WETLANDS LOSS DUE TO AGRICULTURAL CONVERSION: A SURVEY OF RECENT DATA

February 1990

United States Environmental Protection Agency
Office of Policy, Planning, and Evaluation
Washington, D.C. 20460

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

WETLANDS LOSS DUE TO AGRICULTURAL CONVERSION: A SURVEY OF RECENT DATA

Introduction

This report surveys currently available sources of data on the conversion of wetlands to agriculture in the United States. Unfortunately, relatively few sources provide a direct indication of the rate of conversion or the total number of wetlands converted. The only complete set of data currently available on the loss of U.S. wetlands to agriculture is the National Wetlands Inventory (NWI), conducted by the U.S. Fish and Wildlife Service. The NWI provides statistical estimates of wetland acreage for the lower 48 states between the mid-1950s and the mid-1970s. The NWI data show that nearly 12 million acres of wetlands had been converted to agricultural use during that 20-year period (Frayer et al. 1983). These conversions represented 87 percent of all wetlands lost in that time frame (Tiner 1984). The Office of Technology Assessment analyzed the NWI data and reported that agricultural conversions accounted for 98 percent of the net losses from all causes suffered by freshwater wetlands (OTA 1984).

The only source of national data regarding wetlands converted to agriculture since the mid-1970s is that produced by the U.S. Department of Agriculture's (USDA) Soil Conservation Service (SCS) in its administration of the Food Security Act of 1985. The data reported by the SCS include the number and acres of remaining wetlands and converted wetlands on farms participating in USDA benefit programs. As of October 16, 1989, SCS had made wetland determinations on a limited number of farms and had identified approximately 77,000 acres of wetlands converted for agricultural use on these farms since December 23, 1985. This figure represents an unknown fraction of the total conversions since 1985 as SCS determinations are not yet complete. The SCS data also do not include conversions on non-participant farms or lawful conversions pursuant to some exemptions under the Food Security Act.

In addition to these sources of data on actual conversions, there is information available on the potential for the conversion of remaining wetlands in the 1982 National Resources Inventory (NRI), conducted by the SCS. The NRI estimates that of the 78.4 million acres of nonfederal wetlands existing in the United States in 1982, 5.1 million acres of wetlands have a high or medium potential for conversion and an additional 28 million acres have a low potential for conversion. The NRI rated a wetland's potential for conversion based mainly upon the use of similar lands in surrounding areas. Another means of estimating conversion potential is to look at economic incentives for conversion. One study estimates that 16 million acres of the wetlands remaining in 1982 would be profitable if converted at 1985 crop prices (Heimlich 1986). At the end of 1989, the SCS completed an update of the NRI with data from 1987. These wetlands data, however, have not yet been analyzed.

Overview

Part One of this report presents the best available sources of data on wetlands losses due to agricultural conversion. This section includes the SCS determinations of farm wetland acreage and conversions; the estimates made by the NWI of conversions from the mid-1950s to the mid-1970s; regional analyses of this aspect of the NWI data; and other related regional studies.

Part Two describes the data available regarding the *potential* for agricultural conversion of the remaining wetlands in the United States. This section presents various estimates of the percentage of wetlands likely to be converted in the near future. The data are compiled regionally as well as for critical wetland areas. This section also reviews an economic analysis of the profitability of agricultural conversion and an analysis of the effectiveness of Swampbuster sanctions in deterring conversions.

Parts Three and Four examine several types of data that might indicate indirectly either the extent of recent conversions or the likelihood of future conversions. Part Three includes a consideration of the recent trends in crop prices and agricultural land use, and examines projections of future crop prices and demand for farmland. Part Four considers historical trends in agricultural drainage and reviews recent waterfowl population inclines and declines.

PART I

AGRICULTURAL CONVERSION

Introduction

The Food Security Act (FSA) Progress Reports, published quarterly by the USDA Soil Conservation Service (SCS), are the only available sources of data concerning the conversion of wetlands in the late 1980s. As part of the administration of the "Swampbuster" program, SCS technicians assess participating farms for the number and acreage of remaining wetlands and wetlands converted since the inception of the program in 1985. The SCS assessments are not complete for many states and regions, however, and do not provide the basis for a reasonable estimate of the total number of recent conversions. Part One includes a further explanation of the assessment process and a breakdown of the data from the Progress Report of October 16, 1989.

The only complete source of data on wetlands conversions is the National Wetlands Inventory (NWI), which covers the period between the mid-1950s and the mid-1970s. Conducted by the U.S. Fish and Wildlife Service, the NWI is intended to provide estimates of wetland acreage, wetland loss, and causes and rates of wetland loss in the lower 48 states during that 20-year period (see Appendix A for information on the survey methods and parameters). The Fish and Wildlife Service is required to produce an update of the NWI data by September 30, 1990, and at 10-year intervals thereafter.

Part One of this report includes the results of the NWI as interpreted and reported in three major sources. Frayer et al. (1983) reports that a total of 13.6 million acres of wetlands were lost, of which 11.85 million acres (87 percent of the total losses) were converted to agriculture. Tiner (1984) reports that an average net loss, due to all causes of 458,000 acres of wetlands occurred each year in the 20-year period. The Office of Technology Assessment (OTA 1984) reinterpreted the same data and estimated that wetlands suffered an annual average net loss of 550,000 acres, 80 percent of which was attributed to agriculture. OTA further estimated that the rate of wetlands loss has decreased by approximately 50 percent since 1975. Part One also includes data on the acute losses of inland, freshwater wetlands (also referred to as palustrine vegetated). According to the data in Frayer et al. (1983), 99 percent of the 11.85 million acres of wetlands lost to agriculture were classified as palustrine vegetated.

Finally, Part One reviews several sources of regional information, including OTA's breakdown of the NWI data into 13 physiogeographic regions. NWI data were designed to be reliable at the national level only, however, and few comparable statistics exist on the state or regional level. The final section of Part One cites several sources of regional data, other than the NWI, which may be referred to for further information.

U.S.D.A. FOOD SECURITY ACT PROGRESS REPORTS

The U.S. Department of Agriculture's (USDA) Food Security Act Progress Reports present the most current data regarding wetlands acreage on agricultural lands and wetlands converted to agriculture. The USDA collects quarterly reports that document the Soil Conservation Service's (SCS) determination of the number of wetlands converted since December 23, 1985; their cumulative acreage; and the number of farms and acres for which positive wetland and highly erodible land determinations have been made.

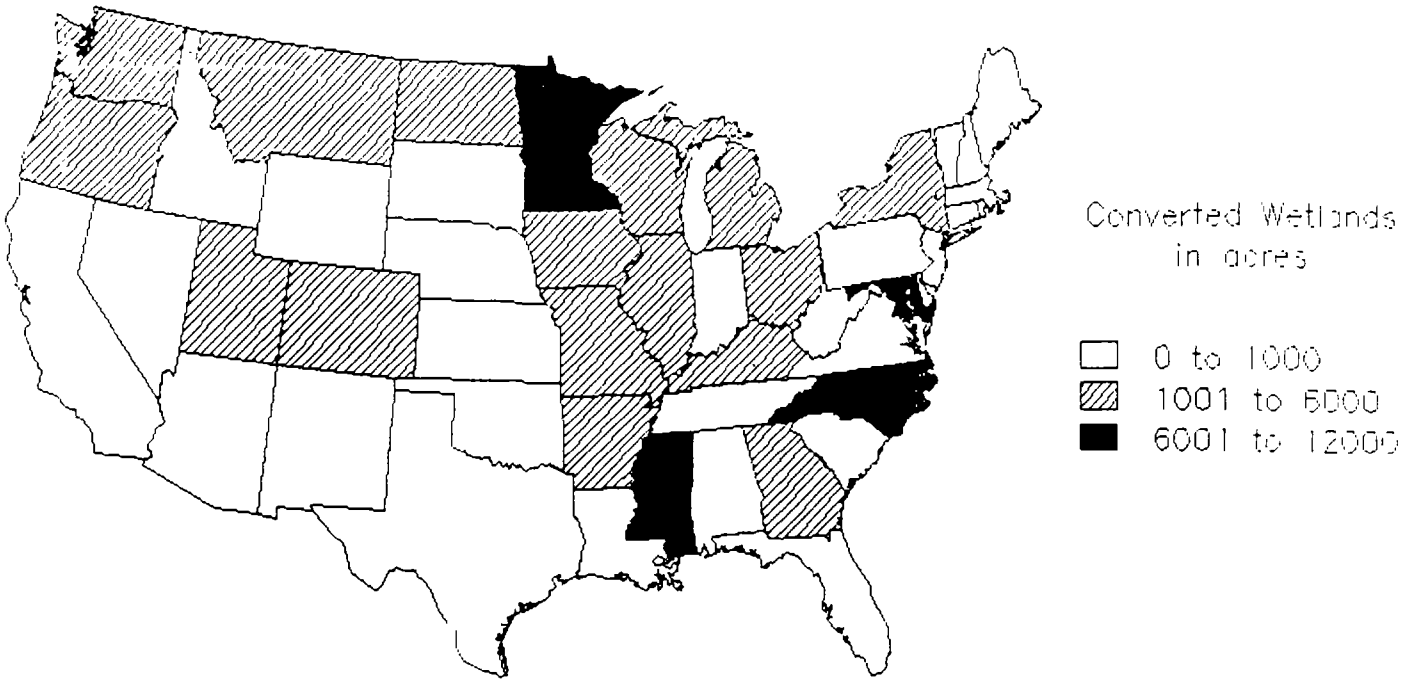
Of those lands evaluated as of October 16, 1989, the USDA reports that 6,647,815 acres of wetlands exist on farms, and 77,260 acres of wetlands have been converted to agriculture since December 23, 1985. It is impossible to estimate from these data the total number or acres of wetlands converted since 1985 for three reasons. First, the SCS data accounts for only those farms covered by the Swampbuster Program. Conversions on non-participant farms are not counted.

Second, the USDA reports that at the present time it is impossible to determine what percentage of USDA program participant farms have been assessed. Farmers are allowed to register their lands with the SCS as single farms or in multiple tracts. The SCS data do not distinguish farms from tracts, making it impossible to determine what percentage of farms have been assessed to date.

Third, even if the percentage of program participant farms assessed were known, a straight-line extrapolation of the wetlands acreage and conversions could not be made accurately due to a sampling bias. Rather than sampling U.S. farms randomly, the SCS began by looking at those areas with high potentials for conversion and those farms for which, during any crop year, the producer indicated on form AD-1026 that he or she intended to produce crops on "wet areas." Consequently, the completed wetland and converted wetland determinations do not comprise a representative sample.

FIGURE 1.1

ACRES OF WETLANDS REPORTED CONVERTED SINCE DECEMBER 23, 1985



Based upon data from U.S. Department of Agriculture. (1989). Food Security Act Progress Report of October 16, 1989. Washington, D.C.: USDA, Soil Conservation Service.

• This map illustrates the acreage of converted wetlands, by state, according to Soil Conservation Service (SCS) determinations made thus far on program participant lands. Nationally, a total of 77,260 acres of wetland conversions have been reported, plus 2,648 acres converted pursuant to the "minimal effects" exemption to the Food Security Act Swampbuster Program.

• The data illustrated above account only for wetlands on program participant farms that have been assessed by the SCS since December 23, 1985.

• The data do not account for wetlands on non-program farms; wetlands converted before December 23, 1985; wetlands converted after December 23, 1985, where the conversion commenced before that date; or wetlands converted on farms that have not been assessed.

• Table 1.1 on the following page presents the full set of data on wetland conversions from the October 16, 1989, Food Security Act Progress Report. The table includes the number and acres of program participant farms or tracts with wetlands that have been assessed in each state to date; the number and acres of wetlands converted on those farms or tracts since December 1985; the number and acres of wetlands that were lawfully converted under the "minimal effects" exemption; and the number of farms or tracts on which no wetlands were found ("negative wetland determinations").

TABLE 1.1

FOOD SECURITY ACT PROGRESS REPORT, OCTOBER 16, 1989

	Farms w/ Wetlands		Converted Wetlands		Minimal Effect Determ.		Neg. Wet. Det.
	number	acres	number	acres	number	acres	number
ALABAMA	70	1355	5	57	0	0	609
ALASKA	0	0	0	0	0	0	41
ARIZONA	25	149	0	0	0	0	1418
ARKANSAS	1212	91630	45	1662	2	19	1401
CALIFORNIA	1992	110378	5	840	0	0	6323
COLORADO	1589	55280	11	2245	4	30	9847
CONNECTICUT	401	3249	2	22	0	0	582
DELAWARE	180	1046	2	5	0	0	987
FLORIDA	4390	271628	14	117	0	0	4466
GEORGIA	13271	377604	201	2858	2	29	23531
HAWAII	0	0	0	0	0	0	139
IDAHO	1416	89380	2	18	2	6	4962
ILLINOIS	2253	19036	151	2300	0	0	0
INDIANA	1848	14950	57	323	0	0	1072
IOWA	6923	53990	212	2857	7	104	41577
KANSAS	4946	151501	5	254	0	0	91436
KENTUCKY	1136	28174	104	1989	0	0	4830
LOUISIANA	11008	687540	26	922	0	0	41812
MAINE	432	11891	6	111	0	0	128
MARYLAND	1835	8162	99	6179	0	0	2400
MASSACHUSETTS	258	3099	0	0	0	0	2674
MICHIGAN	14172	292712	214	2087	0	0	13244
MINNESOTA	42586	542771	950	11445	27	970	27573
MISSISSIPPI	2420	214105	45	6943	40	478	1128
MISSOURI	2019	291540	70	2048	31	502	15549
MONTANA	6500	404747	65	3749	0	0	2137
NEBRASKA	2037	16498	37	477	2	13	126
NEVADA	156	56327	4	99	0	0	162
NEW HAMPSHIRE	127	1470	4	27	0	0	497
NEW JERSEY	302	1508	5	181	0	0	42
NEW MEXICO	194	2189	1	454	0	0	7905
NEW YORK	22520	175109	68	1422	5	12	13407
NORTH CAROLINA	3371	111159	258	11625	4	37	9203
NORTH DAKOTA	53186	1780854	155	1018	19	94	11752
OHIO	701	13229	69	1233	1	45	1309
OKLAHOMA	172	4734	2	300	1	20	3775
OREGON	2983	50429	214	3373	0	0	249
PENNSYLVANIA	1582	16963	17	485	0	0	47717
RHODE ISLAND	44	400	0	0	0	0	85
SOUTH CAROLINA	107	1542	5	98	0	0	3639
SOUTH DAKOTA	2512	31809	108	604	18	251	37
TENNESSEE	4515	152261	30	442	0	0	37000
TEXAS	7506	168361	25	676	0	0	80089
UTAH	1158	30545	45	1732	1	23	8944
VERMONT	710	19339	5	67	0	0	1372
VIRGINIA	654	6374	4	115	0	0	8565
WASHINGTON	1892	40330	28	1237	0	0	4939
WEST VIRGINIA	291	1380	17	132	0	0	2733
WISCONSIN	8274	210502	347	2385	5	15	9973
WYOMING	399	28548	4	47	0	0	3554
PUERTO RICO	1	38	0	0	0	0	1
TOTAL	**238276**	**6647815**	**3743**	**77260**	**171**	**2648**	**556941**

TABLE 1.2

ACRES OF WETLANDS LOST TO AGRICULTURAL, URBAN, AND OTHER USES: MID-1950s TO MID-1970s

Wetland Type	Acres mid-1950s	Acres mid-1970s	Net Change	LOSSES DUE TO: Agriculture	Urban	Other	Total Losses[1]
				(x 1,000 acres)			
PALUST. NON-VEG.	2,704.4	4,970.5	+2,266.1	125.7	34.7	60.4	220.8
PALUST. VEGETATED	99,818.2	88,765.9	-11,052.3	11,719.9	925.2	617.0	13,262.1
Forested	55,707.4	49,713.4	-5,994.0	6,241.5	372.9	243.9	6,831.3
Scrub-Shrub	10,998.2	10,611.1	-387.1	952.6	128.0	49.5	1,130.1
Emergent	33,112.6	28,441.4	-4,671.2	4,552.8	424.3	323.6	5,300.7
ALL PALUSTRINE	102,522.6	93,736.4	-8,786.2	11,845.6	959.9	677.4	13,482.9
ALL ESTUARINE	5,609.2	5,242.3	-366.9	9.5[2]	127.3	14.9	151.7
TOTAL ESTUARINE & PALUSTRINE	108,131.8	98,978.7	-9,153.1	11,855.1	1,087.2	692.3	13,634.6

Based on National Wetlands Inventory (NWI) data as reported in Frayer et al. (1983). Status and Trends of Wetlands and Deepwater Habitats. Fort Collins, CO: Colorado State University, Department of Forest and Wood Sciences.

- NWI data show that approximately 11.85 million acres of wetlands were converted to agricultural use betwen the mid-1950s and the mid-1970s. Agricultural conversions represent 87 percent of all wetlands lost in that period. Palustrine vegetated wetlands suffered the greatest loss to agriculture: 11.7 million acres.

- The average net loss of wetlands each year due to all causes was 458,000 acres (Tiner 1984).

- The Office of Technology Assessment (OTA) reprocessed the NWI data and reported the results in slightly different form (OTA 1984). OTA considered additional types of wetland losses, including the conversion of wetlands into deep water, open water, or unconsolidated shore lands, and therefore arrived at a larger estimate of total losses. OTA also calculated a net loss figure for each use category. OTA's findings include:

  - A total of approximately 14.6 million acres of freshwater (palustrine vegetated) wetlands were lost during the 20 year period. 80 percent of these losses were attributed to agricultural use.

  - There was a net loss of approximately 11 million acres of freshwater wetlands; 98 percent of the net loss was due to agricultural use.

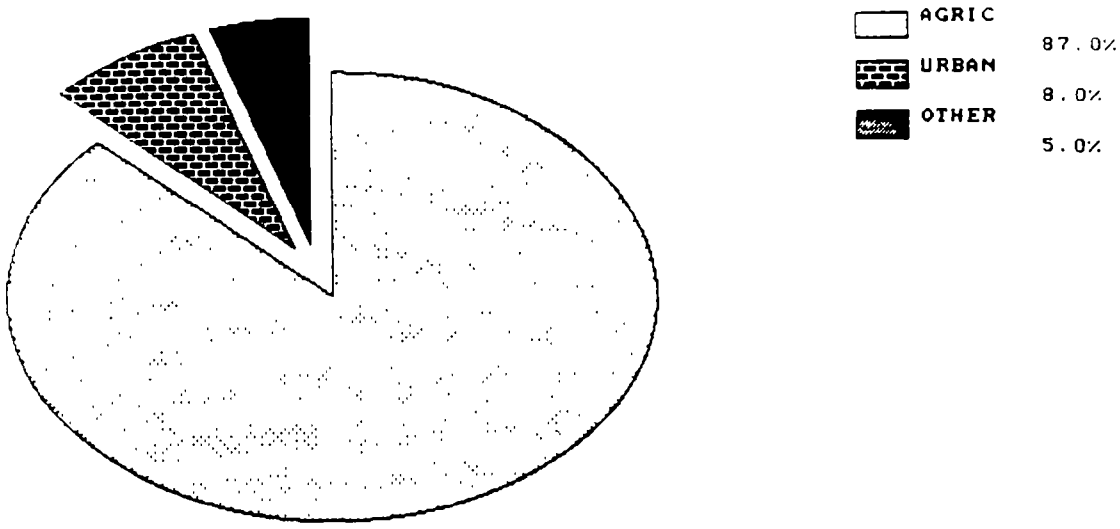
  - There was an average net loss each year of about 550,000 acres of freshwater wetlands. (Note: OTA estimated that this annual net loss rate was reduced by 50 percent since 1975.)

[1] Total losses are more than net change due to gains in acreage of some types of wetlands over the twenty-year period.

[2] This figure has a standard error that makes it about one-half as reliable as any other estimate in this table.

FIGURE 1.2

CAUSES OF WETLANDS LOSS:
MID-1950s TO MID-1970s



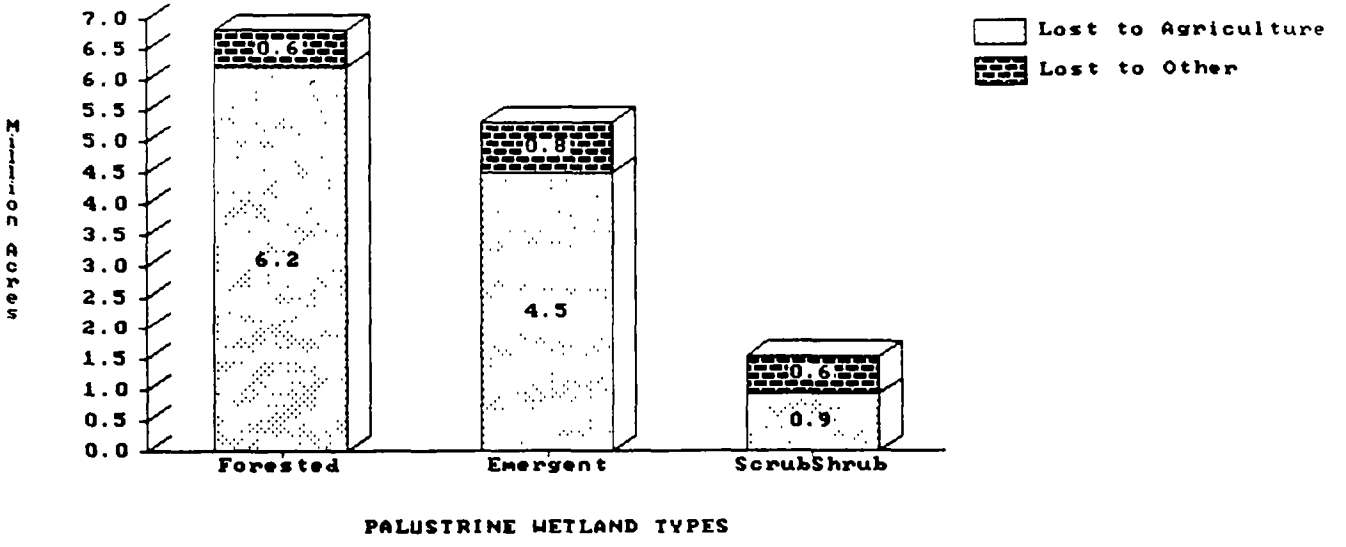
Tiner, Ralph W. (1984) Wetlands of the United States: Current Status and Recent Trends. Newton Corner, MA: U.S. Fish and Wildlife Service.

- Total wetlands lost were 13.6 million acres (Frayer et al., 1983).

- 11.85 million acres of wetlands were converted to agriculture. (Frayer et al., 1983). Virtually all of these were freshwater wetlands.

FIGURE 1.3

PALUSTRINE WETLANDS LOST:
MID-1950s TO MID-1970s



Based on National Wetlands Inventory (NWI) data as reported in Frayer et al. (1983). Status and Trends of Wetlands and Deepwater Habitats. Fort Collins, CO: Colorado State University, Department of Forest and Wood Sciences.

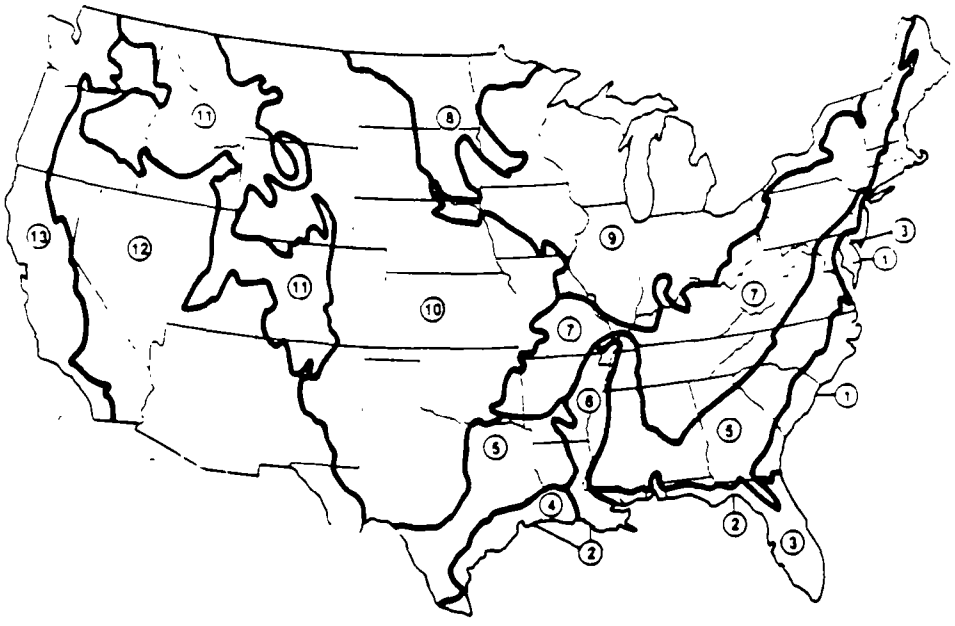
• Of all wetland types, palustrine vegetated wetlands suffered the most significant losses due to agriculture: 99 percent of the 11.85 million acres of wetlands converted to agriculture were palustrine vegetated. Forested wetlands made up 53 percent of the palustrine wetland lost to agriculture, followed by emergent (39%) and scrub-shrub (8%).

• Urban development leads the causes listed as "other."

• The Office of Technology Assessment (OTA 1984), using the NWI data, found that of all causes, agricultural conversion was the predominant reason for losses suffered by freshwater wetlands (essentially the same category as palustrine vegetated). OTA reports that agriculture accounted for 98 percent of the net losses to all causes of freshwater wetlands.

FIGURE 1.4

REGIONAL PATTERN OF WETLANDS LOST TO ALL CAUSES:
MID-1950s TO MID-1970s



REGION	WETLANDS LOST TO ALL CAUSES (x 1000 acres)	REGION	WETLANDS LOST TO ALL CAUSES (x 1000 acres)
1-Atlantic Coastal Zone	84	7-Eastern Highlands	322
2-Gulf Coastal Zone	371	8-Dakota-Minnesota Draft and Lake Bed Flats	816
3-Atlantic Coastal Flats	1274	9-Upper Midwest	2286
4-Gulf Coastal Flats	1872	10-Central	763
5-Gulf-Atlantic Rolling Plain	2310	11-Rocky Mountains	125
6-Lower Mississippi Alluvial Plain	3749	12-Intermontane	685
		13-Pacific Mountains	473

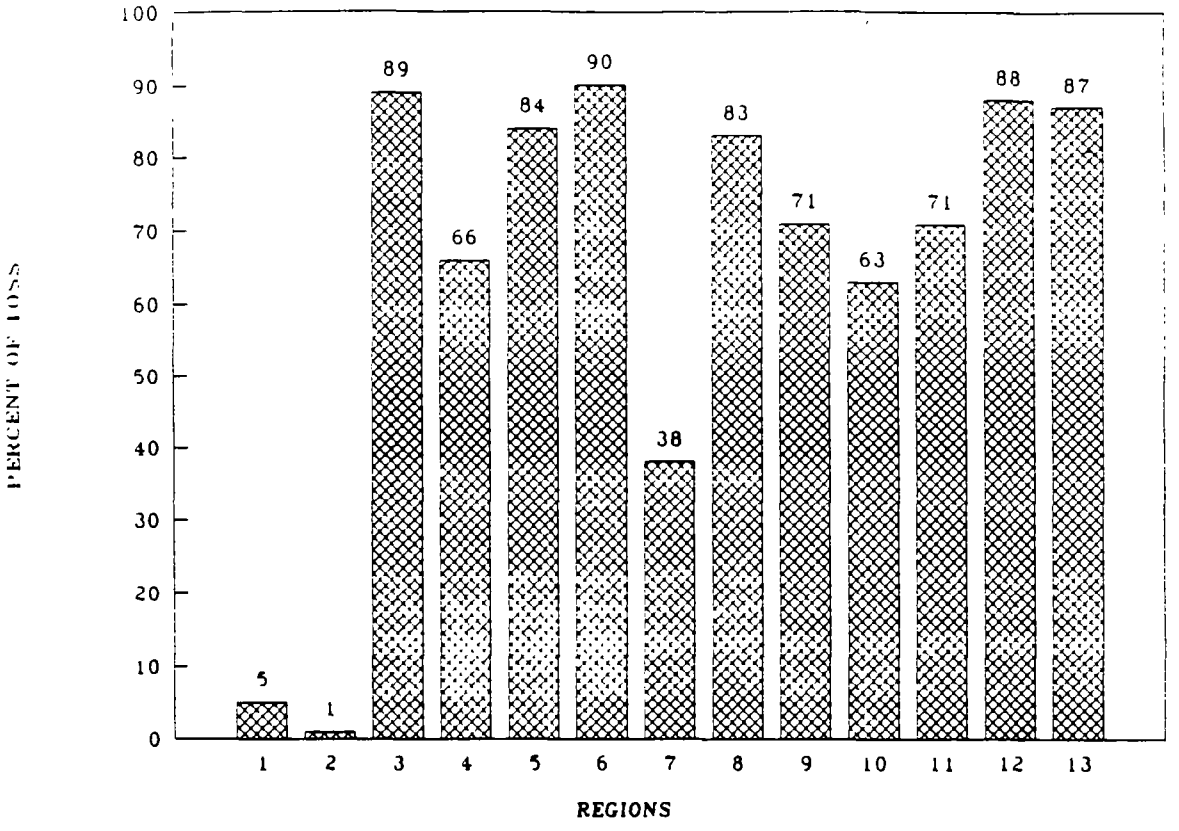
Office of Technology Assessment. (1984). Wetlands: Their Use and Regulation. Washington, D.C.: U.S. Congress, OTA. Report No OTA-0-206.

• The Office of Technology Assessment (OTA) produced the results of the National Wetlands Inventory (NWI) for the 13 physiographic regions represented on the map above. The Lower Mississippi, Gulf-Atlantic, and Upper Midwest regions suffered the greatest number of acres of freshwater wetlands lost to all causes. Figure 1.5, on the following page, illustrates the percentage of total losses in each region that were due to agricultural conversion.

• Problems with regional data: Very large standard errors are associated with NWI data on a regional level. Furthermore, the geographical subdivisions used by OTA are based upon similar physical characteristics and not upon land use.

FIGURE 1.5

PERCENTAGE OF WETLAND LOSS DUE TO AGRICULTURE, BY REGION: MID-1950s TO MID-1970s



Based upon data from Office of Technology. (1984). Wetlands: Their Use and Regulation. Washington, D.C.: U.S. Congress, OTA. Report No. OTA-0-206.

• This graph presents the percentages of wetlands acres in each region lost to all causes that were used for agriculture. The Office of Technology Assessment (OTA) used National Wetlands Inventory data for its study.[1]

• The actual losses of freshwater vegetated wetlands to agriculture range from 1 to 90 percent of total losses in the 13 regions. However, agriculture was the greatest cause of loss of freshwater vegetated wetlands in every region. The percentage of losses to all causes attributed to agricultural conversion was greater than the national average listed by OTA as 80 percent (see p. 7) in six regions.

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1 For actual region names see Figure 1.4.

OTHER REGIONAL STUDIES OF WETLANDS LOSS DUE TO AGRICULTURAL CONVERSION

- Goldman-Carter, Janice, et al. (1989). Statement of the National Wildlife Federation Before the House Committee on Agriculture, July 13, 1989.

This testimony provides a useful overview of several sources of data pertaining to wetland trends in the six critical wetland areas, identified in Tiner (1984), where agricultural conversion is a major threat.

- Goldstein, Jon. (1988). The Impact of Federal Programs on Wetlands, Volume One: The Lower Mississippi Alluvial Plain and the Prairie Pothole Region. Washington, D.C.: U.S. Department of the Interior.

Includes a detailed analysis of wetland trends, including agricultural conversions and the effect of federal programs, in the Lower Mississippi Alluvial Plain and the Prairie Pothole Region.

- Office of Technology Assessment. (1984). Wetlands: Their Use and Regulation. Washington, D.C.: U.S. Congress, OTA. Report No. OTA-O-206.

This report includes information from 10 case studies. It discusses wetland trends, including conversions to agriculture, in 21 states. The case studies drew from a limited number of local sources of wetland trend information (other than the NWI); general data compiled by Section 404 or state permit programs, where available; and a variety of interviews.

- Tiner, Ralph W. (1987). Mid-Atlantic Wetlands: A Disappearing Natural Treasure. Newton Corner, MA: U.S. Fish and Wildlife Service.

This document contains information on the percentage of wetlands lost to agriculture in Delaware, Maryland, Pennsylvania, Virginia, West Virginia, and the Chesapeake Bay Watershed. The data were drawn from the National Wetlands Inventory (NWI) which estimated changes in wetland acreage between the mid-1950s and the mid-1970s.

- Tiner, Ralph W. (1984). Wetlands of the United States: Current Status and Recent Trends. Newton Corner, MA: U.S. Fish and Wildlife Service.

In addition to summarizing the national data produced by the NWI, this report cites 26 state or regional studies (pp. 34-35) conducted between 1976 and 1983 that estimate percentages of wetlands lost to agricultural conversions and other causes. It also discusses recent wetland trends in the nine critical wetland areas that are identified by Tiner. These areas and their threatened wetland types are: 1) estuarine wetlands of the U.S. coastal zone, 2) Louisiana's coastal marshes, 3) Chesapeake Bay's submerged aquatic beds, 4) South Florida's palustrine wetlands, 5) the Prairie Pothole Region's emergent wetlands, 6) wetlands of the Nebraska Sandhills and Rainwater Basin, 7) forested wetlands of the Lower Mississippi Alluvial Plain, 8) North Carolina's pocosins, and 9) western riparian wetlands.

PART II

CONVERSION POTENTIAL

Although the Soil Conservation Service's (SCS) 1982 National Resources Inventory (NRI) does not contain information on wetland losses due to agriculture, it does provide estimates of the potential for remaining nonfederal wetlands to be converted in the near future. The NRI estimated that, as of 1982, there were approximately 78.4 million acres of nonfederal wetlands remaining in the conterminous United Stated, Hawaii, and Puerto Rico (for an explanation of the study methods and parameters, see Appendix A). SCS technicians rated the inventoried lands' potentials for conversion to cropland within the next 10-15 years and the type of effort required for conversion. The potential for conversion was rated as "zero," "unlikely," "medium," or "high," according to land use trends in the region. "High potential," for example, means that "similar land has been converted to cropland during the last three years." (For further information on the inventory methodology, see Instructions for the SCS-Multiresource Inventory 1981-82, USDA Soil Conservation Service, May 1980.)

Of the lands rated by SCS technicians as having a high or medium potential for conversion to cropland, 5.1 million acres were wetlands (Figure 2.1). About 85 percent (4.3 million acres) of the high and medium potential wetlands could be brought into production with little or no effort on the farm. Slightly more than 3 million of the 4.3 million acres would require drainage. The remaining 15 percent (.8 million acres) would require action by several farms or a special district. An additional 28 million acres of wetlands had a low potential for conversion (rated as "unlikely"). The reports surveyed in this section analyze NRI estimates of the conversion potentials of U.S. wetlands nationally, regionally, and for critical wetland areas. The 14 critical areas where agricultural conversion is a primary threat contain over 80 percent of all the wetland areas rated by the NRI as having a high or medium cropland potential (Figure 2.3 and Table 2.3).

One source not reviewed in this section (Pavelis 1987) analyzed the NRI data and reported a lower estimate of 2.5 million acres of wetlands with a high or medium potential for conversion. Pavelis' estimate is lower than the 5.1 million acre estimate mentioned above partially because Pavelis limits his analysis to privately owned, partially vegetated palustrine wetlands not currently cropped or grazed (Pavelis therefore excludes about 35 million acres of wetlands from his analysis, including almost 13 million acres owned by state or local governments).

While the NRI estimates the conversion potentials of wetlands based mainly on physical characteristics, other studies based upon economic incentives have arrived at higher estimates of the number of wetlands likely to be converted. One study surveyed here (Heimlich and Langner, July-August 1986) estimates that approximately 16 million acres of remaining nonfederal wetlands would have been profitable if planted at 1985 commodity prices (Table 2.4). This section of the report also presents the results of one study (Heimlich 1989) which estimates that of about 17 million acres of wetlands with some potential for conversion, only about 6 million acres are likely to be protected by Swampbuster sanctions (Figure 2.4).

TABLE 2.1

ESTIMATED POTENTIALS FOR CONVERSION OF WETLANDS[1] TO AGRICULTURE AND THE EFFORT REQUIRED TO CONVERT

(Million Acres)

Conversion Potential	No effort	On-farm effort	Multifarm or project[2]	Not applicable	Total
High or medium	0.5	3.8	0.7	*	5.1
Unlikely	0.8	16.0	9.4	1.9	28.0
Zero	0.3	4.3	4.8	8.9	18.3
Other	0	0	0	19.2	19.2
Total[3]	1.6	24.1	14.9	30.0	70.7

Based on data from the 1982 National Resources Inventory as reported in Heimlich, Ralph E., and Linda L. Langner (1986). Swampbusting: Wetlands Conversion and Farm Programs. Washington, D.C.. U.S. Department of Agriculture, Economic Research Service

* Fewer than 100,000 acres

- Palustrine wetlands are the wetland type most frequently converted to agriculture (see Figure 1.3). Of the 70.7 million acres of nonfederal palustrine wetlands existing in the U.S. in 1982, only 5.1 million acres (7%) were rated by SCS technicians as having "high or medium" potential for conversion; 19.2 million (27%) were already in cropland or in an irreversible use ("other"); 18.3 million (26%) were rated as having "zero" potential for conversion; and 28.0 million (40%) were considered "unlikely" to be converted soon.

- Almost 85 percent (4.3 million acres) of high- and medium-potential palustrine wetlands could be brought into production with no effort or with minor work on the farm (columns labeled "No effort" and On-farm effort"). Heimlich and Langner also report that slightly more than 3 million of the 4.3 million acres would require some form of drainage.

- Those wetland acres with a high- or medium-potential for conversion are further broken down in the study cited according to the reason preventing their conversion: about 78 percent of the 5.1 million acres are too wet; 10 percent have restrictive soil conditions, such as low fertility, high erosion potential, alkalinity, salinity, or restrictive root zones; and 12 percent have no reasons preventing their conversion.

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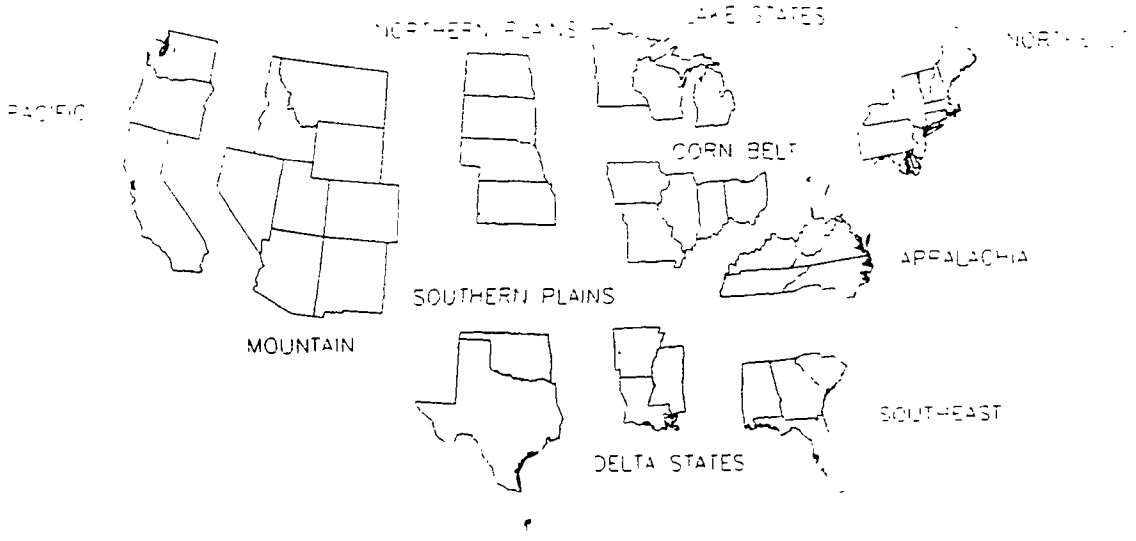
1 Includes only nonfederal palustrine wetlands.

2 Conversion requires action by several farms or a special district.

3 Detail may not add to totals due to rounding.

NONFEDERAL PALUSTRINE WETLANDS WITH HIGH OR MEDIUM POTENTIAL FOR CONVERSION BY REGION

FIGURE 2.1



• The USDA Second RCA Appraisal (1987) contains wetlands data from the 1982 National Resources Inventory (NRI) broken down into the above regions. The table below lists, by region, the total palustrine wetlands acreage, along with the acreage of palustrine wetlands rated by the NRI as having a medium or high potential for conversion to agriculture in the near future.

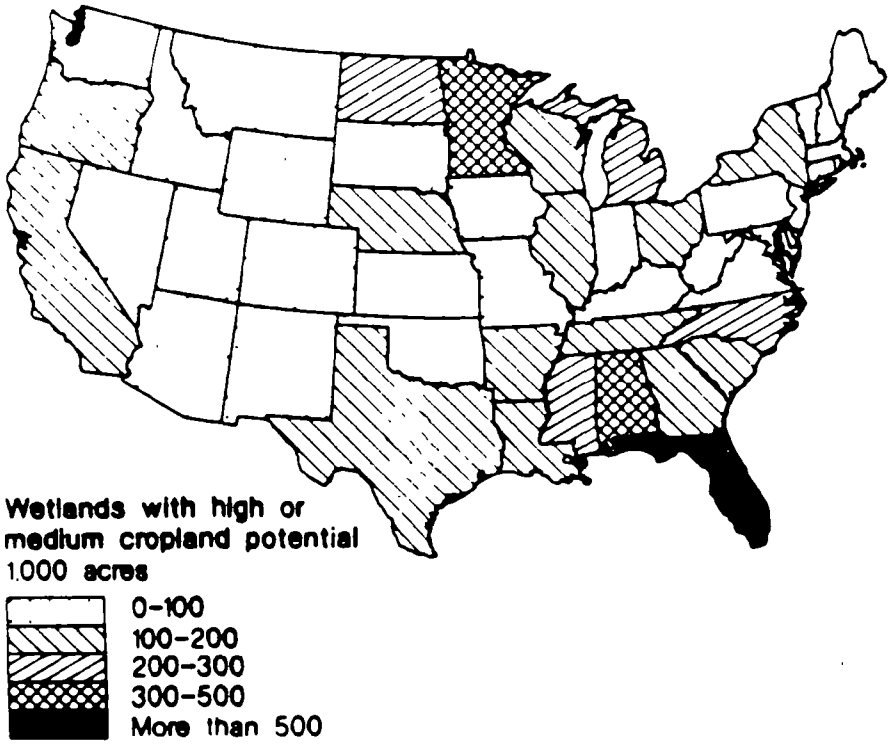
TABLE 2.2

	Total Palustrine Wetlands Acres (x1000)	Wetlands with High or Medium Potential Acres (x1000)	Percent of Total Palustrine Wetlands in the Region
Northeast	7,571	469	6
Appalachia	5,077	567	11
Southeast	18,416	1,288	7
Lake States	16,783	742	4
Corn Belt	2,180	371	17
Delta States	7,381	546	7
Northern Plains	5,489	553	10
Southern Plains	2,578	124	5
Mountain	2,841	205	7
Pacific	2,334	320	14
Total	**70,650**	**5,185**	**7**

Based on U.S. Department of Agriculture. (1987). The Second RCA Appraisal: Soil, Water, and Related Resources on Nonfederal Land in the United States, Analysis of Condition and Trends. Washington, D.C.: USDA, Soil Conservation Service.

FIGURE 2.2

NONFEDERAL PALUSTRINE WETLANDS WITH
HIGH OR MEDIUM POTENTIAL FOR CONVERSION BY STATE



Heimlich, Ralph E., and Linda L. Langner. (1986). Swampbusting: Wetlands Conversion and Farm Programs. Washington, D.C.: U.S. Department of Agriculture, Economic Research Service.

• This map illustrates the state-by-state distribution of nonfederal palustrine wetlands that were determined to have high or medium potential for conversion to agriculture by the 1982 National Resources Inventory (NRI).

• Many areas that had large losses of wetlands due to agricultural conversion during the 1960s and 1970s have relatively few remaining wetlands with high or medium cropland potential. Louisiana and Arkansas, for example, have only 144,000 and 121,000 acres of potentially convertible bottomlands, respectively, a fraction of the 1.7 million acres that each state lost between the mid-1950s and the mid-1970s. Conversely, Alabama and North Dakota had small or no net losses of wetlands between the mid-1950s and mid-1970s and had 401,000 and 298,000 of high and medium potential wetlands remaining in 1982. Florida and Minnesota had relatively high losses through the 1970s and still have more than 500,000 acres of wetlands with high or medium cropland potential.

FIGURE 2.3

CRITICAL WETLAND AREAS WITH HIGH OR MEDIUM POTENTIAL FOR CONVERSION

Heimlich, Ralph E., and Linda L. Langner. (1986). Swampbusting: Wetlands Conversion and Farm Programs. Washington, D.C.: U.S. Department of Agriculture, Economic Research Service.

- This map represents 14 wetland areas where agricultural conversion is a primary threat. Areas one through six (clear on the map) are wetland areas identified in Tiner (1984). Heimlich and Langner matched Tiner's six problem areas as closely as possible with Major Land Resource Areas (MLRA's) in order to determine how many wetland areas with high or medium conversion potential fell into those six areas. The remaining eight regions (shaded on the map) are identified by Heimlich and Langner and represent all other MLRA's with substantial wetlands of high and medium potential for conversion.

- Taken together, these 14 wetland areas contain 57 percent of nonfederal wetland acres and 82 percent of all wetlands with high conversion potential (for data, see Table 2.3).

TABLE 2.3

CONVERSION POTENTIAL OF WETLANDS IN TINER'S CRITICAL PROBLEM AREAS
(x1,000 acres)

		High	Medium	Unlikely	Other	Total
1.	South Florida	62	321	1,566	1,455	4,470
2.	Prairie Pothole	98	472	1,540	2,103	4,888
3.	Nebraska Sandhills and Rainwater Basin	26	105	479	173	859
4.	Lower Mississippi	96	302	302	1,724	1,415
5.	Coastal Pocosins	18	271	2,578	3,183	7,754
6.	Western Riparian	2	33	166	1,125	1,441
	SUBTOTAL	**302**	**1,504**	**8,053**	**9,454**	**23,676**

CONVERSION POTENTIAL OF WETLANDS IN OTHER PROBLEM AREAS
(x 1,000 acres)

		High	Medium	Unlikely	Other	Total
7.	Corn Belt States	63	169	500	556	1,471
8.	Kentucky/Tennessee	49	86	163	181	551
9.	Appalachia/Southern Piedmont	57	228	1,073	139	1,810
10.	Southern Coastal Plain	123	509	4,762	11,080	9,328
11.	Hudson River Valley	9	30	472	480	1,317
12.	Northern Minnesota	13	52	644	1,728	3,449
13.	Washington/Oregon	19	55	121	84	335
14.	Lake States	32	138	1,418	378	2,520
	SUBTOTAL	**365**	**1,267**	**9,153**	**4,626**	**20,781**
	TOTAL-CRITICAL AREAS	667	2,771	17,206	14,080	44,457
	TOTAL-NONFEDERAL	813	4,371	28,467	25,986	78,384
	PERCENT OF NONFEDERAL	82%	63%	60%	54%	57%

Based on data from the 1982 National Resources Inventory as reported in Heimlich, Ralph E., and Linda L. Langner. (1986). Swampbusting: Wetlands Conversion and Farm Programs. Washington, D.C.: U.S. Department of Agriculture, Economic Research Service.

TABLE 2.4

ESTIMATED ACRES OF PROFITABLE WETLANDS,
IF CONVERTED FOR PROGRAM CROPS

Short-Run Returns at:	Season-average Prices	Target Prices	1985 Program Participation[1]
		(Million acres)	
Positive	13.8	22.7	15.9
Negative	25.1	16.2	23.0
Without Yields	39.5	39.5	39.5
TOTAL NONFEDERAL WETLAND ACRES	78.4	78.4	78.4

Heimlich, Ralph E., and Linda L. Langner. (July/August, 1986). "Swampbusting in Perspective." Journal of Soil and Water Conservation. Volume 41, No. 4.

- This study estimates the number of acres of nonfederal wetlands remaining in the United States (reported in the 1982 National Resources Inventory (NRI)) that would have earned positive, negative, or zero short-run returns in 1985 if converted for the production of program crops. The calculations were based on 1985 commodity prices. The study concludes that about 16 million acres of wetlands remaining in 1982 would have earned positive, short-run returns if converted at 1985 program participation rates.

- Short-run returns were considered "positive" if estimated crop yields multiplied by crop prices were greater than production costs. Estimated crop yields were obtained from the Soil Conservation Service's (SCS) Soil Interpretation Data (SOILS 5) for each point inventoried by the 1982 NRI. Estimated production costs were derived from crop budgets supplied by the Federal Enterprise Data System and direct costs of clearing and drainage supplied by SCS.

- This study does not account for many of the factors considered by the 1982 NRI to limit potential productivity, such as an area's size, accessibility, and ownership. The NRI estimated 5.1 million acres of wetlands to have a high or medium potential for conversion and 28 million acres to have a low potential for conversion. (see Figure 2.1).

[1] Profitable acres at season-average and target prices weighted by state program participation rates.

TABLE 2.5

ESTIMATED ACRES OF PROFITABLE WETLANDS IN 12 CRITICAL AREAS

	Area	Acres of Wetlands with Positive, Short-run Returns if Converted at: Season-Average Prices	Target Prices
		1,000 Acres	
1.	South Florida Palustrine Wetlands	0	29
2.	Prairie Potholes	64	47
3.	Nebraska Sandhills and Rainwater Basin	142	143
4.	Lower Mississippi Alluvial Plain	1,889	3,792
5.	Coastal Pocosins	635	2,740
6.	Western Riparian	0	22
	SUBTOTAL (1-6)	**2,730**	**6,771**
7.	Corn Belt	290	409
8.	Kentucky/Tennessee	106	160
9.	Appalachia/Southern Piedmont	829	1,258
10.	Southern Coastal Plain	4,392	7,086
11.	Washington/Oregon	50	61
12.	Lake States	29	315
	SUBTOTAL (7-12)	**6,236**	**9,289**

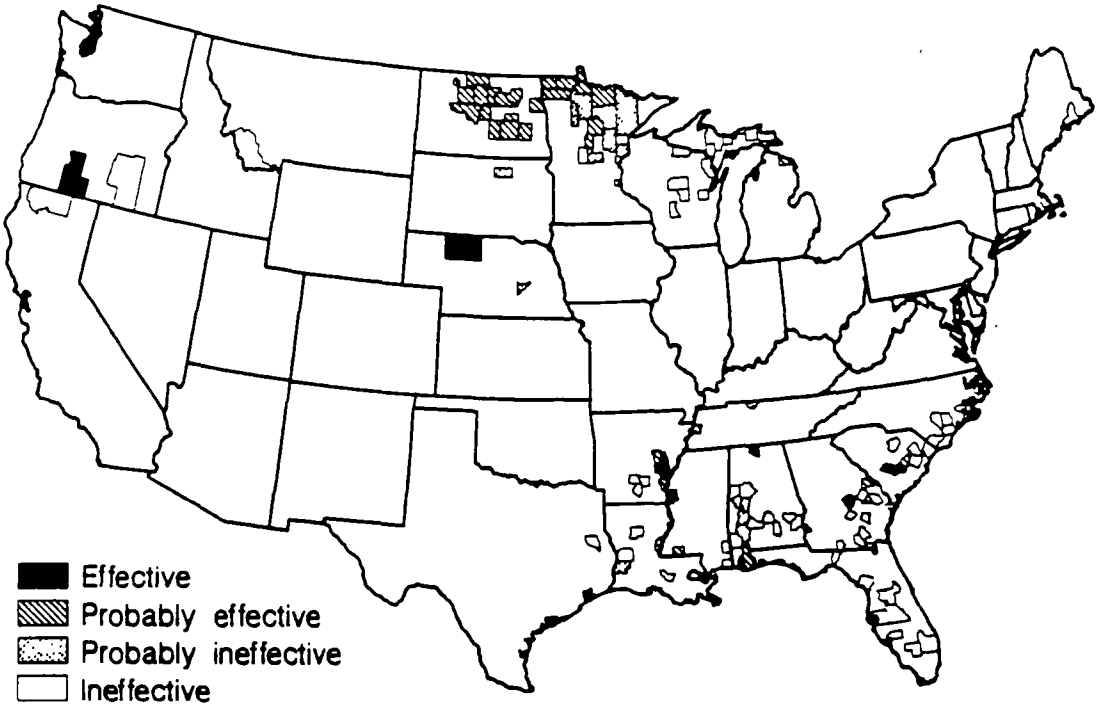
Heimlich, Ralph E., and Linda L. Langner. (July/August, 1986). "Swampbusting in Perspective." Journal of Soil and Water Conservation. Volume 41, No. 4.

- This study estimates the number of acres of wetlands in each of 12 critical wetland areas that would earn positive short-run returns if converted for the production of program crops. The first group consists of six critical wetland areas identified by Tiner (1984) where agricultural conversion is considered a major threat. The second group consists of six critical wetland regions identified by Heimlich and Langner (see map in Figure 2.3).

- These 12 critical areas contain about 70 percent of the total U.S. wetlands estimated to be profitable if converted at target prices, and about 65 percent of the total U.S. wetlands estimated to be profitable if converted at season-acreage prices (for national data, see Table 2.4).

FIGURE 2.4

SWAMPBUSTER EFFECTIVENESS FOR WETLANDS IN SELECTED STATES[1]



Heimlich, Ralph E. (1989). "The Swampbuster Provision: An A Priori Evaluation of Effectiveness." Wetlands: Concerns and Successes. American Water Resources Association.

- Heimlich analyzes wetland location and likelihood of conversion to cropland (based on data from the 1982 NRI) in relation to the profitability of local agriculture and its dependence on agricultural program payments. This analysis assumes that Swampbuster is *fully* implemented and that commodity prices will remain relatively constant over the next several years.

- Of the 78.4 million acres of nonfederal wetlands remaining in the U.S. in 1982, Heimlich estimates that about 17 million acres have some probablility of being converted to cropland. Of these acres, he estimates that the Swampbuster provisions will likely retard the conversion of only about 6 million ("Effective" plus "Moderately Effective"). The remaining 11 million acres probably will not be affected by Swampbuster ("Moderately Ineffective" plus "Ineffective") either because crops grown in those areas are not subject to government programs and/or because farm operators do not depend on government payments to a significant extent.

- This study produced data for 19 selected states on the estimated effectiveness of Swampbuster provisions in retarding the conversion of vulnerable wetlands. Swampbuster is predicted to be least effective in Florida, central Alabama, the Atlantic Coastal Plain, Wisconsin and Upper Michigan, part of the Klamath Basin, and coastal Massachussets and Maine.

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[1] The data presented in this table accounts only for the 17 million acres of wetlands considered by Heimlich to have some probability of conversion to agriculture.

PART III

AGRICULTURAL INDICATORS

Agricultural land use trends may indicate whether the conversion of wetlands to agriculture can be expected to increase or decrease in the short term. This section contains data on crop prices and planted acres from 1973 to the present, as well as data on projected agricultural trends. Due to the magnitude of factors influencing both crop prices and a producer's decision regarding each year's planted acres, however, any conclusions drawn about wetland conversion from these isolated components must be tentative.

Current

Based only upon the historical data provided in this section, current pressures to convert wetlands do not appear to be severe. In comparison to annual averages since the early 1970s, the recent seasonal average prices per bushel received by farmers for wheat, corn, and soy have generally been in decline, despite a modest rise in 1987 (Figure 3.1). The amount of acres planted in 1987 and 1988 for all three crops are also well below the historic trend (Figures 3.2, 3.3). The decrease in both prices and acres planted may indicate that current pressure to convert wetlands to agricultural land is lower than in the past.

Short Term

When observing short term trends in acres planted, an important factor to consider is the Conservation Reserve Program (CRP). The aggregate farmland currently idled by the CRP accounts for approximately 28 million acres to date. Land enrolled in the CRP accounts for some, but not all, of the decline in planted acreage (Figure 3.3). It is reasonable to expect that the relative pressure to convert wetlands will *increase* in the short term as acreage is idled by the CRP.

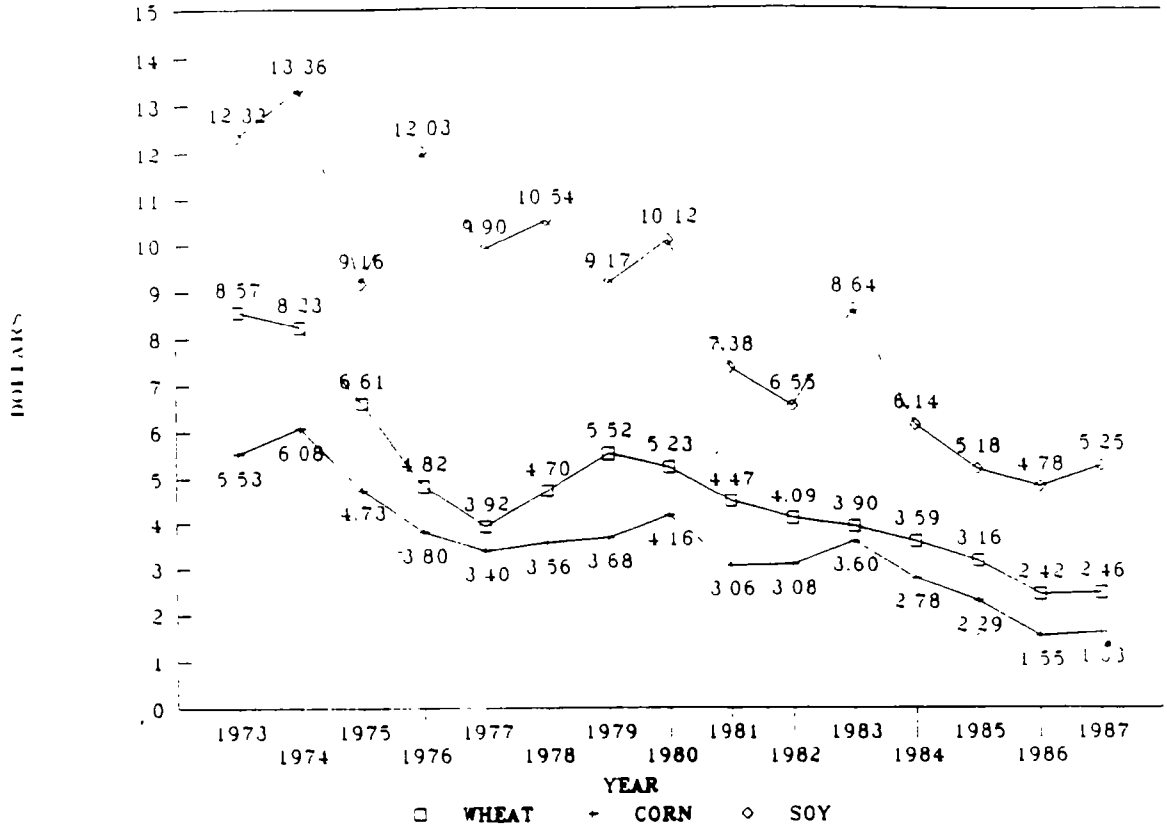
Forecasting data indicate both a modest rise in corn, wheat, and soy prices over the 1987/88 projections (Figure 3.4) and a substantial rise in the number of acres planted for corn and wheat within the next decade (Figure 3.5). If prices and planted acreage increase during the near term as forecast, the ensuing demand for cropland acreage, coupled with the abundance of land currently restricted under the CRP, may intensify the pressure to convert wetlands to agriculture during the early and mid-1990s. Some relief can be expected, however, during the late 1990s when CRP contracts expire and currently idled land is again available for production.

Long Term

Projections drawn from the Center for Agricultural and Rural Development (CARD) model, estimating the planted acres of soy, wheat, and corn for the years 1990, 2000, and 2030, indicate a substantial rise in acreage planted for soy and wheat between 2000 and 2030 (Figure 3.6). If this expected increase occurs, those wetlands easily and inexpensively converted to agriculture for these crops may become threatened.

FIGURE 3.1

SEASON AVERAGE PRICE RECEIVED BY FARMERS PER BUSHEL[1]



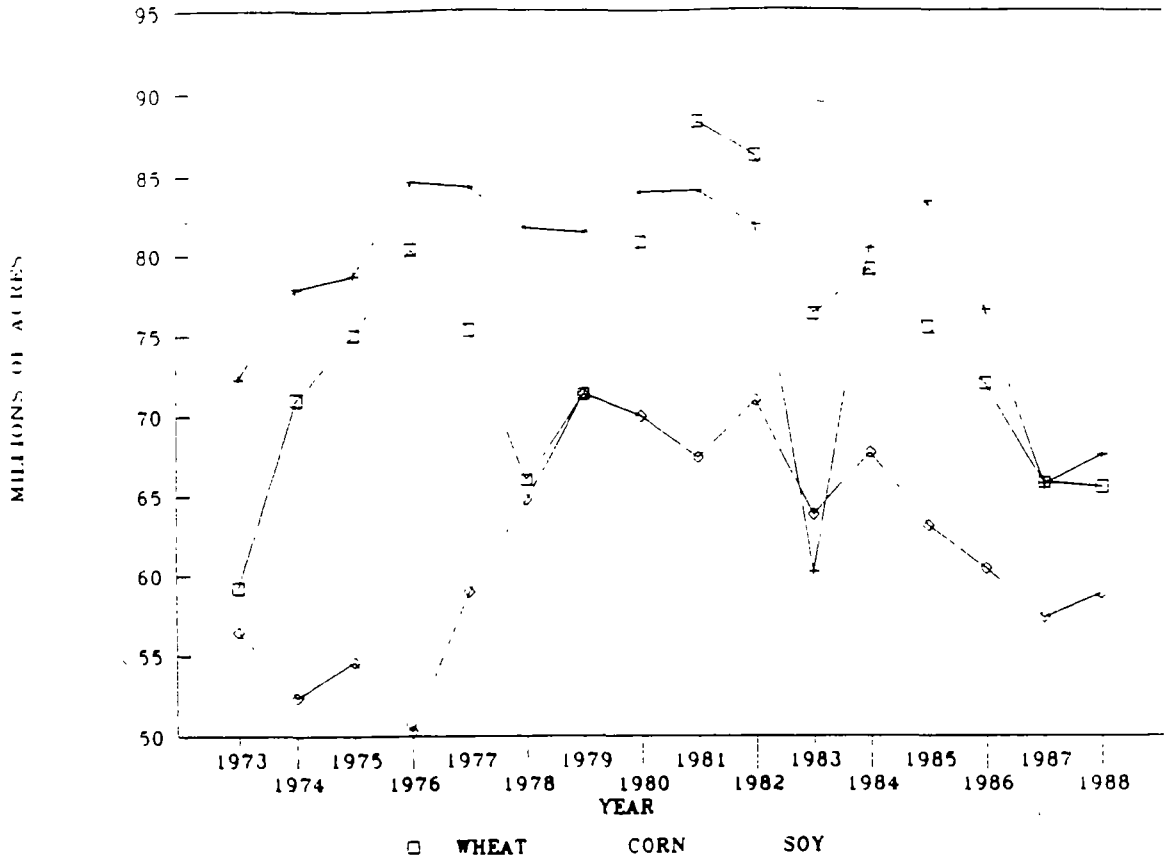
United States Department of Agriculture. (1988). Agricultural Statistics 1988. Washington, D.C.: USDA, National Agricultural Statistics Service. (Figures for 1987 are preliminary).

• The prices for all three crops have been on a strong downward trend since 1974 and appear to be at their lowest during the late 1980s. If this trend continues, it appears that demand for additional cropland will not be rising greatly in the near future. Estimates concerning price projections into the future are in Figure 3.4.

[1] Prices given have been adjusted for inflation and are in terms of 1986 dollars. All prices include allowance for loans outstanding and purchases by the government valued at the average loan and purchase rate, by States, where applicable.

FIGURE 3.2

ACRES PLANTED IN THE UNITED STATES[1]



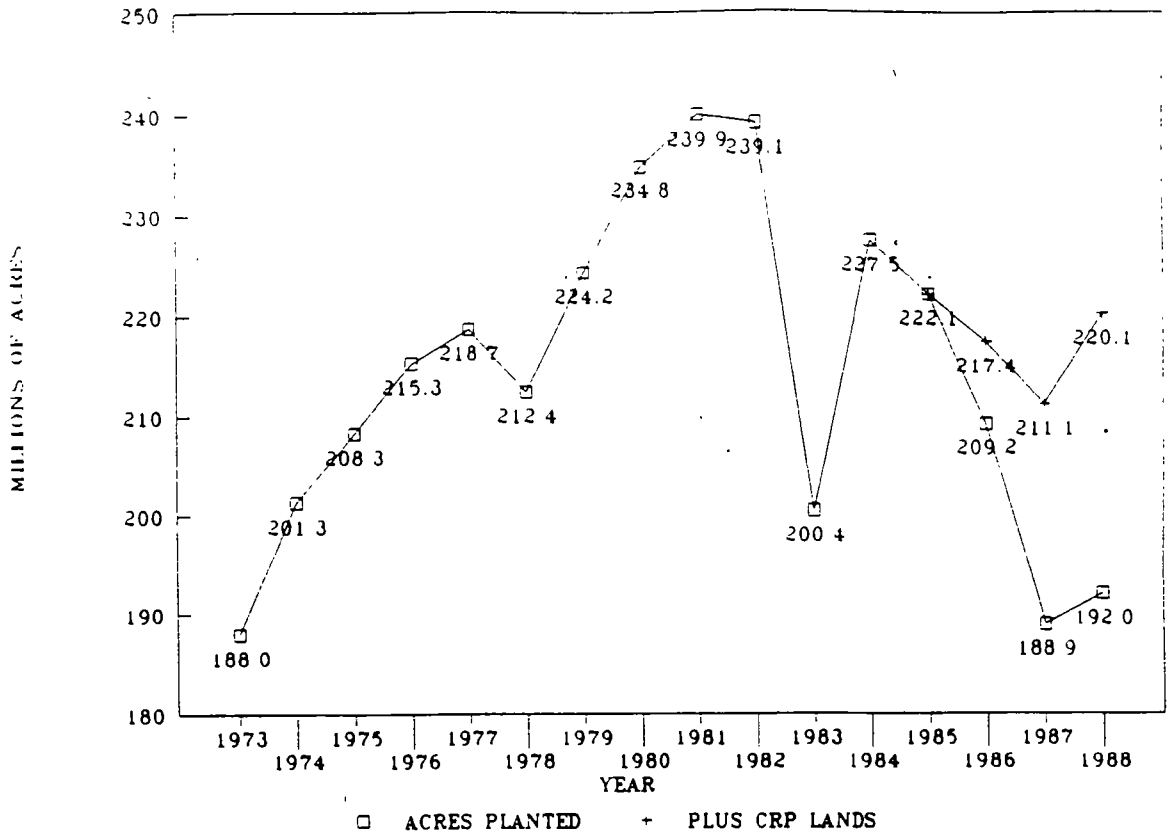
Compilations from United States Department of Agriculture. (1980-1988). Crop Production. Annual Reports. Washington, D C. National Agricultural Statistics Service.

• The number of acres planted seems to have been on a downward trend since the mid-1980s. Except for the extreme swing in acres planted for corn in 1983, the number of acres planted for all the crops in 1988 is approximately equal to the amount planted in 1973. Correlating this Figure with the decline in prices shown in Figure 3.1, the apparent trend that demand for new cropland in the future will be decreasing appears to be reinforced. Estimates concerning acreage projections into the future are in Figures 3.5 and 3.6.

[1] Figures were obtained by the USDA from yield surveys, including mailed reports from farmers for all crops and actual field observations and measurements for corn, soybeans, and wheat.

FIGURE 3.3

TOTAL ACRES PLANTED IN THE UNITED STATES[1]



Data regarding planted acres compiled from: United States Department of Agriculture. (1980-1988). Crop Production. Annual Reports. Washington, D.C.: National Agricultural Statistics Service. Data regarding Conservation Reserve Program idled lands derived from the U.S. Department of Agriculture.[2]

• This Figure presents the aggregate historic trend of all three crops. The total number of acres planted rose steadily until 1981 and has been on a decline since then. However, many of these lands have been enrolled in the Conservation Reserve Program (CRP) and are not available for crop production until the late 1990s. Thus, if prices rise in the short-terms, additional acreage may have to come from new conversions. Estimates concerning acreage projections are in Figures 3.5 and 3.6.

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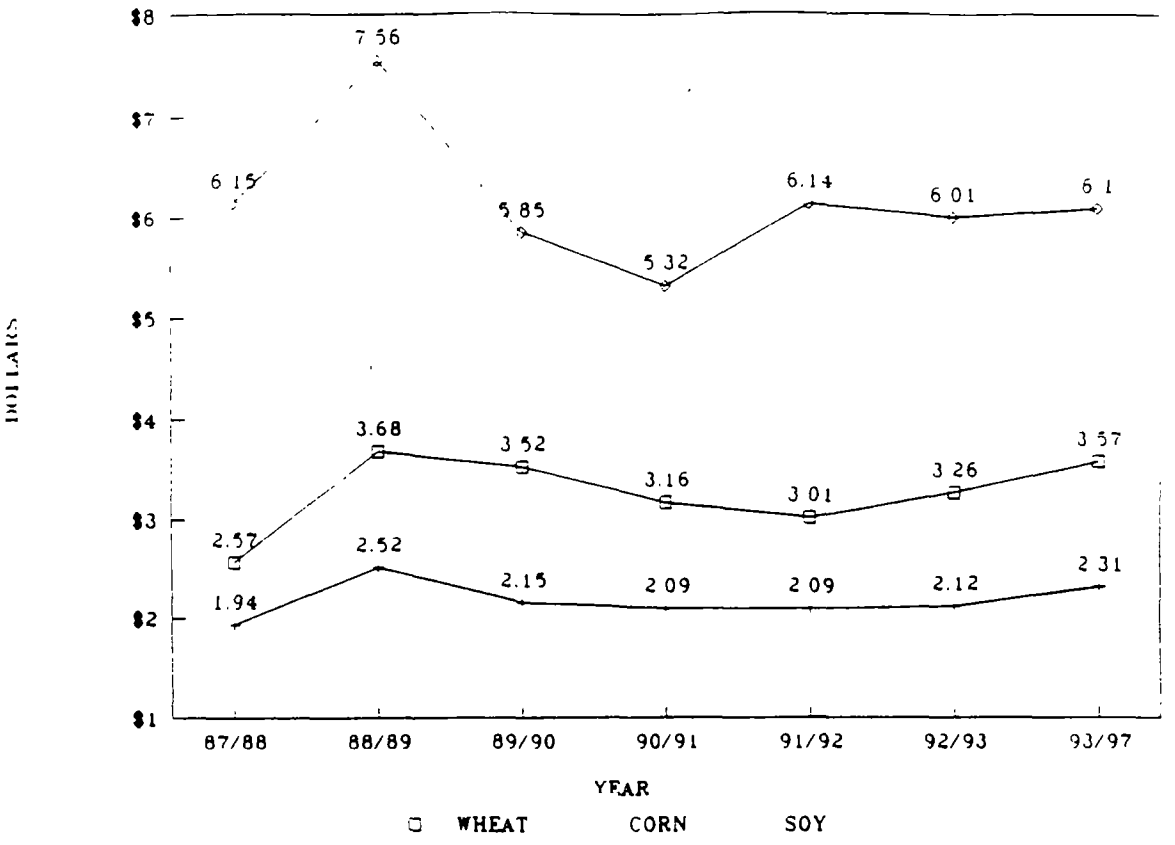
[1] Figures indicating planted acres were obtained by the USDA from yield surveys, including mailed reports from farmers for all crops and actual field observations and measurements for corn, soybeans, and wheat.

[2] Secondary line indicates planted acres plus acres idled by the Conservation Reserve Program. Note that CRP acreage also includes some cropland previously devoted to crops other than soy, wheat, and corn.

FIGURE 3.4

PROJECTION OF PRICE PER BUSHEL



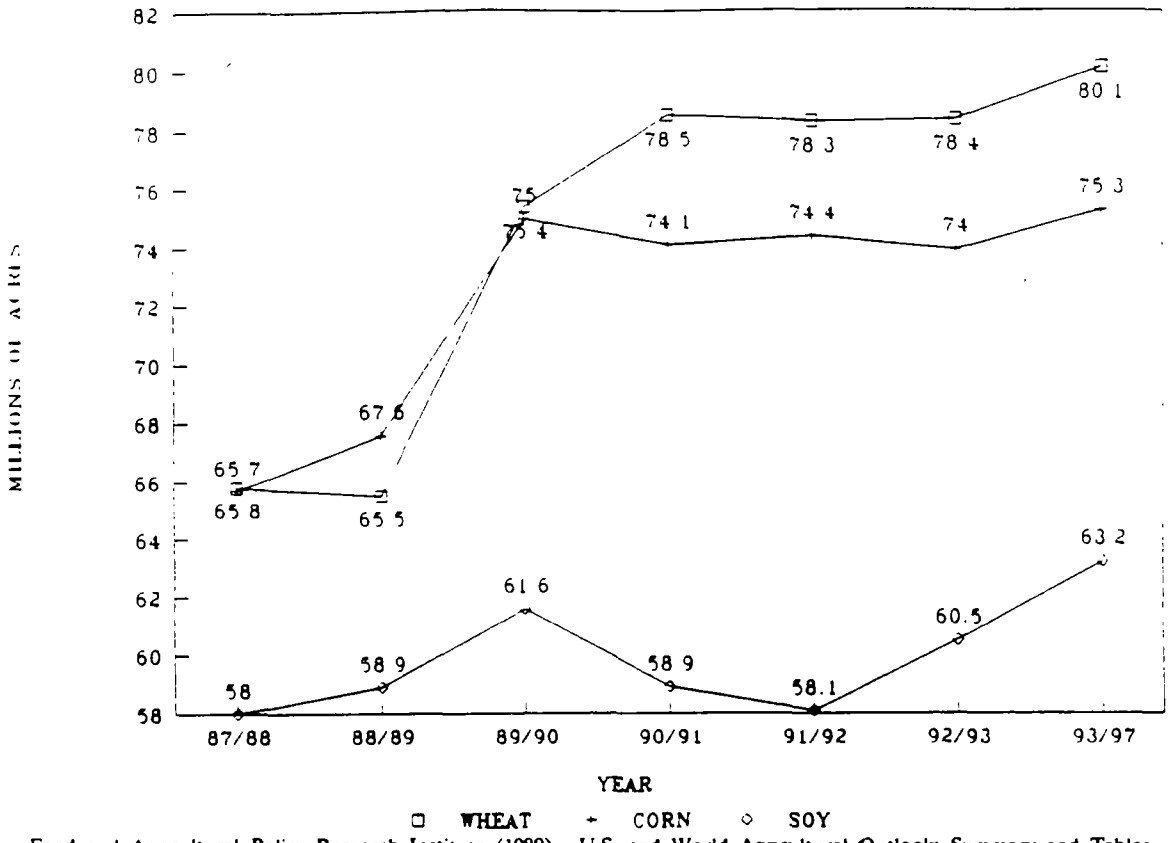
Food and Agricultural Policy Research Institute. (1989). U.S. and World Agricultural Outlook: Summary and Tables. Iowa State University, University of Missouri-Columbia.

• The Food and Agricultural Policy Research Institute (FAPRI) projections assume that the Food Security Act of 1985, as amended, will remain in effect until it expires in 1990, and that the new farm bill will hold target prices constant at the 1990 level.

• In contrast to the downward trend in crop prices shown in Figure 3.1, FAPRI predicts an increase in prices for all three crops to around 1983-1984 prices by the end of the 1990s. Such a rise may indicate an increase in demand for these crops and an increase in cropland planted in the 1990s. Estimates concerning acreage projections into the future are in Figure 3.5 and 3.6.

FIGURE 3.5

PROJECTION OF ACRES PLANTED - FAPRI



Food and Agricultural Policy Research Institute (1989). U.S. and World Agricultural Outlook: Summary and Tables. Iowa State University, University of Missouri-Columbia.

• The Food and Agricultural Policy Research Institute (FAPRI) projections assume that the Food Security Act (FSA) of 1985, as amended, will remain in effect until it expires in 1990, and that the new farm bill will hold target prices constant at the 1990 level.

• According to FAPRI, the acreage planted to major U.S. crops has been declining since the implementation of the FSA due to the large amount of acreage idled by government programs. As the acreage reduction program (ARP) is cut back in response to the 1988 drought, planted acreage is expected to increase by more than 20 million acres in 1989/90, and to remain fairly stable at that level for the next few years. Growth in planted acreage is expected to resume in the latter half of the decade, as export-led price increases bring more land into production.

• Considering the projected increase in acres shown here and the projected price increase shown in Figure 3.4, the demand for cropland may rise in the near future. For long-term predictions concerning acreage, see Figure 3.6.

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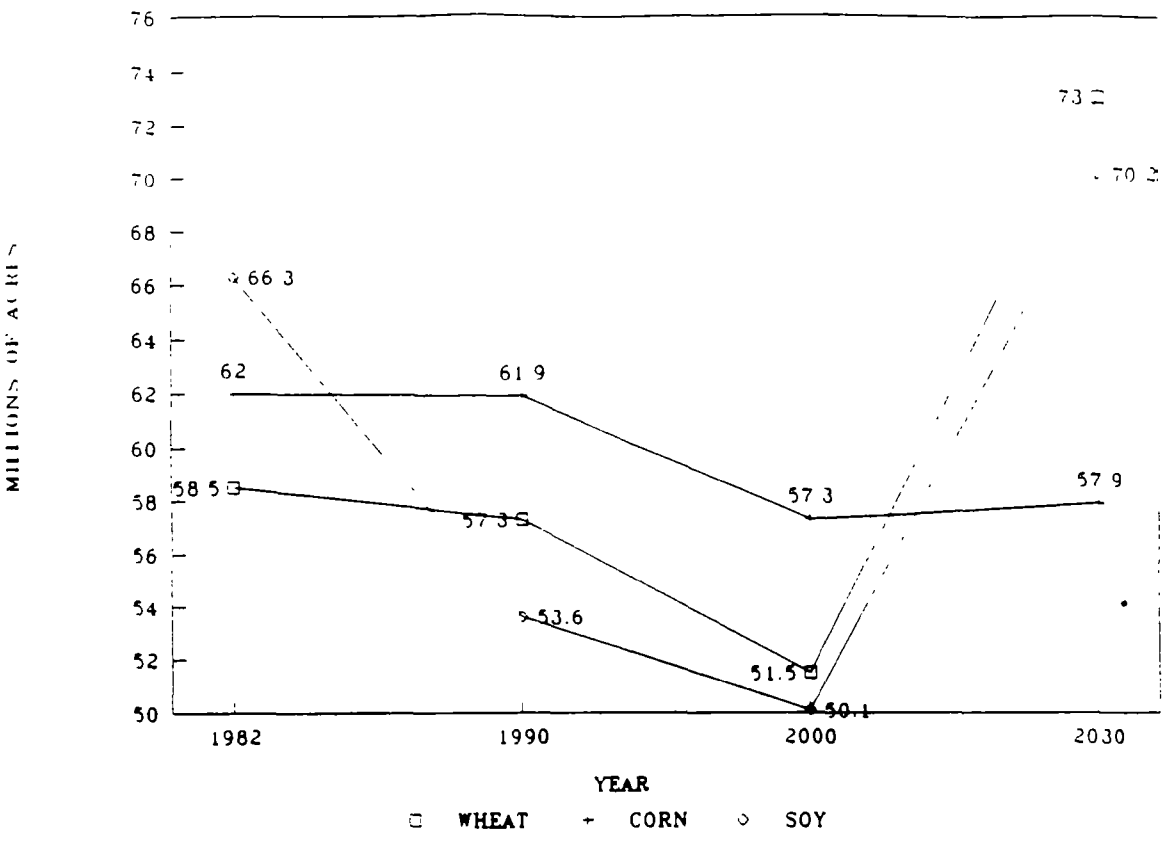
[1] Higher prices and the reduction in the ARP rate from 27.5 percent to 10 percent is projected to result in a 10 million acre increase in wheat plantings in 1989/90, to 75 million acres. For 1990/91 and beyond, the ARP rate is assumed to be 5 percent, and wheat planted area fluctuates at about 78-80 million acres.

FIGURE 3.6

PROJECTION OF ACRES PLANTED - CARD[1]



United States Department of Agriculture. (1987). The Second RCA Appraisal: Soil, Water, and Related Resources on Nonfederal Land in the United States, Analysis of Condition and Trends. Review Draft. Washington, D.C.. USDA, Soil Conservation Service. Reprinted in U.S. Environmental Protection Agency. (1989). Natural Resources for the 21st Century: An Evaluation of the Effects of Land Use on Environmental Quality. Washington, D.C.: EPA, Office of Policy Planning & Evaluation.

• The projections, based upon figures from the USDA, are drawn from the Center for Agricultural and Rural Development (CARD) model. Used primarily to determine whether the United States has adequate resources to provide for future agricultural demands, the CARD model uses linear programming to project cropland required, acreage planted by crop, and crop production for the United States to the year 2030.

[1] The projections are determined by estimating the minimum costs of production subject to three constraints: linear descriptions of production functions, resource availability, and demand for food and fiber commodities. The demand estimates are supplied by the Department of Commerce, Bureau of Economic Analysis (domestic demand), and by the USDA Economic Research Service (export demand). The CARD model produces a "most likely situation" scenario that is characterized by moderate growth in exports and in productivity.

PART IV

OTHER INDICATORS: TRENDS IN FARM DRAINAGE AND WATERFOWL POPULATION

Farm Drainage

By 1985, farmers had drained nearly 110 million acres of land in the United States (Figure 4.1). Although the rate of drainage has slowed since the 1950s, the number of acres drained was still significant in the early 1980s, averaging over 600,000 acres per year (Table 4.1). Such drainage does not necessarily indicate drainage of wetlands, however, because not all wet soils are classified as wetlands. For instance, on nonfederal lands, the 1982 National Resources Inventory found 78 million acres of wetlands and a total of 126 million acres of undrained wet soils (Pavelis 1987). Therefore, there must be at least 48 million acres of undrained wet soils on these lands that are not counted as wetlands.

Trends in farmland drainage may provide an indirect indication of trends in wetland drainage. The Office of Technology Assessment (OTA 1984), for instance, estimated the rate of wetland conversions from 1975 to 1980 based upon the percentage of surface-drained farmlands that were wetlands in the two decades prior to 1975. This section of the report includes OTA's findings, as well as an estimate of the rate of wetland conversions from 1975 to 1985 based upon more recent drainage data. National trends in farmland drainage must be interpreted with caution, however, as intensive drainage in certain states and regions may continue even as the national rate declines.

It is also important to note that more than 70 percent of the farmland drained in the nation is used for crops (other uses include pastureland, rangeland, and forestland; see Table 4.2). Furthermore, in the 23 states that use drainage extensively, an average of 25 percent of the cropland consisted of drained wet soils in 1985 (Pavelis 1987). Future demand for expanded cropland acreage, therefore, may be followed by an increase in drainage and an accompanying increase in pressure for wetland conversion.

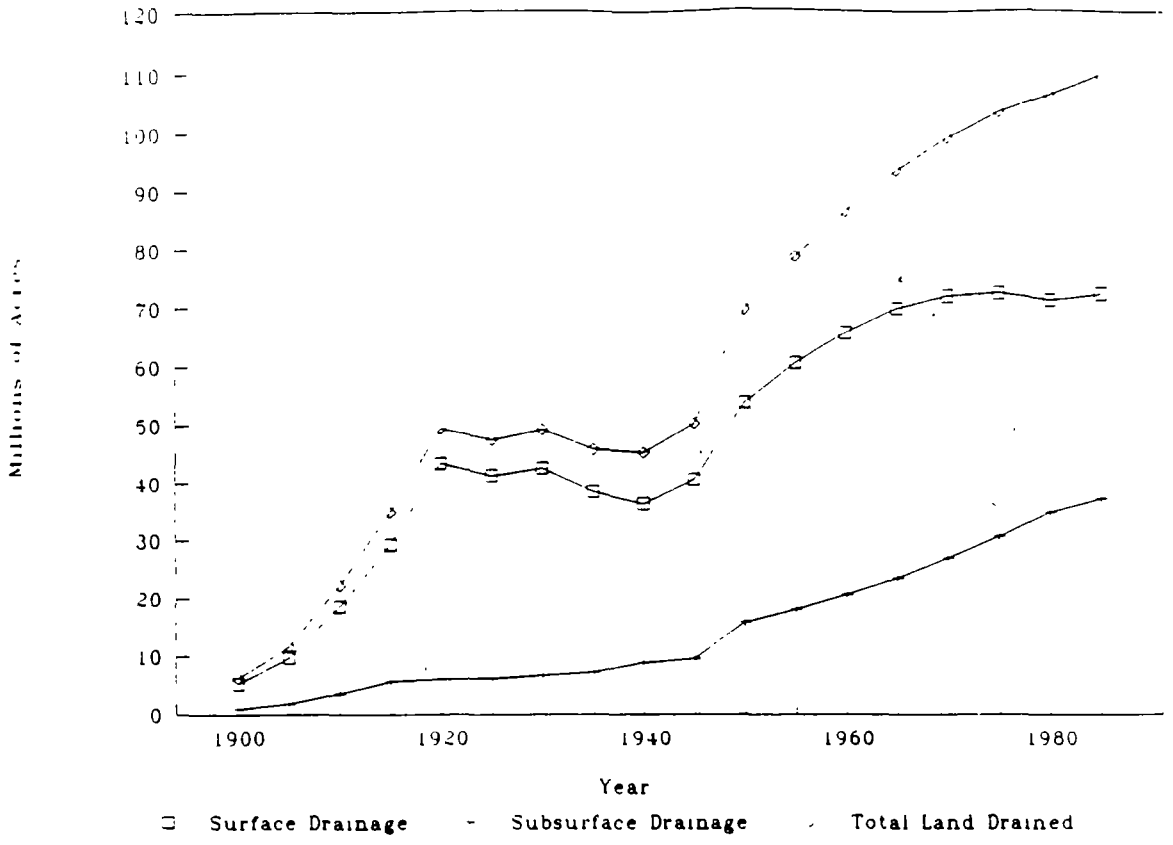
Waterfowl Populations

Migrating waterfowl populations depend upon wetland areas for nesting, resting, and breeding in many agricultural regions, such as the prairie pothole area in the north-central United States. To the extent that fluctuations in waterfowl population figures reflect either the scarcity or abundance of wetland habitat, increases or declines in waterfowl populations may be an indirect indicator of trends in the agricultural conversion of wetlands.

Figure 4.2 represents fluctuations in duck breeding populations in North America from 1955 to 1989. The population in the mid to late 1980s was the lowest in 20 years and significantly less than the cumulative average for the 44 year period. The recent downward trend may be attributed to many factors, including loss of wetland habitat, drought, and other unfavorable conditions.

FIGURE 4.1

LAND DRAINED ON U.S. FARMS: 1900-1985[1]



Adapted from Pavelis, George A., ed. (1987). Farm Drainage in the United States: History, Status, and Prospects. Washington, D.C.: U.S. Department of Agriculture, Economic Research Service.

• Although the rate of farmland drainage in the U.S. has been greatly reduced over the past 40 years, farmland continued to be drained at an average rate of over 600,000 acres per year from 1980 to 1985 (see Table 4.1). By 1985, nearly 110 million acres of farmland had been drained. It appears that most of the drainage since 1975 was accomplished through subsurface systems, as the amount of surface drainage remained fairly constant during that period.[2]

• National drainage trends may be misleading, however, since drainage activity may be intense in some states and regions. For instance, significant drainage activity is still taking place in the Lower Mississippi River Valley, Florida, and the Southeast in general (OTA 1984). In 1985, five states (Arkansas, Louisiana, Mississippi, Indiana, and Ohio) had drained at least 50 percent of their cropland (Pavelis 1987).

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1 Pavelis' drainage data is based on agricultural census information, supplemented with recent data from USDA agencies, including the National Resources Inventory.

2 The recent increase in the use of subsurface drainage systems can be attributed to improved equipment and material, lower maintenance costs, and minimal damage to the land (Pavelis 1987).

TABLE 4.1

RATE OF FARMLAND DRAINAGE IN THE UNITED STATES: 1950-1985

Year	Cumulative Acres Drained	Marginal Change in Acres Drained	Year	Cumulative Acres Drained	Marginal Change in Acres Drained
	(million acres)			(million acres)	
1950	69.9	---	1981	106.7	.4
1955	78.9	9.0	1982	107.2	.5
1960	86.6	7.7	1983	108.1	.9
1965	93.6	7.0	1984	109.0	.9
1970	99.1	5.4	1985	109.7	.7
1975	103.4	4.3			
1980	106.3	2.9			

Adapted from Pavelis, George A., ed. (1987). Farm Drainage in the United States: History, Status, and Prospects. Washington, D.C. U.S. Department of Agriculture, Economic Research Service.

• Based upon preliminary drainage data in an earlier draft of Pavelis' report, the Office of Technology Assessment (OTA 1984) estimated the rate of wetland conversions from 1975 to 1980 to be 250,000 acres per year, about half of the estimated 550,000 acres converted per year from 1955 to 1975.[1] OTA derived the percentage of farmland drained that were wetlands by comparing surface drainage data[2] from 1955 to 1975 with estimates from the NWI on wetlands lost to agriculture during roughly the same period. OTA found that approximately 65 percent of the farmland surface-drained between 1955 and 1975 were wetlands, and applied the same percentage to farmland surface-drained between 1975 and 1980.

• Since OTA's report in 1984, Pavelis has revised his data on drainage from 1955 to 1980 and provided new data for drainage in the 1980s (see Table 4.1 above). As reported in Pavelis (1987), the area of surface-drained farmland has actually decreased slightly from 1975 to 1985. Therefore, trends in surface drainage may no longer be a reliable indication of trends in wetland conversions. However, we can find the percentage of total farmland drained (both surface and subsurface) that were wetlands and derive a new estimate. Based upon data from 1955 to 1975, about 45 percent of the total area drained was wetlands. Applying this percentage to the 6.3 million acres of farmland drained from 1975 to 1985, we can estimate that about 2.8 million acres, or 280,000 acres per year, of wetlands were converted during that period.

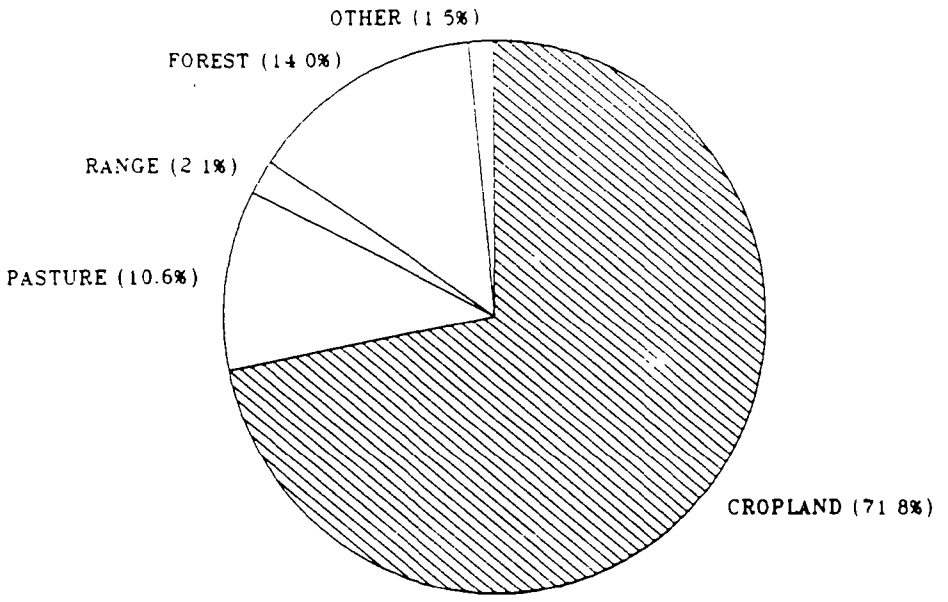
---

1 Wetland loss rate estimated in National Wetlands Inventory (NWI).

2 OTA assumed that most wetland conversions involved surface, not subsurface, drainage.

FIGURE 4.2

USES OF DRAINED RURAL LANDS: 1982[1]



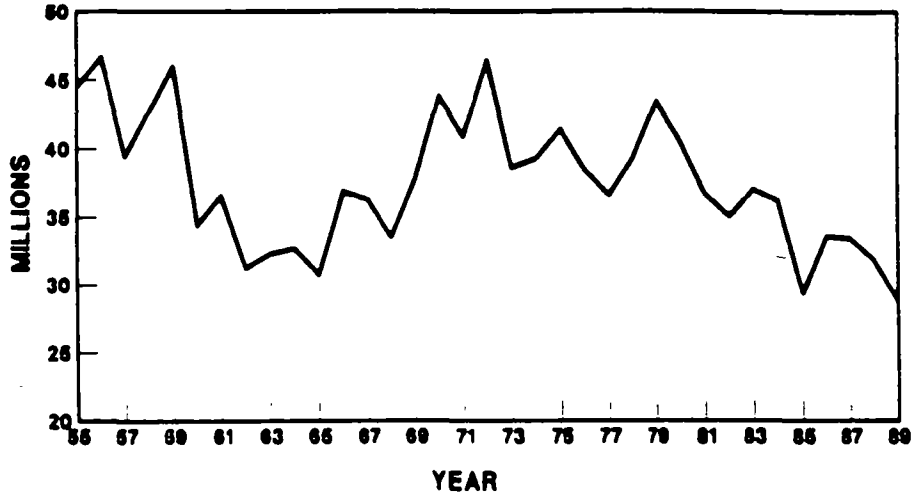
Pavelis, George A., ed. (1987). Farm Drainage in the United States: History, Status, and Prospects. Washington, D.C.: U.S. Department of Agriculture, Economic Research Service.

• Out of a total of about 107 million acres of rural land that was drained as of 1982, approximately 70 percent was used for cropland in production. However, the potential may exist for the other 30 percent to be converted to cropland at a later time.

1 Data is based upon the results of the 1982 National Resources Inventory.

FIGURE 4.3

DUCK BREEDING POPULATIONS
IN NORTH AMERICA: 1955 TO 1989[1]



U S Fish and Wildlife Service and Canadian Wildlife Service. (1989). Status of Waterfowl & Fall Flight Forecast. Washington, D.C. U S. Fish and Wildlife Service.

- The total duck population for 1989, estimated at 30.9 million, decreased 8 percent from the 1988 estimate of 33.6 million, and is 24 percent below the 1955-88 average.

- The duck population of the mid to late-1980s is at the lowest recorded number in 20 years.

- According to the report, the downward trend in the duck population can only be reversed if a return to more normal weather patterns is accompanied by a significant reduction in the impacts of agricultural activities on wetland areas important to breeding waterfowl.

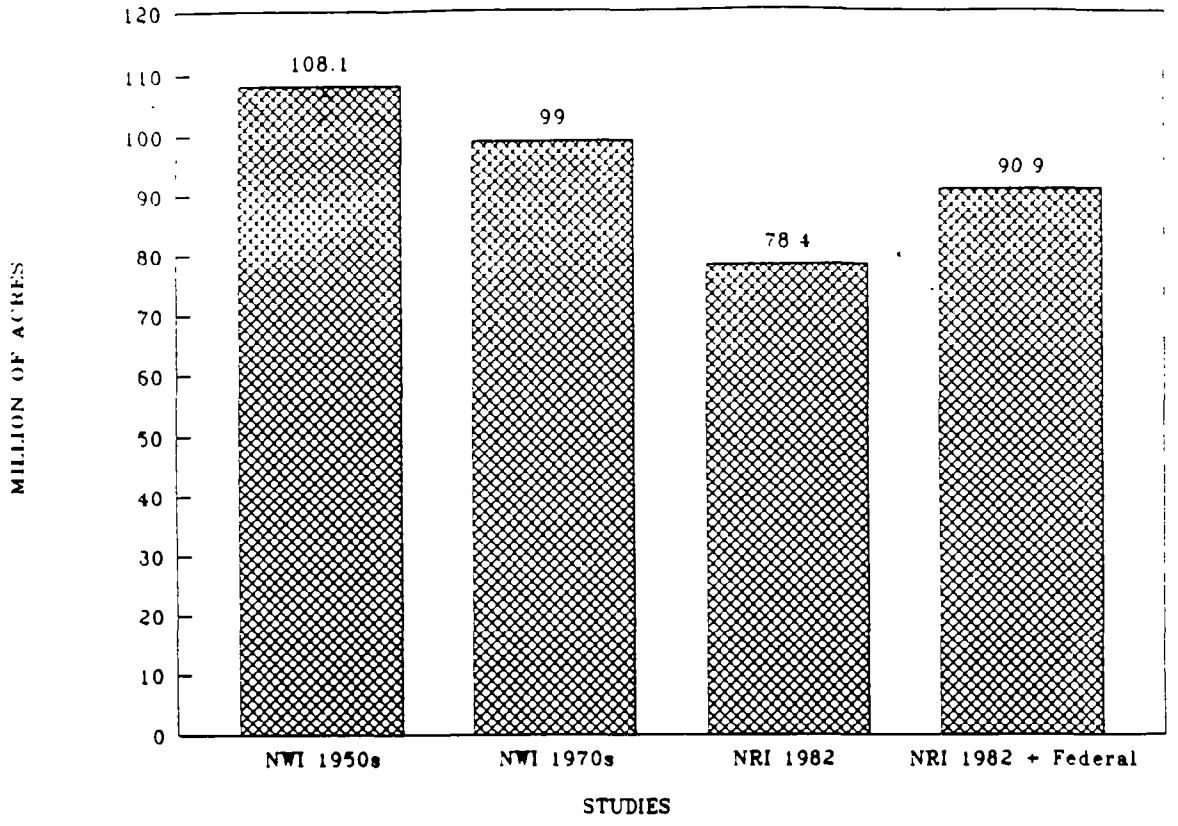
[1] The duck breeding population survey is initiated in early May and ends in mid-June of each year. Its purpose is to determine the species and number of potential breeding ducks in the principal nesting areas of North America. Aerial counts of ducks are corrected with "visibility rates" derived from sample transects that are censused from both the air and the ground. Figures exclude scoters, elders, oldsquaws, and mergansers.

APPENDIX A

COMPARISON OF WETLANDS ACREAGE STUDIES

FIGURE A.1

COMPARISON OF WETLANDS ACREAGE STUDIES



Based on Heimlich, Ralph E., and Linda L. Langner. (1986). Swampbusting: Wetlands Conversion and Farm Programs. Washington, D.C.: U S. Department of Agriculture, Economic Research Service.

• This graph illustrates recent estimates of total wetland acreage in the United States as determined by the National Wetlands Inventory (NWI) for both the mid-1950s and the mid-1970s; the 1982 National Resources Inventory (NRI), which surveyed nonfederal wetlands only; and the sum of the NRI nonfederal wetlands estimate and an estimate of federal wetland acreage cited in Heimlich and Langner (1986).

• "NWI 1950s" (108.1 million) and "NWI 1970s" (99.0 million) represent the total wetland acreages estimated by the National Wetlands Inventory to exist in the lower 48 states during the mid-1950s and the mid-1970s. The inventory was conducted by the U.S. Fish and Wildlife Service (see Frayer et al, 1983). The inventory compared black and white aerial photographs from the mid-1950s with photographs from the mid-1970s and estimated wetland acreage, changes in wetlands, and causes of change. The conclusions were extrapolated from a random sample of 3,635 4-square-mile units. The NWI uses the wetland classification system found in Cowardin (1979).

(CONTINUED ON NEXT PAGE)

- The NWI is designed to produce national statistics that, on average, have a probability of 90 percent that estimated totals for each wetland category are within 10 percent of the true figure. The standard errors of each individual estimate vary widely and were not meant to be relied on for state or regional analyses.

- "NRI 1982" (78.4 million) represents the total wetland acreage estimated by the 1982 National Resources Inventory to exist on nonfederal lands in the conterminous United States, plus Hawaii and Puerto Rico, as of 1982. The NRI was conducted by the USDA Soil Conservation Service for *nonfederal lands only*, including land owned by state, county, municipal, and Indian governments. Data were collected and extrapolated from field observations of 841,860 sample points in nearly 350,000 primary sampling units of approximately 160 acres each. The NRI classifies wetlands according to both the Circular 39 system (Shaw and Fredine, 1956) and the five major classes (Marine, Estuarine, Riverine, Lacustrine, and Palustrine) found in Cowardin (1956).

- The NRI is designed to achieve a 95 percent confidence interval around estimates of acreages comprising at least 10 percent of a major land resource area (MLRA).

- Possible explanations for the 20.6 million acre difference between the NWI and the NRI include: 1) the NRI does not include federal lands; 2) the NRI may fail to account for some intermittent wetlands; and 3) the loss of wetlands between the mid-1970s and 1982 (Heimlich and Langner, 1986).

- "NRI 1982 + Federal" (90.9 million) represents the NRI estimate of nonfederal wetland acreage as of 1982 plus an estimate of 12.5 million acres of federally held wetlands as of 1985 produced by Dale Pierce, Department of the Interior (cited in Heimlich and Langner, 1986).

APPENDIX B

BIBLIOGRAPHY

BIBLIOGRAPHY

Clark, Edwin H. II. (1989). "Market and Intervention Failures in the Management of Wetlands: Case Study on the United States (Draft)." Paris, France: Organization for Economic Co-operation and Development.

Cowardin, L.M., V. Carter, F.C. Gobet, and E.T. LaRoe. (1979). Classification of Wetlands and Deepwater Habitats of the United States. Washington, D.C.: U.S. Fish and Wildlife Service.

Dahl, Thomas E., and H. Ross Pywell. (1989). "National Status and Trends Study: Estimating Wetland Resources in the 1980's." Wetlands: Concerns and Successes. American Water Resources Association.

Food and Agriculture Policy Research Institute. (1989). U.S. and World Agricultural Outlook: Summary of Tables. Iowa State University, University of Missouri-Columbia.

Frayer, W.E., T.J. Monahan, D.C. Bowden, and F. A. Graybill. (1983). Status and Trends of Wetlands and Deepwater Habitats in the Conterminous United States, 1950s to 1970s. Ft. Collins, CO: Colorado State University, Department of Forest and Wood Sciences.

Goldman-Carter, Janice, et al. (1989). Statement of the National Wildlife Federation before the House Committee on Agriculture, July 13, 1989.

Goldstein, Jon. (1988). The Impact of Federal Programs on Wetlands, Volume One: The Lower Mississippi Alluvial Plain and the Prairie Pothole Region. Washington, D.C.: U.S. Department of the Interior.

Heimlich, Ralph E. (1989). "The Swampbuster Provision: An *A Priori* Evaluation of Effectiveness." Wetlands: Concerns and Successes. American Water Resources Association.

Heimlich, Ralph E., and Linda L. Langner. (July/August 1986). "Swampbusting in Perspective." Journal of Soil and Water Conservation. Volume 41, No. 4.

Heimlich, Ralph E., and Linda L. Langner. (1986). Swampbusting: Wetlands Conversion and Farm Programs. Washington, D.C.: U.S. Department of Agriculture, Economic Research Service.

Office of Technology Assessment. (1984). Wetlands: Their Use and Regulation. Washington, D.C.: U.S. Congress, OTA. Report No. OTA-0-206.

Pavelis, George, ed. (1987). Farm Drainage in the United States: History, Status, and Prospects. Washington, D.C.: U.S. Department of Agriculture, Economic Research Service.

Shaw, S.P., and C.G. Fredine. (1956). Wetlands of the United States: Their Extent and Their Value to Waterfowl and Other Wildlife. Washington, D.C.: U.S. Fish and Wildlife Service. Circular 39.

Teels, Billy, David Davis, Bill Wilen, and Harvey Nelson. (1988). "Status and Trends of America's Wetlands." Washington, D.C.: USDA, Soil Conservation Service.

Tiner, Ralph W. (1987). Mid-Atlantic Wetlands: A Disappearing Natural Treasure. Newton Corner, MA: U.S. Fish and Wildlife Service.

Tiner, Ralph W. (1984). Wetlands of the United States: Current Status and Trends. Newton Corner, MA: U.S. Fish and Wildlife Service.

U.S. Department of Agriculture. (1988). Agricultural Statistics 1988. Washington, D.C.: USDA, National Agricultural Statistics Service.

U.S. Department of Agriculture. (1987). Basic Statistics: 1982 National Resources Inventory. Washington, D.C.: USDA, Soil Conservation Service. Statistical Bulletin Number 756.

U.S. Department of Agriculture. (1980-1988). Crop Production. Annual Reports. Washington, D.C.: USDA, National Agricultural Statistics Service.

U.S. Department of Agriculture. (1989). Food Security Act Progress Report, October 16, 1989. Washington, D.C.: USDA, Soil Conservation Service.

U.S. Department of Agriculture. (1980). Instructions for the SCS-Multiresource Inventory, 1981-82. Washington, D.C.: USDA, Soil Conservation Service.

U.S. Department of Agriculture. (1987). The Second RCA Appraisal: Soil, Water, and Related Resources on Nonfederal Land in the United States, Analysis of Conditions and Trends. Washington, D.C.: USDA.

U.S. Environmental Protection Agency (1989). Natural Resources for the 21st Century: An Evaluation of the Effects of Land Use on Environmental Quality. Washington, D.C.: U.S. EPA, Office of Policy, Planning, and Evaluation.

U.S. Fish and Wildlife Service. (1988). Proceedings of the National Symposium on Protection of Wetlands from Agricultural Impacts.

U.S. Fish and Wildlife Service and Canadian Wildlife Service. (1989). Status of Waterfowl and Fall Flight Forecast. Washington, D.C.: U.S. Fish and Wildlife Service.