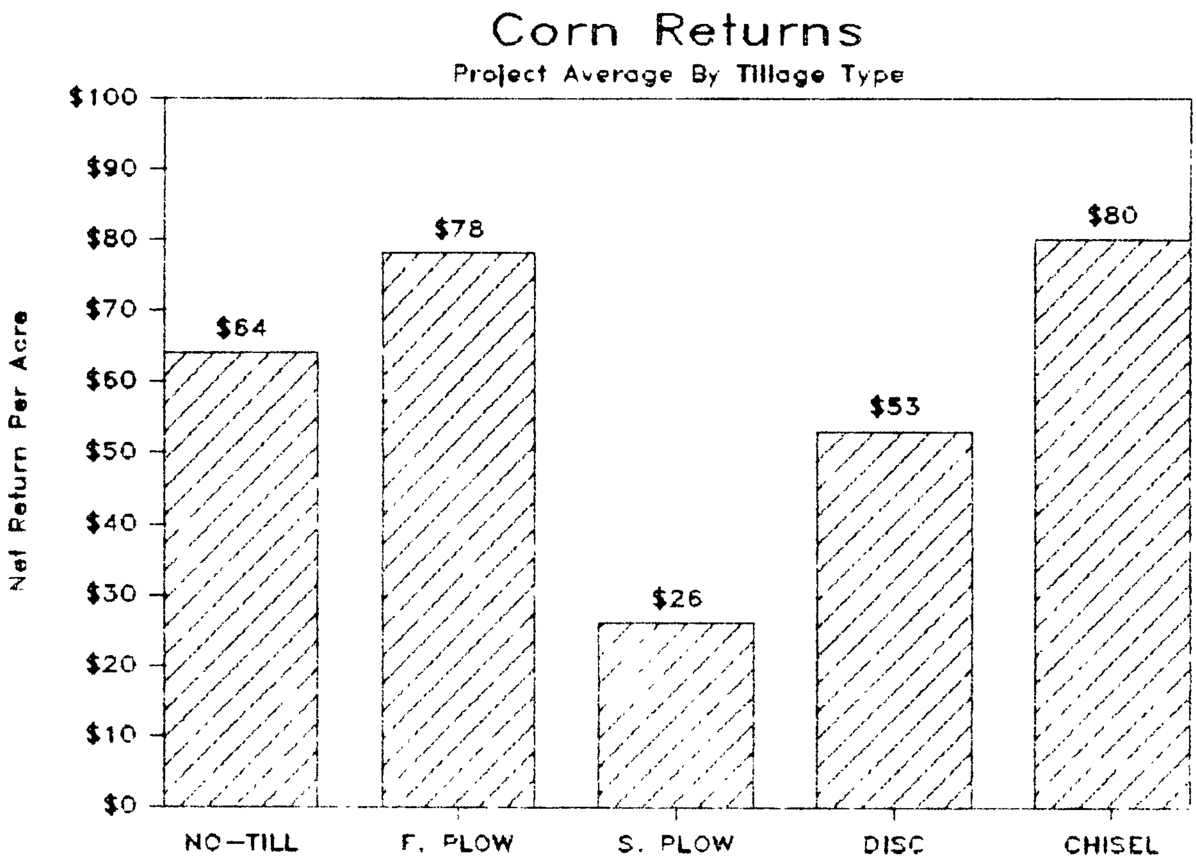


Figure 22. Corn returns per acre by tillage type.

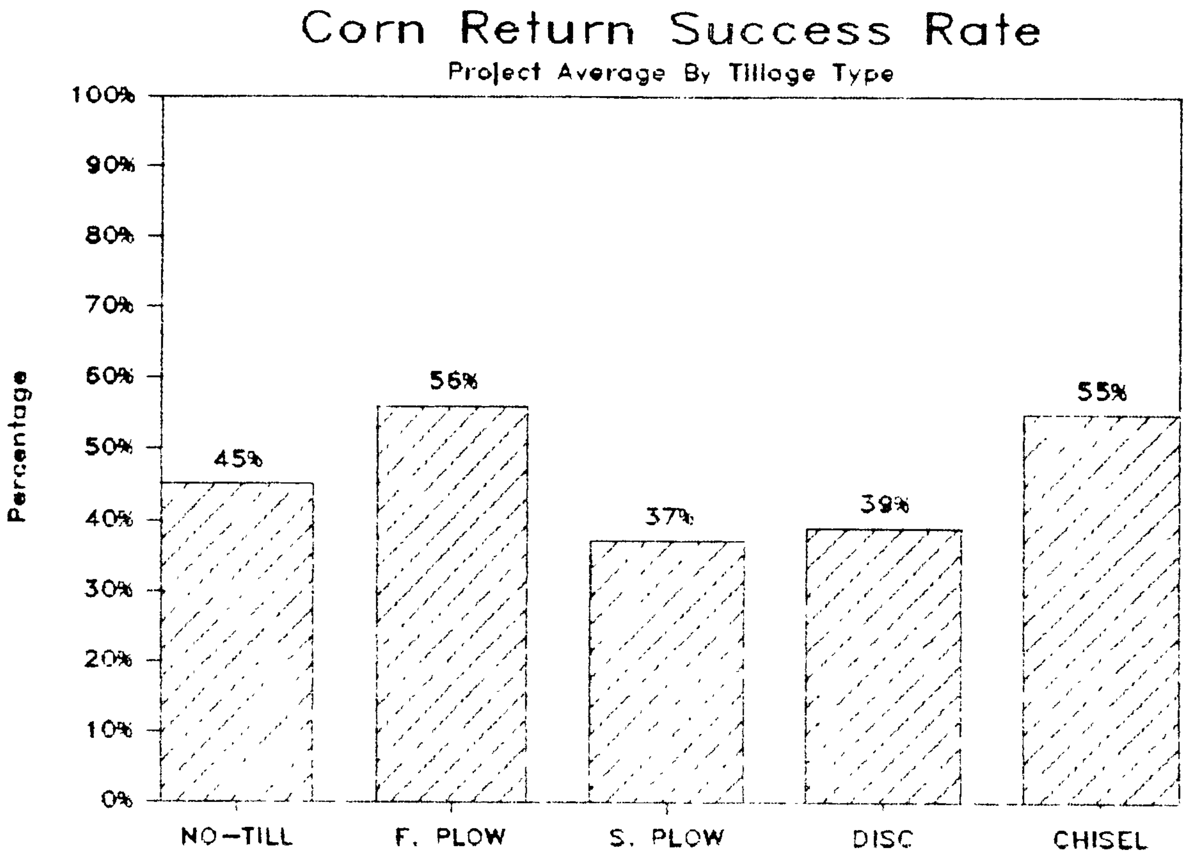


Figure 23. Corn return success rate.

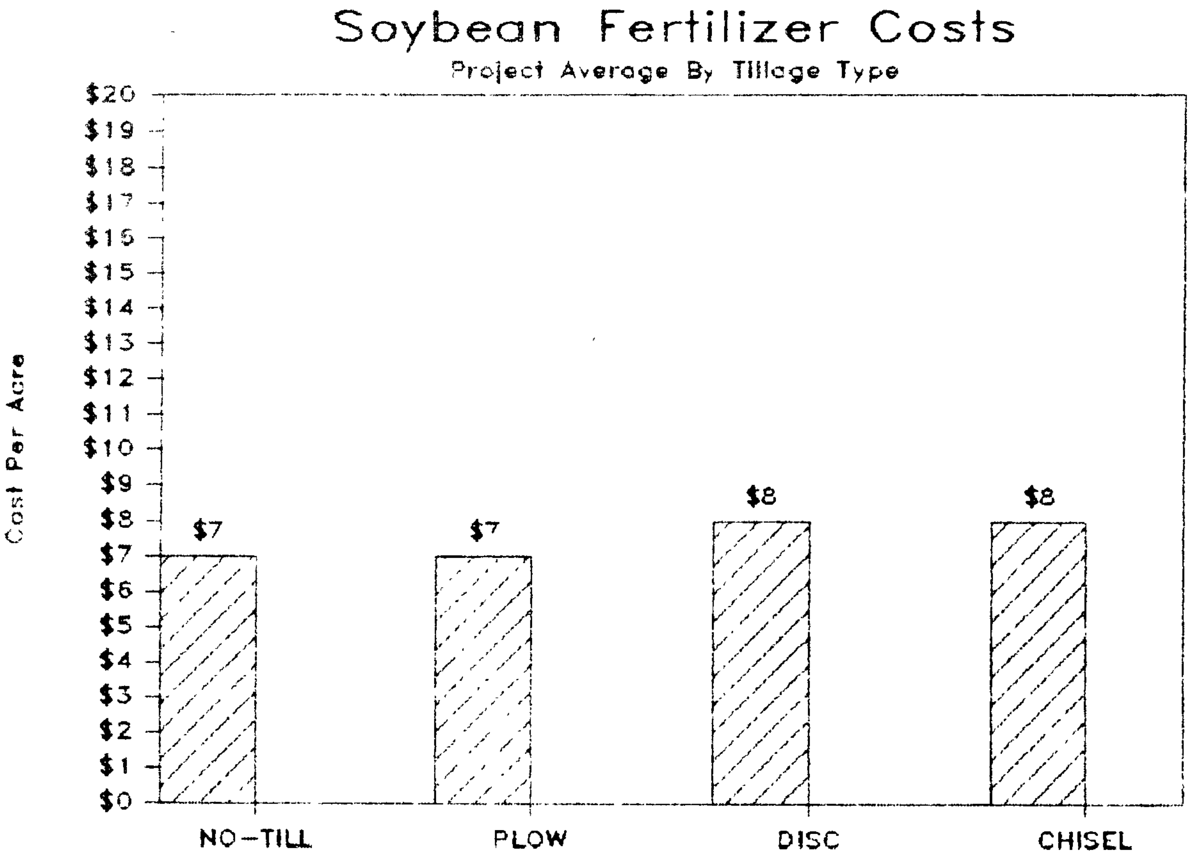


Figure 24. Soybean fertilizer costs per acre by tillage system.

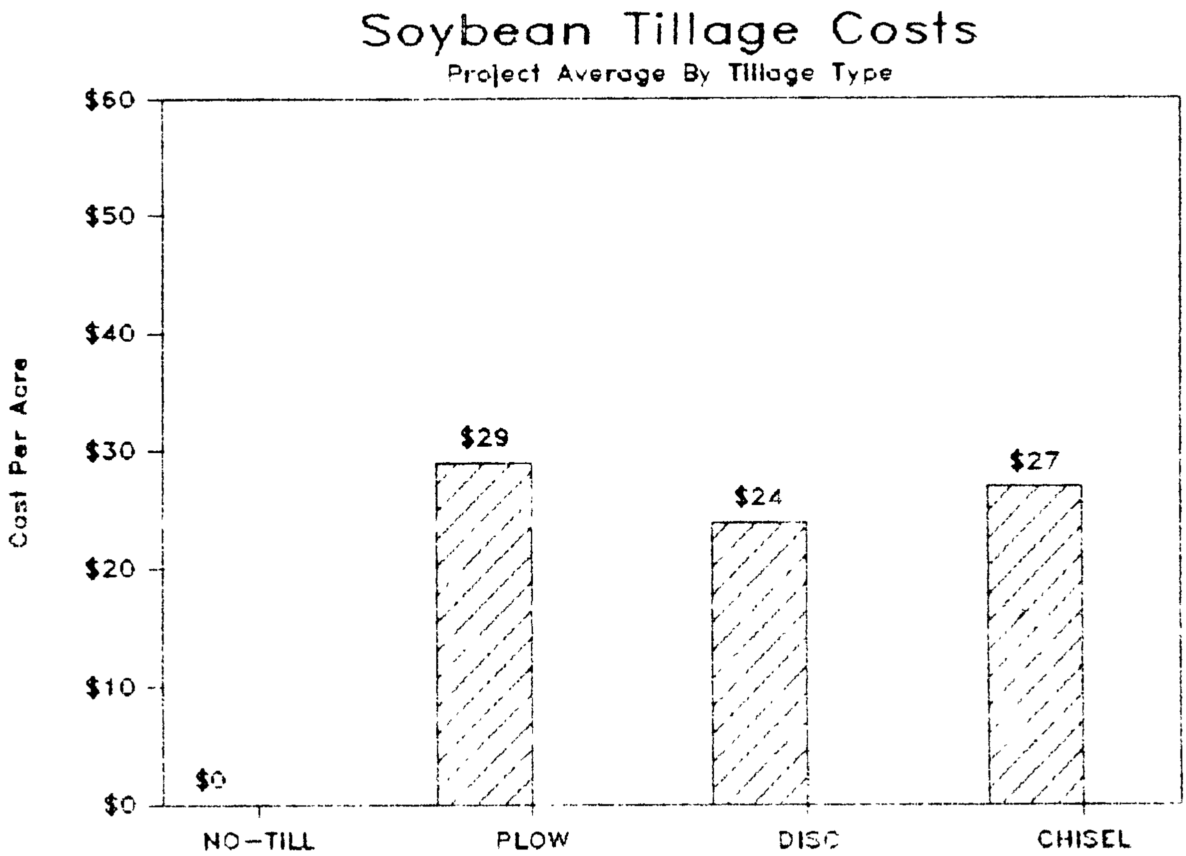


Figure 25. Soybean tillage costs per acre by tillage system.

A significant difference between systems was again indicated in the herbicide cost category (Figure 26). No-till was the method showing the highest average cost per acre. As was noted in the corn production cost section earlier, the application of a contact herbicide on no-till plots represents the majority of this increase. The plow system had the lowest cost, and there was no real difference between disc and chisel.

The miscellaneous category was fairly consistent. The following averages resulted: no-till, $65/acre; plow, $64/acre; disc, $62/acre; and chisel, $61/acre.

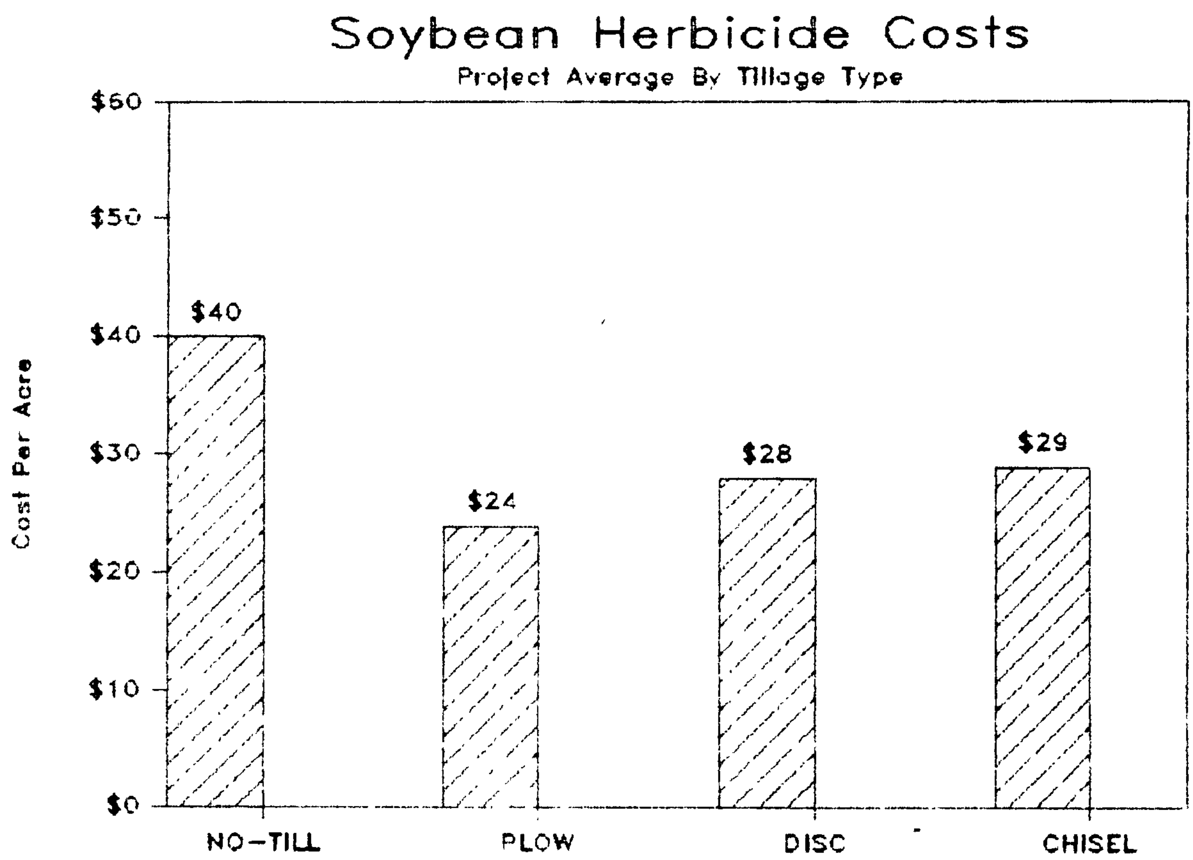


Figure 26. Soybean herbicide costs per acre by tillage system.

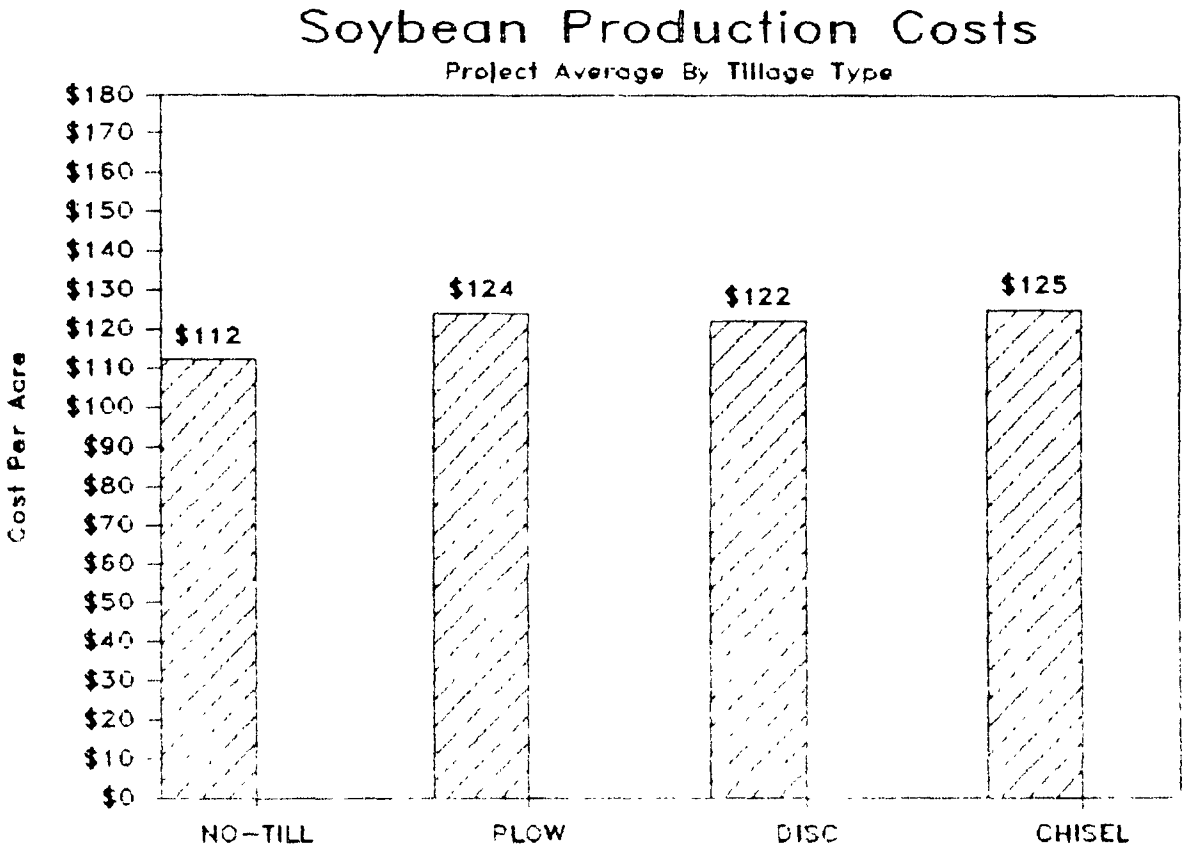


Figure 27. Total soybean production costs per acre by tillage system.

Net Returns--

The yearly net returns are listed according to the tillage system in Table 15. A large variation can be seen between tillage systems. Each system, except for spring plow, had the highest net return in at least one of the five Project years.

Table 15 also gives the average net return for each tillage type for the entire Project period. Figure 28 portrays this same data in graphic form. No-till produced by far the highest net average return.

Success rate is illustrated in both Table 15 and Figure 29. Offset disc had the highest success rate compared to the other systems. There was no significant difference between disc, chisel and fall plow. Every system tested was successful at least half the time.

TABLE 15. COMPARISON OF BEAN PLOT RETURNS BY TILLAGE SYSTEM

	NO-TILL	FALL PLOW	SPRING PLOW	OFFSET DISC	COULTER CHISEL
1985 Avg.	$ 84£(4)	$127 (7)	$ 89 (3)	$ 78 (4)	$ 97 (12)
1984 Avg.	174 (8)	147 (8)	110 (3)	129 (7)	136 (7)
1983 Avg.	185 (13)	168 (14)	80 (1)	131 (17)	128 (11)
1982 Avg.	95 (12)	79 (7)	111 (7)	113 (13)	119 (12)
1981 Avg.	117 (9)	81 (7)	96 (2)	116 (9)	94 (8)
Project Average	$131 (46)	$120 (43)	$ 97 (16)	$113 (50)	$115 (50)
Success Rate	23/46	23/43	8/16	28/50	27/50

£ returns reported in dollars/acre
( ) indicates number of tests

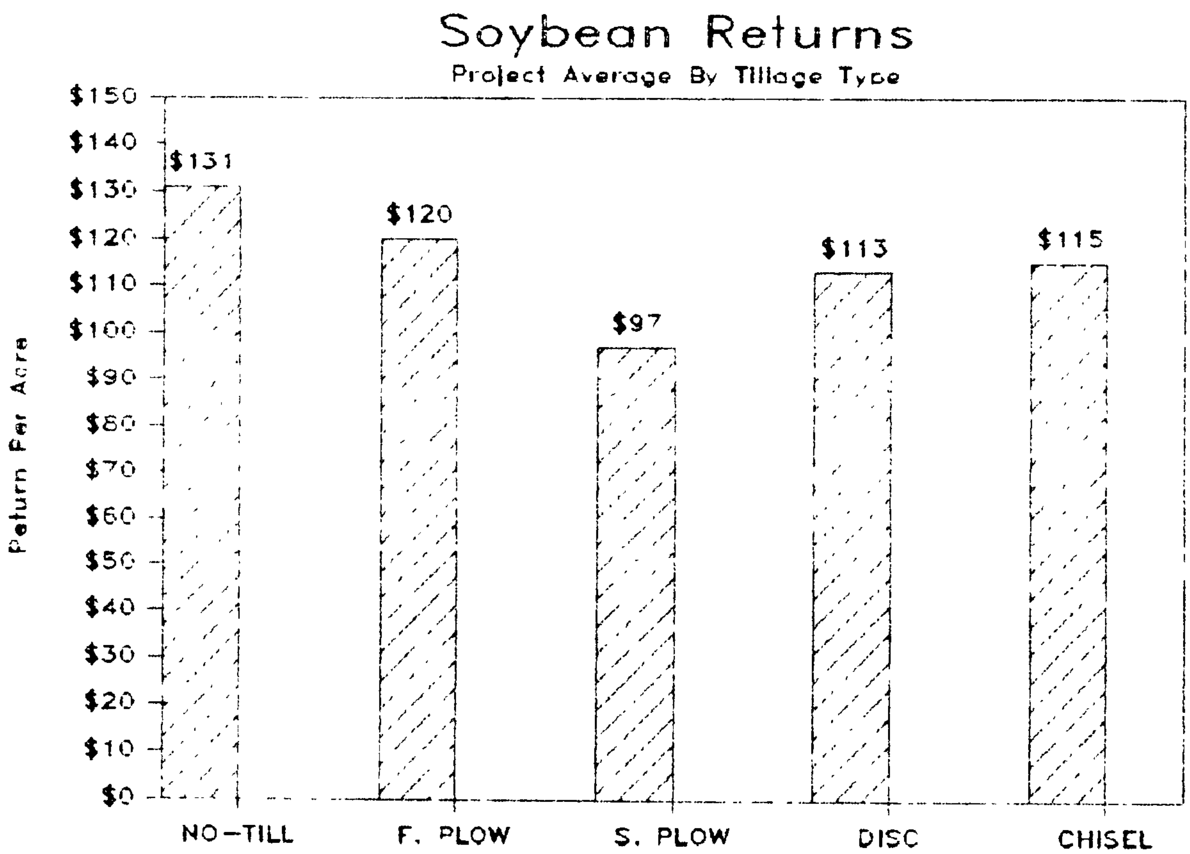


Figure 28. Soybean returns per acre by tillage type.

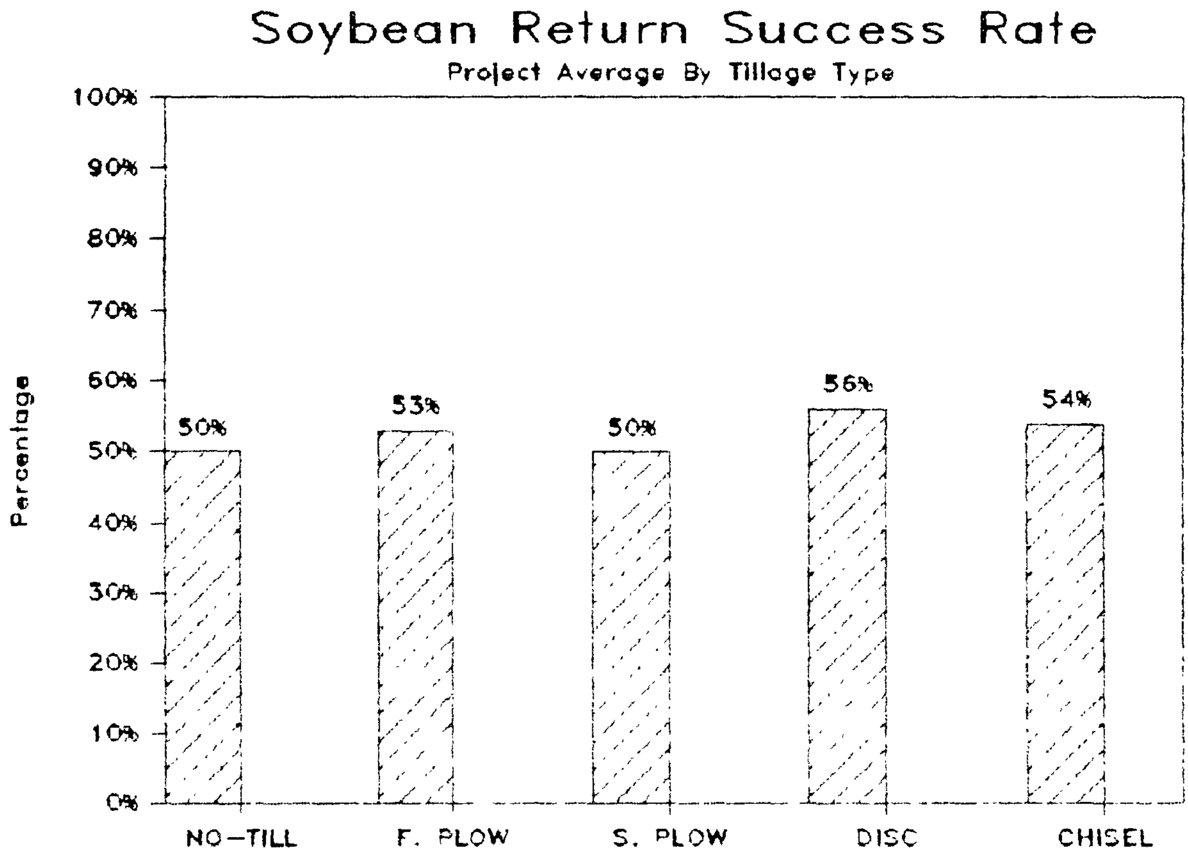


Figure 29. Soybean return success rate by tillage type.

SECTION 4e

CONSERVATION TILLAGE RECOMMENDATIONS

CONSERVATION TILLAGE APPLICATION

We have learned the basics and we know that conservation tillage practices can be successfully applied to Allen County soils. Now we need to refine these practices and improve upon our skills.

Mulch Tillage

The primary task ahead in mulch tillage is to convince farmers to leave the minimum 30 percent residue cover after planting that is required to effectively control erosion. We estimate that thirty percent of the farmland in the county is currently being maintained under reduced tillage practices.

No-till

Much more refinement is needed in this area compared to mulch tillage. No-till equipment, especially planters, has seen considerable modification during the Project's course, But even more improvements are required for better performance in the field. The District needs to keep apprised of the progress and changes in conservation tillage tools.

We also have much to learn about weed control, particularly in no-till soybeans. Excellent control for an economical price is critical.

Better residue management must be achieved. For example, fields with a soybean stubble residue sometimes fall short of the minimum 30 percent residue cover after planting. Again, farmer cooperation will be essential.

It is an established fact that no-till requires increased production skills for success. Even though the U.S. E.P.A. funded Conservation Tillage Demonstration Project has ended, the District will continue to educate themselves and others, particularly Allen County farmers, and provide technical assistance upon request.

INSTITUTIONAL ARRANGEMENTS

Erosion control has been, and will remain, a priority of the Allen S.W.C.D. Since conservation tillage practices have shown to provide cost-effective erosion control, the District will continue to strongly promote and encourage its use and implementation. The encourage its use and implementation. The District will promote conservation tillage in the county, and will continue to use the Project equipment to further adoption of the practice.

FUTURE DEMONSTRATION PROJECT

The Allen S.W.C.D. has leased approximately 170 acres from the Allen County Commissioners for a demonstration farm. The farm's operation highlights the use of various conservation practices, including no-till and mulch tillage. The land has been secured through a ten year lease. District staff will perform the necessary labor.

The farm is an opportunity for the District to do some extensive testing. We know that not everything we try will be successful. Rather than ask area farmers to take such risks on their own farms, we now have a place to demonstrate alternative techniques and evaluate the results.

It is the goal of the District to interest and involve the entire county, rural and urban, in the demonstration farm. Through field days, tours and other planned activities, we believe that the demonstrations and exhibits will draw much attention and gain much exposure which will further conservation throughout the county.

HOW WILL THE PROJECT ACCOMPLISHMENT BE MAINTAINED?

At the time that this report was written, the Allen S.W.C.D. was beginning the revision of their long range plan. Since much time and money were invested in the Project, the District is definitely planning to carry on in order to maintain the accomplishments.

We will continue to share the data that has been obtained and evaluated with anyone who is interested. This includes the yearly reports, this final report, and individual plot information if needed.

It is possible that the District staff will seek cultural data from area farmers who are using conservation tillage practices. Farmers would be contacted in the early summer to determine interest and the necessary information would be collected late in the fall, after harvest. A simple publication of these results would be developed by the District and made available to the public.

The District Board at this time is not making the equipment available to area farmers. They want to see how heavy the workload at the demonstration farm is before they commit themselves to anything else. The majority of the farm's acreage will be planted using the no-till method. If they do offer the use of the farm machinery in the future, it will most likely be limited to farmers who did not participate in the Project. With as much custom planting and equipment rental as is available to Allen County farmers, the District does not feel that they are "abandoning" anyone.

SECTION 4f

TESTIMONIALS

" I want to continue to farm and I want to leave something for future generations to farm. Conservation tillage is one of the best things I believe I can do to insure both."

- Jay Begg, area farmer

"In no-till corn, I made the same money as conventional and saved soil."

- Richard Bixel, area farmer

"I feel that the program has been very successful in that farmers could see, first hand, that these methods will work and also how to handle the problems that might come up."

- Marlin Burkholder, area farmer

"We really appreciated the efforts of the District to work with us. This has been a valuable learning experience for our instructors and students."

- James Cooper, Agricultural Supervisor, Apollo Joint Vocational School

"Farmers are seeing that they have to use different methods to control wind and water erosion, I see more ground worked with a chisel plow or offset disc every year."

- Bob Ernest, area farmer

"Even if a guy isn't conservation minded, the savings of time and fuel will be enough to make a person switch. I feel more people would be using conservation tillage now if it weren't for the present state of the farming economy and the fact that the cost of the needed equipment stops many of us."

- David Hefner, area farmer and Allen S.W.C.D. Board Member

"This I feel was an excellent program. It gave farmers a chance to see how conservation tillage works without jumping into it all at once and taking a gamble that it will work."

- Brian Jostpille, vocational agriculture student and F.F.A. member, Elida High School

"No-till is not something you just jump into without some kind of help or knowledge. It is deceiving. You think you know how to do it right and you're completely wrong. The Allen S.W.C.D. really helped me on this."

- Dennis Kahle, area farmer

"We use conservation tillage now and get good yields and I like the way it protects and prevents the loss of more soil."

- David Moser, area farmer

"Conservation tillage gave me more time to do my other work."

- Jim Pohlman, area farmer and attorney

"Thanks Allen S.W.C.D. for the introduction to no-till farming. Test plots are nice to look at, but until a farmer personally no-tills for 2 or 3 years he can't be convinced."

- Doug Post, area farmer

"Not enough farmers realize they are to be stewards of the soil"

- Joseph Schmersal, area farmer

"This project offered us the opportunity to try equipment that we wouldn't have been willing to buy on a trial basis. We also received much advice and assistance from the S.W.C.D./S.C.S. staff."

- Tom Schumacher, area farmer

"The tillage project was operated in a very businesslike and fair manner and was open to all who showed an interest in it."

- Don Spallinger, area landowner

"We need to conserve our soil. We have taken out too many fence rows and wood lots and the water runs wild, taking the soil with it."

- Rodney Stratton, area farmer

"The more efficient farmers will be able to stay in the farming business. No-till can make a farmer more efficient than a conventional farmer because of the substantial savings in investment."

- Jon Troyer, area farmer

"People are becoming more conscious of the erosion problem we have and are becoming more willing to do something about it."

- Jim Weaver, area farmer

SECTION 5a

RURAL SEWAGE DEMONSTRATION PROJECT

PURPOSE

With the ever increasing concern to reduce contaminants from entering Lake Erie, the U.S. E.P.A. sponsored several projects to demonstrate ways to achieve improved water quality within the Lake Erie drainage basin. A conclusion of one such study, the Black Creek Project in Allen County, Indiana, was that sewage effluent contributed to water quality problems within the Maumee Drainage Basin of Lake Erie. From this study, funds were granted to the Allen S.W.C.D. in Allen County, Ohio to demonstrate a means of achieving improved water quality in areas where a high concentration of failed individual sewage systems exists.

GOALS

Specific goals of the project were as follows:

1. To monitor the existing condition of the project area and quantify the existing effects on water quality.

2. To monitor the project area after replacement of the failed systems and quantify improvements in water quality.

3. To demonstrate administrative and procedural arrangements for bringing about replacement of the failed systems.

4. To serve as a model program which could be carried out in other problem areas within the Maumee Basin.

5. To evaluate the relative phosphorus and nitrogen contributions of agricultural run-off versus domestic sewage sources within the project area.

SCOPE

The Allen S.W.C.D. felt an intensive program on a small scale would be the most cost effective with the monies received from the Grant. At a public planning meeting conducted for the Project, the Allen County General Health District (A.C.G.H.D.) recommended that the Goodman Ditch (Bath Township Ditch #787-1938) would meet the needs for this study. Their office had received a number of complaints of the streams condition from residents in the area and had also observed evidence of raw sewage in the water.

The scope of the Project was to monitor the existing water quality of the stream upstream and downstream of the Subdivision. Once completed, chemcical evaluations of all the septic systems in the Subdivision were performed and any unable to meet state standards were required to be improved. Afterwards, additional monitoring took place and the data compared to determine the effects of the sewage improvements on water quality.

BACKGROUND

The watershed of the Goodman Ditch consists of approximately 590 acres located in Section 5 and 6 of Bath Township, Allen County, Ohio. The stream discharges directly into Sugar Creek. Further downstream Sugar Creek joins the Ottawa River which then flows into the Auglaize River and finally into the Maumee.

The watershed of the project site consists of basically two distinct areas: one being cropland with a few residential homes and the other a subdivision of homes. The cropland area, representing 512 acres, is farmed mostly by fall plowing the ground, working it smooth in the Spring and planting it to a crop using a corn-soybean-wheat rotation. Two sets of railroad tracks as well as a portion of Lutz Road and Stewart Road are included in the area (Figure 30). The subdivision covers 78 acres with houses on lots of 1/2 acre to 4 acres in size. The houses ranged in age from 5 to over 40 years old with most still having their original sewage disposal system. All the properties ultimately drain to the Goodman Ditch, an open drainage ditch flowing through the subdivision.

GRANT APPLICATION

The portion of the Allen S.W.C.D. grant allocated to the Rural Sewage Demonstration Project was to be budgeted into three categories: construction, monitoring, and the health department (Table 16). The monies from the construction account were to provide funds on a cost-sharing basis to the landowners in the amount of 75 percent of the cost installation of a new sewage disposal system. The Allen S.W.C.D. contracted with Heidelberg College, Water Quality Laboratory, Tiffin, Ohio to perform the necessary stream sampling which was paid from the monitoring account. The health department account was set up to cover the cost to the A.C.G.H.D. in its services provided to the Project.

TABLE 16. SUMMARY OF PROPOSED AND ACTUAL BUDGET FOR THE RURAL SEWAGE DEMONSTRATION PROJECT

Account	Proposed Budget	Actual Budget: Expenses	Actual Budget: In-kind Contributions	Actual Budget: Total
Construction	$120,000.00	$ 77,169.57	$25,723.18	$102,892.75
Monitoring	48,500.00	30,472.22	7,618.29	38,090.51
Health Dept.	6,500.00	0.00	5,460.00	5,460.00
Total	$175,000.00	$107,641.79	$38,801.47	$146,443.26

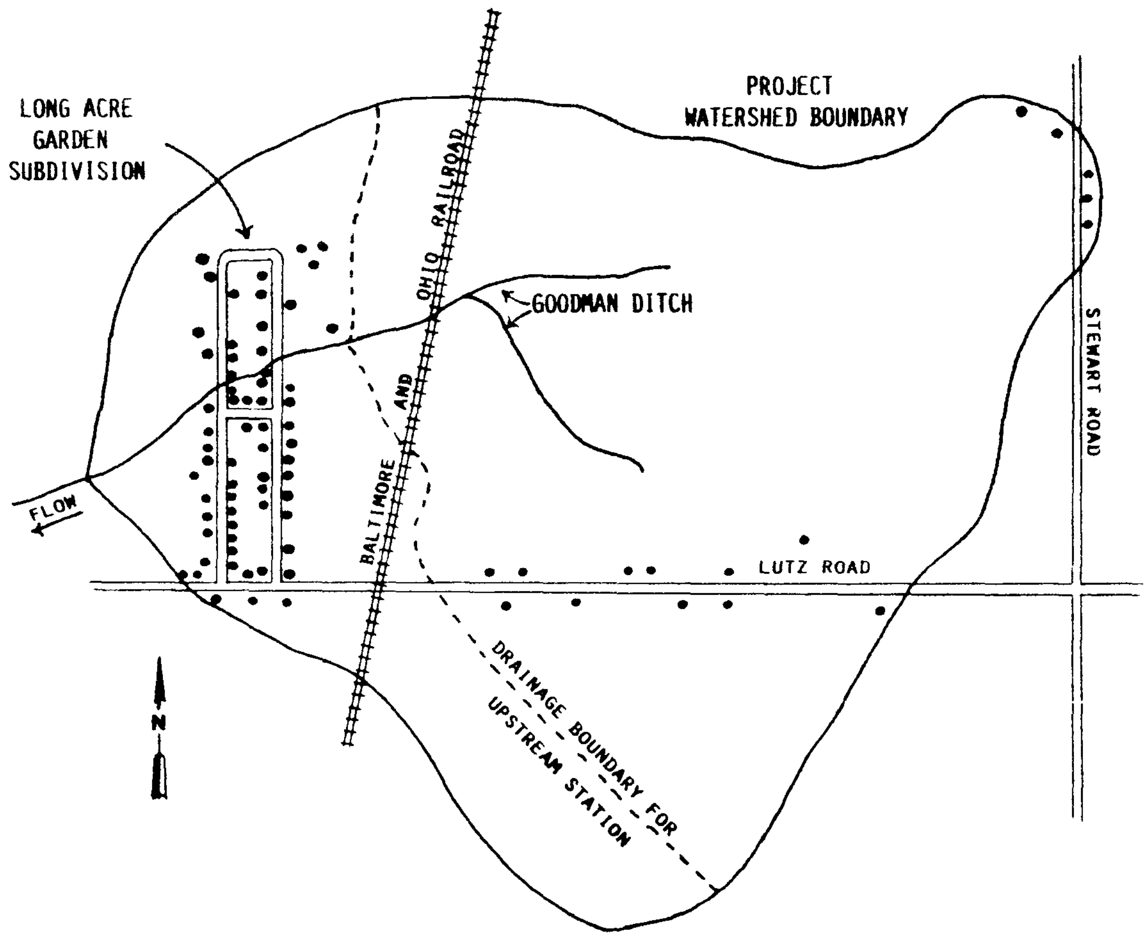


Figure 30. Watershed map of rural sewage project.

ORGANIZATION

Agency Roles and Responsibilities

The agencies directly involved with the Project were the Allen S.W.C.D., the A.C.G.H.D. and the Heidelberg College. The Allen S.W.C.D., being the grantee, was responsible for the overall administration and budgeting of the Project while the A.C.G.H.D. and Heidelberg College were under contract with the District to provide their respective services.

Funding Mechanisms

All funding was administered by the Allen S.W.C.D. The Heidelberg College, under contract with the Allen S.W.C.D., was required to provide 20 percent matching monies toward their cost of services. This had been reduced from 25 percent due to a limited budget at Heidelberg College. The landowners and the A.C.G.H.D. were required to provide 25 percent matching monies toward the completion of the Project. The A.C.G.H.D. actually donated all their time and services (100 percent) toward the Project due to the overwhelming public support of their work and the good working relationship between the Allen S.W.C.D. and the A.C.G.H.D.

Accountability

The A.C.G.H.D. and Heidelberg College were required to report to the Allen S.W.C.D. on their work completed and any expenses incurred. The A.C.G.H.D. reported quarterly while Heidelberg College reported after each group of studies were completed.

SECTION 5b

RURAL SEWAGE O ERATING PROCEDURES

PROJECT COORDINATION

The Allen S.W.C.D. was to coordinate the services of Heidelberg College and the A.C.G.H.D. to facilitate proper control, monitoring and evaluation of the study.

Contract with Heidelberg College

The Allen S.W.C.D. contracted with the Water Quality Laboratory of Heidelberg College to perform the water sampling of Goodman Ditch. Dr. David Baker of Heidelberg College was to oversee the monitoring conducted on the ditch. High and low flow samples were to be taken upstream and downstream of the subdivision both before and after the sewage systems were updated. Sampling was to measure nutrients, suspended solids, biochemical oxygen demand, fecal coliform, fecal streptococcus bacteria, flow and stage of the stream, and macroinvertebrates.

Two sampling stations, one upstream and the other downstream of the subdivision, were set up by Heidelberg College (Figure 30). Preliminary water sampling was taken during four 6-day studies between September, 1980 and September 1981. Three studies were done when the ditch was in low flow conditions and one during a high flow.

Additional sampling was performed after all the approved systems were installed. Three studies were contracted for but only two were performed due to scheduling conflicts with Heidelberg College. It is important to note that these two studies were done during low flow conditions in the ditch. The upstream sampling station was in the same location but the downstream station was moved 100 feet further downstream due to home construction at the original site. The sampling was done during 5-day studies in late August and early October of 1984.

Contract with Allen County General Health District

The Allen S.W.C.D. contracted with the A.C.G.H.D. to conduct sewage effluent testing of all houses in the subdivision and then supervise the installation of any new sewage system. The A.C.G.H.D. was to evaluate the operation and performance of the sewage disposal systems of the sixty homes. Upon determining the outlet of their present system, either by asking the landowners or by using a tracer dye, samples were taken to determine sewage effluent quality. The effluent produced from the systems were required to meet the Home Sewage Disposal Rules of the State of Ohio. The standards for off-lot discharge of sewage effluent are (A)Biochemical Oxygen Demand (B.O.D.) -the arithmetic mean of two or more effluent samples taken at intervals of not less than twenty four hours shall not exceed twenty milligrams per liter, and (B)Suspended Solids - the arithmetic mean of two or more effluent samples taken at intervals of not less that 24 hours shall not exceed forty milligrams per liter.

A household unable to meet these standards was required to upgrade or replace their existing system. A 3-way agreement was then signed by the landowner, the A.C.G.H.D., and the Allen S.W.C.D. explaining the responsibility of each party in correcting the substandard sewage system. The A.C.G.H.D. provided the landowners with technical plans of an alternative system suitable to their needs. A certified contractor hired by the landowner was required to install the system within 90 days after notice of violation was given. The A.C.G.H.D. supervised the installation of the systems and notified the Allen S.W.C.D. when each installed system was completed for cost-sharing payment to be made.

Bills submitted for work on installing the systems were approved by Bill Kelly, Director of Environmental Health at the A.C.G.H.D. This was done as a means to prevent any overcharging of work to cover the landowners share of the payment. The bills were then approved by the Board of Supervisors of the Allen S.W.C.D. for payment with a check made out jointly to the landowner and the contractor.

INFORMATION AND EDUCATION

Prior to the start of the project work, the A.C.G.H.D. sent a letter to all landowners in the subdivision stating what the project was to accomplish. No other educational program was planned due to the acceptance of the project in the area. This high acceptance was probably because of the cost-sharing incentives.

INCENTIVES FOR LANDOWNERS

Although landowners with malfunctioning systems were required by law to comply with the standards, assistance was available to provide a favorable response. The A.C.G.H.D. did cooperate with the necessary landowners in suggesting alternative systems, and providing engineering plans and follow-up to the proposal. The Allen S.W.C.D. also provided 75 percent of the cost of installation of these new systems with the landowners only having to provide the remaining 25 percent.

SECTION 5c

RURAL SEWAGE PROJECT ACCOMPLISHMENTS

NUMBER OF PROJECT PARTICIPANTS

At the [illegible] the Project in the Long Acre Garden Subdivision, [illegible] of the [illegible] dwellings already had aeration disposal systems that were [illegible] inspected by the A.C.G.H.D. Upon evaluation of the remaining 47 systems, five dwellings had properly f[illegible] septic systems, eight dwellings had systems that did not [illegible] produce any off-lot discharge that could contaminate the Goodm[illegible], and 34 were classified as having substandard sewage disposal systems.

The 34 substandard systems were ordered to be improved. The preferred type of system in the State of Ohio is one that produces no off-lot discharge of effluent. Such systems have a septic tank, a leaching tile field of approximately 7,500 to 10,000 square feet based on household size (a larger than normal leaching field was required here due to the soil type in the area), and curtain drains along the perimeter of the leaching field to increase soil drainage. These systems must also be installed at least 50 feet from any water supply. Twenty-one properties did have adequate lot size to install this type of system while the remaining 13 were required to install aeration systems which produce an off-lot discharge acceptable to state guidelines (Table 17).

RELATIONSHIP OF AGRICULTURAL RUNOFF TO SEWAGE EFFLUENT

Within the Project area, two sampling stations were operated. One station was located upstream of the Long Acre Gardens Subdivision which sampled water draining primarily from agricultural land with a few rural farm houses, and the other station was downstream of the Subdivision which sampled drainage from the houses in the Subdivision along with the input of the agricultural area. After the sewage improvements were performed, monitoring was performed only at the downstream station. The lack of any water input at the upstream station at the time of the sampling made it impossible to obtain any useful information at this site. Therefore, only the sampling of the pre-sewage installations with both station receiving water will be discussed in the section.

TABLE 17. STATUS OF PRIVATE SEWAGE DISPOSAL SYSTEMS

Type of Home Treatment	Pre-installation period On-lot Discharge	Pre-installation period Off-lot Discharge	Post-installation period On-lot Discharge	Post-installation period Off-lot Discharge
Aeration units	--	13	--	26
Adequate septic tank/ sand filter systems	--	5	--	5
Adequate septic tank/ leach bed systems	8	--	29	0
Substandard systems	0	34	0	0
Total	8	52	29	31

Four sampling periods were performed before any improvements to the sewage systems were made and the results are listed in Table 18. Water flowing out of the subdivision was enriched with nutrients as compared to the upstream sampling station. These amounts are a strong indication of septic tank effluent entering the stream between the two sampling stations. Septic tank effluent is characterized by high soluble reactive phosphorus and ammonia. Chloride and conductivity also showed large increases probably due to the extensive use of water softeners in the Subdivision.

The nitrate concentrations also increased between the two stations although the septic tank effluents themselves contain very little nitrate. Upon reaching the soil and atmosphere, ammonia from the septic tanks is oxidized to nitrate.

All three low flow studies clearly showed evidence of sewage effluent pollution in the stream. The one study conducted during a high flow period more nearly typified agricultural runoff conditions. Most of the concentrations were reduced because of the dilution effects of the increased water flow. According to Dr. Baker, Heidelberg College Water Quality Laboratory, agricultural runoff is characterized by high nitrates and low ammonia which this one study shows. Also noted is that the proportion of soluble phosphorus to total phosphorus is lower in the "agricultural runoff period" verses the low flow periods. The low flow period averaged 84% soluble phosphorus to total phosphorus while the high flow study was only 46%.

Actual quantities of phosphorus or nitrates produced per year from the agricultural area versus the Subdivision could only be obtained through a more lengthy sampling of the watershed area which this Project was not intended to entail.

TABLE 18. AVERAGE CHEMICAL CONCENTRATIONS IN GOODMAN DITCH UPSTREAM AND DOWNSTREAM FROM THE LONG ACRES GARDENS SUBDIVISION.

Study Period	Location	Number of Samples	Soluble Phosphorus mg/l	Total P mg/l	Nitrate + Nitrite mg/l N	Ammonia mg/l N	Chloride mg/l	Conductivity umhos	Susp. Solids mg/l
[illegible]	Upstream	[illegible]	.57	.79	2.32	2.25	137	1246	14
low flow	Downstream	45	1.24	.75	4.88	8.18	735	5902	26
	Ratio (D/U)		[illegible]	4.7	2.1	3.6	5.7	4.7	1.9
11/10/80-11/16/80	Upstream	29	0.46	0.79	0.37	1.85	444	2730	26
low flow	Downstream	48	3.17	4.05	2.61	10.77	858	5232	33
	Ratio (D/U)		6.9	5.1	7.1	5.8	1.8	1.9	1.3
9/14/81-9/20/81	Upstream	42	0.65	0.85	0.65	1.32	411	2574	19
low flow	Downstream	42	2.74	3.11	1.93	8.22	594	3788	15
	Ratio (D/U)		4.2	3.7	3.0	6.2	1.4	1.5	0.8
5/10/81-5/15/81	Upstream	26	0.16	0.44	7.29	0.39	54	631	104
high flow	Downstream	27	0.19	0.41	11.76	0.51	54	510	96
	Ratio (D/U)		1.2	0.9	1.6	1.3	1.0	0.8	0.9

POLLUTANT LOADING REDUCTION

Phosphorus and nitrates concentrations were sampled in the collection of water from the Goodman Ditch. Two sampling periods Pre-1 and Post-2 were very similar in stream characteristics in flow, time of year and rainfall. Table 19 summarized the results of flow and concentration of nutrients for these two periods. Probably the most influential aspect of the Project was the actual reduction of the stream base flow from 6.7 m3/hr to 1.5 m3/hr for these periods. This reduction of 78% can be attributed to the reduction of number of homes with off-lot disposal systems from 52 to 31. In the pre-treatment periods 34 of the off-lot disposal systems were inadequate whereas 21 of these were improved to produce no off-lot discharge. The remaining 13 were installed to an aeration disposal system which when added to the remaining 18 properly functioning aeration systems comes to 31. The table does show that both phosphorus and ammonia concentrations in the ditch were higher in the post-treatment period while nitrate forms were reduced. Possible the most important fact of this graph is that the loading or export of these nutrients from the area were reduced significantly. All three pollutants, phosphorus, nitrates and ammonia were reduced by 69%, 96% and 62%, respectively. Although this does only represent two short periods of time it does demonstrate that the export of pollutants can be significantly reduced by proper on-site treatment of residential sewage. A more in depth study, which was no the intent of this Project, could possibly substantiate this data further.

TABLE 19. PHOSPHOROUS, NITRATE AND AMMONIA CONCENTRATION EXPORT BEFORE AND AFTER SEWAGE SYSTEM IMPROVEMENTS.

Study Period	Flow m3/hr	Phos. conc. mg/l	Phos. export g/hr	Nitrate conc. mg/l	Nitrate export g/hr	Ammonia conc. mg/l	Ammonia export g/hr
Pre-1 10/5/80- 10/6/80	6.7	3.5	23.2	4.9	32.8	8.2	54.9
Post-2 10/1/84 10/6/84	1.5	4.8	7.3	0.9	1.4	13.8	20.7
% change	-78%	+37%	-69%	-82%	-96%	+68%	-62%

EFFECTS BY SMALL RAINFALL-RUNOFF EVENTS

Small rainfall events in the Subdivision increased the stream flow. These occurred during the pre-treatment period on September 18 and 19, 1981 and during the post-treatment period on August 22, 1984. During both of these periods phosphorus concentrations decreased at the downstream station as stream flow increased (Table 20). The average nutrient concentration during these small storm is shown in Table 21.

TABLE 20. EFFECTS OF LIGHT RAIN ON PHOSPHORUS

Date	Time	Flow m3/hr	Soluble Phos. mg/l	Total Phos. mg/l	Phos. Export g/hr
8/22/84	1[illegible]	[illegible].9	4.33	5.00	4.90
	500	1.0	4.82	5.66	10.67
	[illegible]0	22.9[illegible]	1.30	4.31	98.70
	[illegible]0	[illegible].5	1.23	2.22	96.57
	1700	38.30	1.53	1.92	73.54
	2100	10.80	1.31	1.69	18.25
8/23/84	100	.70	1.55	1.85	12.40
	500	9.[illegible]	[illegible]	1.93	19.24
	900	7.5[illegible]	1.51	1.82	13.65
	2200	2.66	2.85	3.44	9.15
8/24/84	200	5.22	2.67	3.23	16.86
	600	4.16	2.56	3.27	13.60
	900	4.48	2.57	3.27	14.65
	1300	11.60	2.21	2.60	30.16
	1600	8.23	2.15	2.62	21.56

TABLE 21. EFFECTS OF A LIGHT RAIN ON NUTRIENT AND SEDIMENT CONCENTRATIONS

	Soluble Phos. mg/l	Total Phos. mg/l	Solids mg/l	Nitrates mg/l	Ammonia mg/l
Pre-treatment period 9/18/81 (0200) to 9/20/81 (1300)					
Mean	1.97	1.96	10	2.1	5.0
Std. Dev.	0.75	0.27	2	1.0	1.5
Post-treatment period 8/22/84 (0900) to 8/24/84 (1600)					
Mean	1.89	2.61	45	1.6	4.5
Std. Dev.	0.56	0.75	84	0.5	1.0

Dr. Baker explains that "Although total phosphorus concentrations decreased the total phosphorus loading increased greatly since the stream flow increased by a much larger factor than the concentrations decreased. It is likely that the phosphorus exported during these events was derived from septic tank sources since it is largely composed of soluble reactive phosphorus and is accompanied by relatively high ammonia concentrations.

It is possible that the stream system itself, upstream from the monitoring site, provides a significant processing area and temporary sink for phosphorus. However phosphorus temporarily stored in the stream system would be exported primarily as particulate phosphorus during runoff events. The increase in phosphorus export observed during the small runoff events in this study was primarily soluble phosphorus, suggesting off-site home sewage as the source of the increased loading rates.

The above data indicates that rainfall/runoff events are significant in the transport of pollutants from off-lot disposal systems to stream systems and that base flow transport rates in stream systems do not reflect the total loading rates from the septic tanks. Consequently measuring total phosphorus loading rates from septic tanks in housing developments such as this one require both storm flow and baseflow studies. The storm flow component would have to be done on a year round basis. Such a study is beyond the scope of the current investigation."

BACTERIOLOGICAL STUDY

The measurement of Dissolved Oxygen (D.O.), B.O.D., and Fecal Bacteria are shown in Table 22. Dissolved Oxygen was relatively low throughout all the testing periods. During Pre-1 and Pre-2, D.O. was reduced from the upstream station to the downstream station. These levels sometimes dipped below levels suitable for some aquatic organisms. In Pre-2 water temperature were low (5 to 0 degrees Celsius), whereas oxygen solubility increases as temperature drop and consequently the oxygen concentration were higher. During Pre-4, the D.O. was high due to the agitation of the increased flow in the stream. In both Post studies, D.O. was extremely low. This is probably due to the very low flow which resulted in stagnant pools.

The B.O.D. is usually associated with concentration of organic matter. In the pre-treatment studies, little variation was evident between the upstream and downstream sampling. This is indicative that organic wastes are present throughout the stream system. Pre-4, a high flow condition, just reduced the concentration of B.O.D. The B.O.D. in the samples were lower during the post-treatment period (Table 23). This could be attributed to either improved sewage treatment in the aeration units or to oxidation of organic matter in either the storm sewers leading to the stream or the stream itself.

TABLE 22. RESULTS OF DISSOLVED OXYGEN, BIOCHEMICAL OXYGEN DEMAND, FECAL COLIFORM AND FECAL STREPTOCOCCI MEASUREMENTS.

	Upstream Station				Downstream Station			
Study	D.O. mg/l	B.O.D. mg/l	Fecal Coliform count/100ml	Fecal Strep. count/100ml	D.O. mg/l	B.O.D. mg/l	Fecal Coliform count/100ml	Fecal Strep. count/100ml
Pre-1 low flow	5.[illegible]	[illegible]	21,[illegible]	[illegible]	3.5	16.6	[illegible]	8.710
Pre-2 low flow	7.[illegible]	[illegible]	[illegible]	[illegible]	8.8	23.0	4,[illegible]	8,127
Pre-3 low flow	5.2	[illegible]	[illegible]	[illegible]	2.6	25.7	6,740	4,550
Pre-4 high flow	9.[illegible]	[illegible]	[illegible]	1,[illegible]	8.8	4.1	[illegible],402	5,298

TABLE 23. AVERAGE DISSOLVED OXYGEN, BIOCHEMICAL OXYGEN DEMAND AND BACTERIAL COUNTS DURING LOW FLOW PERIODS AT THE DOWNSTREAM STATION.

Period	D.O. mg/l	B.O.D. mg/l	Fecal Coliform per 100 ml	Fecal Streptococcus per 100 ml
Pre-1	3.5	17	7,080	8,710
Pre-2	8.8	23	4,200	8,130
Pre-3	2.6	26	6,740	4,550
Post-1	1.0	10	10,600	10,400
Post-2	0.1	13	2,230	1,220

In general, the results showed extremely high fecal bacterial counts at both the upstream and downstream sites. This indicates that fecal material from human and/or other warm blooded animals is entering the streams.

Ohio standards for secondary contact recreation such as wading in the stream, require that fecal coliform counts shall not exceed 5,000 per 100 milliliter in more than 10% of the samples taken during any 30 day period. At the upstream and downstream sites, these values were exceeded 37% and 60% of the time, respectively. These high counts can be attributed to both effluent within the subdivision and agricultural sources upstream. During Pre-4 a large increase in fecal coliform downstream could directly reflect septic wastes within the area. A more rapid transport of sewage effluent could be expected in the spring season or under high stream flows because the effectiveness of septic tank leach fields would be diminished.

Fecal coliform in the Post-treatments averaged out very similar to the Pre-treatment studies. The lack of additional sources of water probable resulted in these high counts. Fecal Streptococci bacteria showed similar characteristics as fecal coliform.

BIOLOGICAL STUDY

An evaluation of the macroinvertebrates within a water source can provide information on the extent of contamination by septic tank effluents. Two studies were conducted within the Goodman Ditch, one before and one after the septic system improvements were made. The pre-installation study was conducted on July 30, 1981 and sampling was done at stations 1a, 1b and 2 (Figure 32). The station 1a was upstream of all inputs of effluent, while 1b was receiving some sewage inputs. Station 2 was located downstream of the Subdivision. The post-installation study was conducted on August 22, 1984 and used stations 1a, 1b and 3 in its sampling. Station 3 was different from the pre-installation site because of the inaccessibility of station 2 at the second study period.

Replicated core samples of stream sediments were taken at each station. The samples were sieved of sediments to determine the type and densities of animals present. Table 24, 25, and 26 show the results of the samples.

From the standpoint of concentrations of invertebrates in the pre-installation study, evidence of organic enrichment at station 1b is provided by a 14-fold increase in the numbers of oligochaete worms (sludge worms) and the 27-fold increase in midge larvae compared to station 1. At station 2 the abundance of midges and worms were only one-third of their station 1b abundances, indicating that the extent of enrichment decreased downstream with an accompanying change toward the biological conditions present at station 1a (Kreiger 1982).

The upstream habitats appeared to be essentially the same in 1984 as in 1981. The species richness (number of kinds of animals) also appeared very similar. In 1981 station 1a revealed

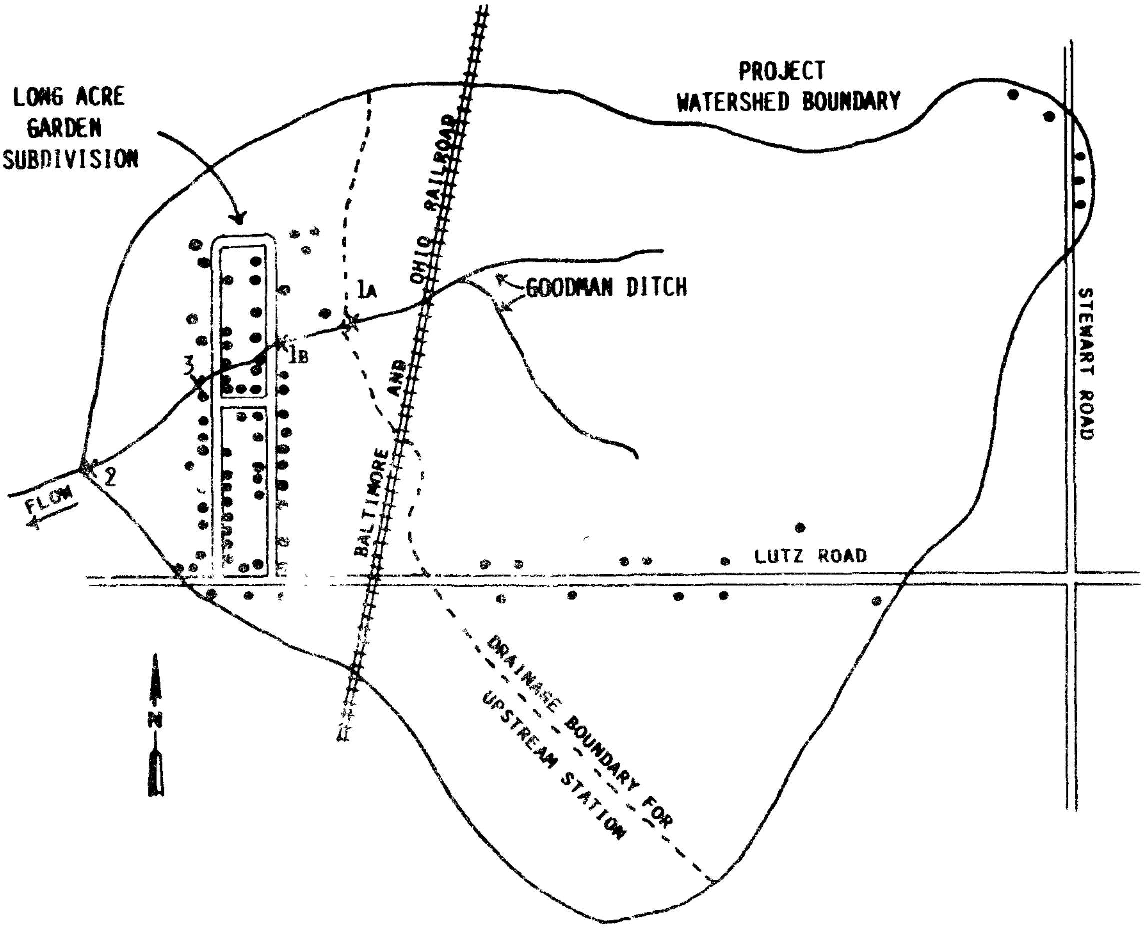


Figure 31. Location of biological sampling stations.

16 different taxa and in 1984 it revealed 20. At station 1b there were 24 taxa in 1981 and 14 in 1984. The differences in these numbers at each station probably reflect random variation due to sampling rather than real environmental differences. A direct comparison of station 2 and 3 cannot be made because they were not in the same location. However, their habitats were similar, and indeed the number of taxa collected were similar with 22 at station 2 and 20 at station 3 (Baker 1985).

The density of oligochaetes and chironomids, and the species comprising these two groups, are important facts for interpreting the quality of sediments in lakes and streams. Even the highest densities recorded in Goodman Ditch were below those which are usually considered to be indicative or degraded conditions due to pollution by sewage. Under such conditions, the number of oligochaetes in a stream often exceed 10,000 per square meter (Baker 1985).

In conclusion, both studies found that the biological degradation of the study area was minimal. At station 1b, which had appeared to be most affected by septic tank effluent in 1981, the number of both the oligochaete worms and the chironomides were much lower in 1984. This change is due to the reduction of septic tank effluents (Baker 1985).

TABLE 24. MACROINVERTEBRATE TAXA COLLECTED AT THE THREE STREAM STATIONS ON JULY 30, 1981.

Taxon	Station 1a	Station 1b	Station 2
Oligochaeta	x	x	x
Insecta			
Diptera			
Chironomeidea, larvae			
Cryptochironomus sp.	x		
Chironomus sp.	x	x	x
Psectrotanypus sp.		x	x
Stictochironomus sp.		x	x
Pentaneurini		x	x
Procladius sp.		x	
Polypedilum sp.			x
Rheotanytarsus complex		x	x
Pupa, unidentified		x	
Syrphidae?		x	
Culicidae, larvae			
Anopheles punctipennis	x		x
Culex quinquefasciatus			x
Ceratopogonidae		x	
Dixidae, *Dixella* sp.	x		
Hemiptera			
Corixidae	x	x	x
Nepidae	x		
Veliidae, *Microvelia*		x	
Gerridae, *Gerris* sp.	x	x	x
Ephemeroptera			
Baetidae, *Callibaetis* sp.	x	x	x
Odonata			
Lestidae, *Lestes* sp.	x	x	x
Libellulidae, *Plathemis* sp.	x		x
Libellulidae, *Libellula* sp.		x	
Cordulliidae, *Tetragoneuria* sp.	x	x	x
Aeshnidae, *Aeshna* sp.	x	x	x
Coleoptera			
Dytiscidae, *Hydroporus* sp.		x	x
Dytiscidae, *Laccophilus* sp.		x	
Dytiscidae, *Agabus* sp.			x
Hydrophilidae, *Tropisternus* sp.			x
Ostrocoda	x	x	x
Decapoda		x	
Mollusca			
Physidae, *Physa* sp.	x	x	x
Planorbidae, *Gyraulus* sp.		x	
Sphaeriidae, *Pisidium casertanum*	x		
Total Taxa	16	24	22

TABLE 25. MACROINVERTEBRATE TAXA COLLECTED AT THE THREE STREAM STATIONS ON AUGUST 22, 1985

Taxon	Station 1a	1b	3
Oligochaeta (worms)	x	x	x
Nematoda (roundworms)			
Insecta			
Diptera (flies)			
Chironomidae			
Chironomus sp.		x	x
Procladius sp.	x	x	x
Pseudochironomus sp.	x		
Psectrotanypus sp.		x	x
Stictochironomus sp.			x
Tanytarsus sp.	x	x	
Culicidae, *Culex* sp.	x	x	x
Ceratopogonidae		x	x
un ID Family A		x	
un ID Family B			x
Psychodidae, *Psychoda*?	x		
Tabanidae, *Chrysops* sp.	x		
Hemiptera (bugs)			
Corixidae, *Sigara* sp.	x		x
Gerridae, *Gerris* sp.	x		x
Ephemeroptera(mayflies)			
Baetidae, *Callibaetis*	x		x
Heptageniidae	x		

Taxon	Station 1a	1b	3
Odonata (dragonflies, damselflies)			
Calopterygidae, *Calopteryx*	x		
Corduliidae, *Somatochlara*		x	
Aeshnidae, *Aeshna* sp.			x
Lestidae, *Archilestes* sp.			x
Coenagrionidae, *Ischnura* ?			x
Anisoptera	x		
Coleoptera (beetles)			
Elmidae, *Optioservus* complex, larva		x	
Haliplidae, *Peltodytes* sp.	x	x	x
Dytiscidae			
Hydroporus sp., adult	x		
Laccophilus sp., larva	x		
Helodidae?			x
Trichoptera (caddisflies)			x
Mollusca (snails, clams)			
Ferrissia sp.	x		
Fossaria? sp.		x	
Physella sp.	x	x	x
Pisidium sp.		x	x
Total taxa	20	14	20

TABLE 26. MEAN NUMBERS PER SQUARE METER OF MACROINVERTEBRATES COLLECTED IN THREE CORE SAMPLES FROM EACH OF THE THREE STREAM STATIONS ON JULY 30, 1981 AND AUGUST 22, 1984

Taxon	July 30, 1981 Station 1a	July 30, 1981 Station 1b	July 30, 1981 Station 2	August 22, 1984 Station 1a	August 22, 1984 Station 1b	August 22, 1984 Station 3
Oligochaeta	151	2,113	754	753	75	2,147
Insecta						
Diptera						
Chironomidae, larva	226	6,036	2,264	678	226	1,808
Cryptochironomus sp.	75	0	0			
Chironomus sp.	75	3,471	604	0	0	678
unidentified	75	754	302	0	0	75
Psectrotanypus sp.	0	754	604	0	0	377
Stictochironomus sp.	0	604	75	0	0	75
Tanypodinae, unidentified	0	75	0	0	0	75
Procladius sp.	0	75	0	678	151	527
Rheotanytarsus complex	0	75	302			
Pentaneurini	0	226	377			
Pupa, unidentified	0	75	0	0	75	0
Syrphidae	0	75	0			
Culicidae, *Anopheles punctipennis*	0	0	75			
Culicadae, *Cullex* sp.				0	0	75
Ceratopogonidae	0	75	0	0	0	75
Hemiptera						
Corixidae, juveniles	0	151	0			
Odonata						
Anisoptera, < 2mm	75	75	0			
Plathemis sp.	0	0	75			
Ephemeroptera						
Baetidae, *Callibaetis* sp.	75	377	75			
Coleoptera						
Dytiscidae, *Hydroporus* larva	0	226	0			
Helodidae?, larva				0	0	75
Ostracoda	75	1,207	0			
Mollusca						
Sphaeriidae, unidentified	75	0	0			
Sphaeriidae, *Pisidium casertanum*	75	0	0			
Planorbidae, *Gyraulus* sp.	0	151	0			
Total	754	10,563	3,244	1,431	376	4,180

SECTION 5D

RURAL SEWAGE CONCLUSIONS

PROJECT IMPACTS

Environmental Effects

The Project was able to reduce the export of phosphorus and nitrates from the study area. This was primarily achieved by the use of on-site disposal systems which do not release any effluent into the Goodman Ditch. Therefore, without this loading the amount of pollutants released from the subdivision as a whole was reduced.

The concentration of pollutants in the ditch was similar to the start of the Project. As far as a health standpoint, the ditch had not improved. The low volume of water in the ditch due to the installation of on-site disposal system may have a adverse effect on the concentration. Without the dilution effect from additional water entering the ditch a ponded situation was created and evaporation may have increased the concentration. Both Post studies were conducted in a low flow conditions of late Summer and early Fall with little rainfall during the study periods.

Economic Impact

The Project did improve the economic value of the area. It can be assumed the houses with the improved sewage systems could have increased in value although no actual dollar figures were directly obtained. Also the fact that all the houses now have approved sewage disposal systems could mean a increase in value of the area as a whole.

Agency Acceptance

Most of the people in the area had never worked with the S.W.C.D. or the A.C.G.H.D. before this Project. This Project did boost exposure of both of these agencies. From personal conversations with the landowners, the participation of the agencies with the landowners was well received. Cost-sharing was a big influence to their cooperation. Without the use of cost-sharing in this area, the success of installation would have been slowed drastically.

PHYSICAL ADAPTABILITY OF SEWAGE IMPROVEMENTS

Many factors can influence the type of sewage system that is needed. The biggest limiting factor that was encountered was the amount of area available to install a septic tank/leach bed disposal system. This type of system is most favored with the A.C.G.H.D. due to the fact there is no off-lot discharge. These systems must have an area of approximately 7,500 to 10,000 square feet of ground area for a two and three bedroom house, respectively and also be at least 50 feet away from a water well. Soil type in the area also influenced the size needed for the leach bed. A heavy clay soil would require a larger area to dispose of the effluent in comparison to a sandy or loamy soil which is more permeable. If any of these requirements could not be met, an alternative system must be used. Thirteen of the total 34 houses with substandard systems were unable to meet these requirements and an aeration type system was installed.

ECONOMIC ADAPTABILITY OF SEWAGE IMPROVEMENT

An advantage of this Project was the use of cost-sharing funds at the rate of 75% of the total cost of sewage system improvements. Without the use of this, acceptance probably would not have been as favorable. The actual economic situation of the landowners in the area could have influenced acceptance. Some of the individuals may not have been able to pay the entire amount though required by law.

The price of the systems installed varied. Aeration systems were less expensive to install because a leach bed field is not necessary. On the average aeration systems cost $2,914 while septic tanks with leach beds were $3,096, a difference of $182. Although aeration systems are more economical to install, they do have continuous maintenance costs of electricity and minor repairs of the motor and other moving parts. A fee is also required by the A.C.G.H.D. to cover an annual inspection of these systems. According to the A.C.G H.D., these systems can under proper maintenance last up to 25 years or more. A septic tank/leach bed system usually have a life expectancy of 20 to 30 years because of the tendency of the leach bed to lose its effectiveness from plugging with particulate matter. Maintenance and actual volume input can greatly influence these results.

SECTION 5E

RURAL SEWAGE RECOMMENDATIONS

PROBLEMS ENCOUNTERED

Two of the 34 landowners were unwilling to install the required improvements in their substandard sewage systems. A stern letter from the A.C.G.H.D. explaining the deficiencies found and the requirements of the law was sent to these individuals who eventually did comply with the project. The poor health condition of the ditch could have prompted many of the residents to be cooperative.

The poor drainage grade of the Goodman Ditch provided many stagnant pools within the area. Although the average grade of the entire portion of ditch through the subdivision is .4%, quiet adequate to drain away water. Many portions were extremely flat resulting in a ponded condition. Without continuous inputs of water into the ditch, the pools would remain and could experience evaporation concentrating their pollutants. An improvement of grade in the ditch would be beneficial as far as a health standpoint and would reduce the nuisance within the residential area.

According to state standards on residential sewage systems the parameters to be met are only B.O.D. and suspended solids. Other pollutants such a phosphorus and nitrates are not addressed in the effluent standards. Without such standards, off-lot discharges of effluent can still be unacceptable in these other water quality parameters. According to the National Sanitation Foundation, the effluent produced from an approved aeration sewage treatment plant has no reduction of total soluble phosphorus and produces high rates of nitrates. Therefore, acceptable aeration systems do release phosphorus and nitrates. Without standards set for such pollutants the adequate control of residential sewage system can not be maintained. The aeration systems installed on 26 sites did meet state standards but were unable to treat or reduce phosphorus export on an individual basis.

The Heidelberg College was originally contracted to perform three post-treatment studies that were to be conducted during Spring high flow, Summer low flow/high temperature, and Fall low flow/low temperature conditions. Only two studies were performed, both during low flow conditions. Scheduling conflicts and other interest forced the College to be unable to perform its work as originally proposed. The additional high flow study could have provided much more data from both the agricultural area and the effects of dilution on effluent.

AGENCY PROGRAMS

The information from this Project reinforced the opinion of the A.C.G.H.D. of the rural sewage problem in this county. Their office has stated that they will strive to offer strict enforcement of the state standards. Limited funding and manpower could be its biggest drawback According to the 1980 Census, over 22% (9,271 of 41,846) of residential dwelling in Allen County are serviced by individual sewage disposal systems.

With this Project, the Allen S.W.C.D. has become more aware of the causes and effects of effluent in open drainways. A large portion of the Districts work is in rural area and with this awareness we may be able to better provide technical assistance to concerned individuals. The Allen S.W.C.D. has also agreed to continue to be supportive of the A.C.G.H.D. in its efforts of control of rural sewage problems.

PROJECT MAINTENANCE

According to the Sewage Disposal Regulation of the A.C.G.H.D., all septic tank-leaching systems installed after November 1, 1974 and all aerobic type treatment systems installed after July 1, 1972 are required to pay a yearly permit fee. This fee is to provide monies for inspection purposes of these systems. All aerobic systems installed after July 1, 1972 are inspected annually due to the constant maintenance requirements and the direct discharge of effluents into public waters. Septic tank systems are spot inspected when a complaint arises , says the A.C.G.H.D. The 26 aeration system within the subdivision are involved in the inspection program. The five other septic systems with off-lot discharge installed before the mandatory inspection program was passed, and the 34 on-site disposal system will only be spot checked when a complaint arises, says the A.C.G.H.D.

FUTURE DEMONSTRATION PROJECTS

Additional information on the effects of the sewage system improvements for an entire year would be important. This would demonstrate total export for a year representing both high and low flow periods. The bio-accumulation of pollutants within the soils of the ditch may also have had some influences on the concentrations found. A buffering effect from the already contaminated ditch many be experienced for a number of years. A question may be asked if there is such an accumulation and how fast it can be naturally reduced after sewage system improvements are made.

Cost-sharing on the installation of improvements was a big attribute to the public acceptance to this Project. Even with the regulations in the law, many homeowners would not have been able to afford to upgrading their systems due to the cost burden of such work. Any additional studies would greatly benefit by the use of cost-sharing funds.

ON-SITE TREATMENT OF SEWAGE WASTES

Accordin~ to Bill Kelly of the A.C.G.H.D., the on-site disposal treatment of sewage wastes is the recommended method in rural areas. It should be noted that (Kreiger) the effectiveness of a on-site septic tank system depends not only on its ability to remove solids and to disperse the effluent, but also on the ability of the underlying soil to remove pathogens and phosphorus during percolation. Jones and Lee explain that phosphate and ammonia ions generally are strongly adsorbed by soil particles, where as nitrate is poorly adsorbed and readily transported in groundwater. This explains that on-site treatment of residential sewage is effect in reducing phosphorus and ammonia export from the site by either surface or ground water. However, it is very important to emphasize that proper management methods of the septic tanks is crucial to their effective operation.

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GLOSSARY

aeration system: A sewage disposal system which utilizes the principle of oxidation in the decomposition of sewage by the introduction of air into the sewage or by surface absorption of air for a sufficient period of time to effect adequate treatment.

basin: A region drained by a single lake or river system.

bedrock: The solid rock that underlies all soil, sand, clay and loose material on the earth's surface.

biochemical oxygen demand: The amount of dissolved oxygen required to meet the metabolic needs of microorganisms in a water environment rich in organic matter.

cooperator: an individual or group that has signed an agreement stating they would be willing to work with and participate in the Soil and Water Conservation District programs.

conservation tillage: Any tillage system that creates a suitable environment for a growing crop while leaving a minimum of 30 percent residue cover on or near the soil surface throughout the year.

contaminant: A material that makes a substance unfit or undesirable.

conventional tillage: Any tillage system that creates a suitable environment for a growing crop but leaves less than a 30 percent residue cover on or near the soil surface throughout the year.

cost-sharing: A method where two or more parties divide the expenditures for goods or services.

crop rotation: A method of maintaining and renewing the fertility of a soil by successive planting of different crops on the same land.

crop land: Land that is suited or used for crops.

cultivate: A method to control weeds and aerate the soil in a growing crop.

curtain drain: A subsoil drain that prevents the entrance of ground water into the area of the household sewage disposal system.

District: Another name for Allen Soil and Water Conservation District.

District Conservationist: The head Soil Conservation Service person assigned to each Soil Conservation Service field office

drain way: A channel or depression that carries away surface water.

drift: Rock debris deposited by a glacier.

effluent: The discharge of waste from a sewer.

erosion: The process in which soil material is transported from the earth's surface by either water or wind.

glacier: A huge mass of laterally limited, moving ice originating from compacted snow.

growing season: The time period from the last killing frost in the Spring to the first killing frost in the Fall.

herbicide: A chemical applied to control unwanted vegetation.

hybrid: The offspring produced by breeding plants of different varieties, species or races.

in-kind: The value of labor or usage of equipment that is contributed to help establish and promote a common cause.

lowlands: A area of land that is low in relation to the surrounding county.

mantle: The layer of rock between the crust and the core of the earth.

monitor: To observe and check the quality of a particular process, activity or subject.

moraine: An accumulation of boulders, stones, or other debris deposited by a glacier.

mulch-tillage: Another name for conservation tillage excluding no-till. (Also reduced-tillage)

no-till: A crop planted into a protective residue cover where no soil disturbance has been made except in the immediate area of the seed at planting.

nutrients: A nourishing substance that promotes growth.

off-lot discharge: The sewage effluent that is released from its original point of origin and treatment.

outwash: Rock material that is deposited by the melt water of a glacier.

pest scouting: A service that is provided to monitor a crop during the growing season.

phosphorous: A chemical compound applied to certain crops to enhance their growth.

pollutant: A waste material that contaminates the air, water or soil.

Project Period: The length of time the Allen S.W.C.D. conducted its demonstration program which was from July, 1980 to July 1985 and included the growing seasons 1981 to 1985.

quarry: An open excavation or pit from which stone is obtained.

relief: The variations in elevations of an area of the earth's surface.

residue: The material remaining in a field after the harvest of a crop.

run-off: Rainfall that is not absorbed by the soil.

sediment: Material suspended and/or deposited in water.

sewage system: A group of devices used to treat or improve waste materials.

soil absorption disposal field: A series of subsurface drains that is used to gradually release into the soil the effluent of a sewage system.

significant difference: In comparing two numbers, it denotes a dissimilarity of greater than five percent.

soil series: Soils that have similar characteristics in sequence of natural layers or horizons from the soil surface down to the parent material.

soil survey: A index of the soils, their characteristics, and uses for a particular region, typically on a county-wide basis.

subsurface drainage: A conduit, such as a tile, pipe or tubing installed beneath the ground surface to collect and/or convey drainage water.

success rate: The number of times a system was equal to or surpassed its comparison, relative to the total number of times that it was tested.

surface drainage: An open channel that is capable of removing drainage water.

till plain: A area composed of glacial drift material.

topsoil: The surface layer of soil.

topography: The physical features of a region.

tributary: A stream or river flowing into a larger stream or river.

variety: A taxonomic category forming a subdivision of a species consisting of naturally occurring characteristics.

water quality: The state or condition of a water supply.

watershed: A region draining into a river, river system or a body of water.

yield: The amount produced; the profit obtained from an investment.

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA-905/2-87-001	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE Water Quality Demonstration Project-Allen County, Ohio		5. REPORT DATE April 1987
		6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Beth A. Seibert, Donald M. Vigh		8. PERFORMING ORGANIZATION REPORT NO. GLNPO Report No. 87-05
9. PERFORMING ORGANIZATION NAME AND ADDRESS Allen County Soil and Water Conservation District, 219 West Northern Avenue, Lima, Ohio 45801		10. PROGRAM ELEMENT NO.
		11. CONTRACT/GRANT NO. S005553
12. SPONSORING AGENCY NAME AND ADDRESS Great Lakes National Program Office, U.S. Environmental Protection Agency, Chicago, Illinois 60604		13. TYPE OF REPORT AND PERIOD COVERED Final 1981-1986
		14. SPONSORING AGENCY CODE USEPA-GLNPO 5GL

15. SUPPLEMENTARY NOTES

Section 108(a) Program Demonstration Project
Ralph G. Christensen - Project Officer

16. ABSTRACT

The project demonstrated to farmers throughout the county, on a voluntary basis, the effects and economics of conservation tillage. An intense educational program was provided, no-till equipment made available and technical assistance was also provided to the farmer as incentives to test conservation tillage on their lands. The response to the adoption of conservation practices was outstanding.

A second part of this demonstration was the evaluation of rural sewer systems. The Allen County General Health District worked with the residential home owners to correct the deficient septic systems. Water Quality monitoring, before and after the renovation process, was conducted of the ditch that the sewage systems drained into. A description of the work is included.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Water quality, Soil erosion, Conservation tillage, No-till, Septic Systems, Economics, Sewage, Local cooperation, Agriculture		

18. DISTRIBUTION STATEMENT Document is available to the public through the National Technical Information Service (NTIS) Springfield, VA 22161	19. SECURITY CLASS *(This Report)*	21. NO. OF PAGES 99
	20. SECURITY CLASS *(This page)*	22. PRICE

EPA Form 2220-1 (9-73)

☆ U S GOVERNMENT PRINTING OFFICE: 1987 - 744-6