Appendix B: Cropland Agriculture

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	Corn	Peanuts	Soy-beans	Barley	Wheat	Rice	Sugar-cane
Res/crop ratio	1	1	2.1	1.2	1.3	1.4	0.8
Fraction residue burned*	0.03	0.03	0.03	0.03	0.03	see below	0.03
Dry matter fraction	0.91	0.86	0.87	0.93	0.93	0.91	0.62
Burning efficiency	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Combustion efficiency	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Fraction carbon	0.4478	0.45	0.45	0.4485	0.4428	0.3806	0.4235
Fraction nitrogen	0.0058	0.0106	0.023	0.0077	0.0062	0.0072	0.004

	All Crops
CH_4 emissions factor	0.005
CH_4 global warming potential	21
N_2O emissions factor	0.007
N_2O global warming potential	310

*Percent of Rice Acreage Burned	2001
Arkansas	0.10
California	0.23
Florida	0.00
Louisiana	0.04
Mississippi	0.40
Missouri	0.05
Texas	0.00

Source: EPA (2003a and 2003b).

Appendix Table B-2 Total U.S. production of crops managed with burning, 1990-2001

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
						Million metric tons						
Wheat	74.29	53.89	67.14	65.22	63.17	59.40	61.98	67.53	69.33	62.57	60.76	53.28
Rice[1]	7.10	7.27	8.20	7.13	9.02	7.94	7.83	8.34	8.57	9.38	8.70	9.69
Sugar-cane	25.52	27.44	27.54	28.19	28.06	27.92	26.73	28.77	30.90	32.02	32.76	31.57
Corn	201.53	189.87	240.72	160.99	255.29	187.97	234.52	233.86	247.88	239.55	251.85	241.48
Barley	9.19	10.11	9.91	8.67	8.16	7.82	8.54	7.84	7.67	6.10	6.94	5.43
Soybeans	52.42	54.06	59.61	50.89	68.44	59.17	64.78	73.18	74.60	72.22	75.06	78.67
Peanuts	1.63	2.23	1.94	1.54	1.93	1.57	1.66	1.61	1.80	1.74	1.48	1.92
Total	371.70	344.88	415.06	322.61	434.07	351.80	406.04	421.12	440.74	423.58	437.55	422.05

Source: USDA NASS Field Crops (1994, 1998); USDA NASS Crop Production (2002).

[1] Rice production data for Florida were estimated from information provided by Smith (1999), Schueneman (1999b, 2001), and Deren (2002).

Appendix Table B-3 State production of crops managed with burning, 2001

	Corn	Peanuts	Soybeans	Barley	Wheat	Rice	Sugarcane
	1,000 bushels	*1,000 lbs.*	*1,000 bushels*	*1,000 bushels*	*1,000 bushels*	*1,000 cwt*	*1,000 tons*
Alaska	ND[1]	ND	ND	ND	ND	ND	ND
Alabama	16,050	547,250	4,725	0	3,360	0	0
Arkansas	26,825	0	91,200	0	50,440	101,312	0
Arizona	5,824	0	0	4,400	8,517	0	0
California	27,200	0	0	5,830	35,105	38,490	0
Colorado	149,800	0	0	8,560	69,168	0	0
Connecticut	ND	0	0	0	0	0	0
Delaware	23,652	0	7,839	2,002	3,477	0	0
Florida	2,262	261,450	261	0	369	501	16,472
Georgia	29,480	1,689,600	4,185	0	10,600	0	0
Hawaii	0	0	0	0	0	0	1,972
Iowa	1,664,400	0	480,480	0	972	0	0
Idaho	6,750	0	0	50,250	85,150	0	0
Illinois	1,649,200	0	477,900	0	43,920	0	0
Indiana	884,520	0	273,910	0	25,080	0	0
Kansas	387,350	0	87,360	400	328,000	0	0
Kentucky	156,200	0	48,800	680	23,760	0	0
Louisiana	45,436	0	20,130	0	8,000	30,014	14,850
Massachusetts	ND	0	0	0	0	0	0
Maryland	55,760	0	20,085	3,825	11,025	0	0
Maine	ND	0	0	1,820	0	0	0
Michigan	199,500	0	63,900	1,008	35,840	0	0
Minnesota	806,000	0	266,400	7,975	79,655	0	0
Missouri	345,800	0	186,200	0	41,040	12,317	0
Mississippi	50,050	0	36,960	0	11,700	16,445	0
Montana	1,924	0	0	29,520	96,570	0	0
North Carolina	78,125	369,000	43,200	1,206	18,330	0	0
North Dakota	81,075	0	71,740	79,750	292,400	0	0
Nebraska	1,139,250	0	222,950	180	59,200	0	0
New Hampshire	ND	0	0	0	0	0	0
New Jersey	7,392	0	3,131	216	1,215	0	0
New Mexico	8,280	66,700	0	0	8,160	0	0
Nevada	ND	0	0	90	270	0	0
New York	56,700	0	5,214	612	6,360	0	0
Ohio	437,460	0	187,780	380	60,300	0	0
Oklahoma	26,250	187,500	5,035	ND	122,100	0	0
Oregon	2,520	0	0	4,500	33,250	0	0
Pennsylvania	97,020	0	14,175	4,200	8,320	0	0
Rhode Island	ND	0	0	0	0	0	0
South Carolina	25,920	30,450	9,460	ND	9,030	0	0
South Dakota	370,600	0	138,570	4,056	76,766	0	0
Tennessee	81,840	0	35,700	0	18,360	0	0
Texas	167,560	855,000	5,670	ND	108,800	14,467	1,507
Utah	2,130	0	0	4,420	6,034	0	0
Virginia	40,590	232,500	17,280	3,750	10,200	0	0
Vermont	ND	0	0	0	0	0	0
Washington	10,450	0	0	21,000	132,580	0	0
Wisconsin	330,200	0	59,660	1,820	10,708	0	0
West Virginia	3,120	0	672	0	464	0	0
Wyoming	6,375	0	0	7,140	3,048	0	0
United States	9,506,840	4,239,450	2,890,572	249,590	1,957,643	213,045	34,801

Source: USDA NASS Crop Production (2002).
[1] ND = no data.

Appendix Table B-4 State estimates of methane emissions from agriculture burning by crop type , 2001

	Corn	Peanuts	Soybeans	Barley	Wheat	Rice	Sugarcane	Total
				Tg CO_2 eq.				
Alaska	ND[1]	ND	ND	ND	ND	ND	ND	ND
Alabama	0.0006	0.0003	0.0004	-[2]	0.0002	-	-	0.0014
Arkansas	0.0010	-	0.0070	-	0.0025	0.0255	-	0.0359
Arizona	0.0002	-	-	0.0002	0.0004	-	-	0.0008
California	0.0010	-	-	0.0002	0.0018	0.0220	-	0.0249
Colorado	0.0053	-	-	0.0003	0.0035	-	-	0.0091
Connecticut	ND	-	-	-	-	-	-	-
Delaware	0.0008	-	0.0006	0.0001	0.0002	-	-	0.0017
Florida	0.0001	0.0002	0.0000	-	0.0000	-	0.0108	0.0110
Georgia	0.0010	0.0010	0.0003	-	0.0005	-	-	0.0029
Hawaii	-	-	-	-	-	-	0.0013	0.0013
Iowa	0.0591	-	0.0369	-	0.0000	-	-	0.0960
Idaho	0.0002	-	-	0.0019	0.0043	-	-	0.0064
Illinois	0.0585	-	0.0367	-	0.0022	-	-	0.0974
Indiana	0.0314	-	0.0210	-	0.0013	-	-	0.0537
Kansas	0.0137	-	0.0067	0.0000	0.0164	-	-	0.0368
Kentucky	0.0055	-	0.0037	0.0000	0.0012	-	-	0.0105
Louisiana	0.0016	-	0.0015	-	0.0004	0.0030	0.0097	0.0163
Massachusetts	ND	-	-	-	-	-	-	-
Maryland	0.0020	-	0.0015	0.0001	0.0006	-	-	0.0042
Maine	ND	-	-	0.0001	-	-	-	0.0001
Michigan	0.0071	-	0.0049	0.0000	0.0018	-	-	0.0138
Minnesota	0.0286	-	0.0204	0.0003	0.0040	-	-	0.0533
Missouri	0.0123	-	0.0143	-	0.0021	0.0015	-	0.0302
Mississippi	0.0018	-	0.0028	-	0.0006	0.0165	-	0.0217
Montana	0.0001	-	-	0.0011	0.0048	-	-	0.0060
North Carolina	0.0028	0.0002	0.0033	0.0000	0.0009	-	-	0.0073
North Dakota	0.0029	-	0.0055	0.0030	0.0146	-	-	0.0260
Nebraska	0.0404	-	0.0171	0.0000	0.0030	-	-	0.0605
New Hampshire	ND	-	-	-	-	-	-	-
New Jersey	0.0003	-	0.0002	0.0000	0.0001	-	-	0.0006
New Mexico	0.0003	0.0000	-	-	0.0004	-	-	0.0007
Nevada	ND	-	-	0.0000	0.0000	-	-	0.0000
New York	0.0020	-	0.0004	0.0000	0.0003	-	-	0.0028
Ohio	0.0155	-	0.0144	0.0000	0.0030	-	-	0.0330
Oklahoma	0.0009	0.0001	0.0004		0.0061	-	-	0.0075
Oregon	0.0001	-	-	0.0002	0.0017	-	-	0.0019
Pennsylvania	0.0034	-	0.0011	0.0002	0.0004	-	-	0.0051
Rhode Island	ND	-	-	-	-	-	-	-
South Carolina	0.0009	0.0000	0.0007		0.0005	-	-	0.0021
South Dakota	0.0132	-	0.0106	0.0002	0.0038	-	-	0.0278
Tennessee	0.0029	-	0.0027	-	0.0009	-	-	0.0066
Texas	0.0059	0.0005	0.0004		0.0054	-	0.0010	0.0133
Utah	0.0001	-	-	0.0002	0.0003	-	-	0.0005
Virginia	0.0014	0.0001	0.0013	0.0001	0.0005	-	-	0.0036
Vermont	ND	-	-	-	-	-	-	-
Washington	0.0004	-	-	0.0008	0.0066	-	-	0.0078
Wisconsin	0.0117	-	0.0046	0.0001	0.0005	-	-	0.0169
West Virginia	0.0001	-	0.0001	-	0.0000	-	-	0.0002
Wyoming	0.0002	-	-	0.0003	0.0002	-	-	0.0006
United States	0.3374	0.0026	0.2218	0.0093	0.0978	0.0686	0.0227	0.7601

[1] ND = no data.
[2] - = zero.

Appendix Table B-5 State nitrous oxide emissions from agriculture burning by crop type for 2001

	Corn	Peanuts	Soybeans	Barley	Wheat	Rice	Sugarcane	Total
				Tg CO_2 eq.				
Alaska	ND[1]	ND	ND	ND	ND	ND	ND	ND
Alabama	0.0002	0.0002	0.0005	-[2]	0.0001	-	-	0.0009
Arkansas	0.0003	-	0.0087	-	0.0009	0.0118	-	0.0216
Arizona	0.0001	-	-	0.0001	0.0001	-	-	0.0003
California	0.0003	-	-	0.0001	0.0006	0.0102	-	0.0111
Colorado	0.0017	-	-	0.0001	0.0012	-	-	0.0030
Connecticut	ND	-	-	-	-	-	-	-
Delaware	0.0003	-	0.0007	0.0000	0.0001	-	-	0.0011
Florida	0.0000	0.0001	0.0000	-	0.0000	-	0.0025	0.0026
Georgia	0.0003	0.0006	0.0004	-	0.0002	-	-	0.0015
Hawaii	-	-	-	-	-	-	0.0003	0.0003
Iowa	0.0187	-	0.0460	-	0.0000	-	-	0.0646
Idaho	0.0001	-	-	0.0008	0.0015	-	-	0.0023
Illinois	0.0185	-	0.0457	-	0.0007	-	-	0.0650
Indiana	0.0099	-	0.0262	-	0.0004	-	-	0.0365
Kansas	0.0043	-	0.0084	0.0000	0.0056	-	-	0.0183
Kentucky	0.0018	-	0.0047	0.0000	0.0004	-	-	0.0068
Louisiana	0.0005	-	0.0019	-	0.0001	0.0014	0.0022	0.0062
Massachusetts	ND	-	-	-	-	-	-	-
Maryland	0.0006	-	0.0019	0.0001	0.0002	-	-	0.0028
Maine	ND	-	-	0.0000	-	-	-	0.0000
Michigan	0.0022	-	0.0061	0.0000	0.0006	-	-	0.0090
Minnesota	0.0090	-	0.0255	0.0001	0.0014	-	-	0.0360
Missouri	0.0039	-	0.0178	-	0.0007	0.0007	-	0.0231
Mississippi	0.0006	-	0.0035	-	0.0002	0.0076	-	0.0119
Montana	0.0000	-	-	0.0005	0.0016	-	-	0.0021
North Carolina	0.0009	0.0001	0.0041	0.0000	0.0003	-	-	0.0055
North Dakota	0.0009	-	0.0069	0.0012	0.0050	-	-	0.0140
Nebraska	0.0128	-	0.0213	0.0000	0.0010	-	-	0.0351
New Hampshire	ND	-	-	-	-	-	-	-
New Jersey	0.0001	-	0.0003	0.0000	0.0000	-	-	0.0004
New Mexico	0.0001	0.0000	-	-	0.0001	-	-	0.0003
Nevada	ND	-	-	0.0000	0.0000	-	-	0.0000
New York	0.0006	-	0.0005	0.0000	0.0001	-	-	0.0013
Ohio	0.0049	-	0.0180	0.0000	0.0010	-	-	0.0239
Oklahoma	0.0003	0.0001	0.0005	ND	0.0021	-	-	0.0029
Oregon	0.0000	-	-	0.0001	0.0006	-	-	0.0007
Pennsylvania	0.0011	-	0.0014	0.0001	0.0001	-	-	0.0027
Rhode Island	ND	-	-	-	-	-	-	-
South Carolina	0.0003	0.0000	0.0009	ND	0.0002	-	-	0.0014
South Dakota	0.0042	-	0.0133	0.0001	0.0013	-	-	0.0188
Tennessee	0.0009	-	0.0034	-	0.0003	-	-	0.0046
Texas	0.0019	0.0003	0.0005	ND	0.0019	-	0.0002	0.0048
Utah	0.0000	-	-	0.0001	0.0001	-	-	0.0002
Virginia	0.0005	0.0001	0.0017	0.0001	0.0002	-	-	0.0024
Vermont	ND	-	-	-	-	-	-	-
Washington	0.0001	-	-	0.0003	0.0023	-	-	0.0027
Wisconsin	0.0037	-	0.0057	0.0000	0.0002	-	-	0.0096
West Virginia	0.0000	-	0.0001	-	0.0000	-	-	0.0001
Wyoming	0.0001	-	-	0.0001	0.0001	-	-	0.0002
United States	0.1066	0.0015	0.2765	0.0039	0.0334	0.0316	0.0052	0.4588

[1] ND = no data.
[2] - = zero.

Appendix Table B-6 Area harvested for rice cultivation, 1990-2001

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
						hectares						
Arkansas	485,633	509,915	558,478	497,774	574,666	542,291	473,493	562,525	601,174	657,831	570,619	656,010
Primary	485,633	509,915	558,478	497,774	574,666	542,291	473,493	562,525	600,971	657,628	570,619	656,010
Ratoon	0	0	0	0	0	0	0	0	202	202	0	0
California	159,854	144,071	159,450	176,851	196,277	188,183	202,347	208,822	185,350	204,371	221,773	190,611
Florida	7,467	12,869	13,962	13,962	14,569	14,569	13,355	11,534	12,141	11,902	10,994	7,314
Primary	4,978	8,580	9,308	9,308	9,713	9,713	8,903	7,689	8,094	7,229	7,801	4,562
Ratoon	2,489	4,290	4,654	4,654	4,856	4,856	4,452	3,845	4,047	4,673	3,193	2,752
Louisiana	286,726	268,312	326,184	278,834	326,184	299,879	280,413	306,718	326,184	324,079	271,955	287,252
Primary	220,558	206,394	250,911	214,488	250,911	230,676	215,702	235,937	250,911	249,292	194,253	220,963
Ratoon	66,168	61,918	75,273	64,346	75,273	69,203	64,711	70,781	75,273	74,788	77,701	66,289
Mississippi	101,174	89,033	111,291	99,150	126,669	116,552	84,176	96,317	108,458	130,716	88,223	102,388
Missouri	32,376	37,232	45,326	37,637	50,182	45,326	38,446	47,349	57,871	74,464	68,393	83,772
Texas	200,000	194,334	198,867	168,839	200,567	180,170	168,839	146,742	160,340	146,742	129,907	122,380
Primary	142,857	138,810	142,048	120,599	143,262	128,693	120,599	104,816	114,529	104,816	86,605	87,414
Ratoon	57,143	55,524	56,819	48,240	57,305	51,477	48,240	41,926	45,811	41,926	43,302	34,966
Total	1,273,229	1,255,767	1,413,557	1,273,047	1,489,114	1,386,969	1,261,068	1,380,008	1,451,518	1,550,106	1,361,864	1,449,726

Source: USDA NASS Field Crops (1994, 1998); USDA NASS Crop Production (2001, 2002).

Appendix Table B-7 Methane from rice cultivation for primary and ratoon operations, by State, 1990-2001

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
						Tg CO_2 eq.						
Primary	5.06	5.00	5.63	5.10	5.96	5.56	5.04	5.57	5.85	6.30	5.46	5.93
Arkansas	2.14	2.25	2.46	2.20	2.53	2.39	2.09	2.48	2.65	2.90	2.52	2.89
California	0.70	0.64	0.70	0.78	0.87	0.83	0.89	0.92	0.82	0.90	0.98	0.84
Florida	0.02	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.04	0.03	0.03	0.02
Louisiana	0.97	0.91	1.11	0.95	1.11	1.02	0.95	1.04	1.11	1.10	0.86	0.97
Mississippi	0.45	0.39	0.49	0.44	0.56	0.51	0.37	0.42	0.48	0.58	0.39	0.45
Missouri	0.14	0.16	0.20	0.17	0.22	0.20	0.17	0.21	0.26	0.33	0.30	0.37
Texas	0.63	0.61	0.63	0.53	0.63	0.57	0.53	0.46	0.51	0.46	0.38	0.39
Ratoon	2.06	1.99	2.24	1.92	2.25	2.06	1.92	1.91	2.05	1.99	2.03	1.70
Arkansas	+[1]	+	+	+	+	+	+	+	+	+	+	+
Florida	0.04	0.07	0.08	0.08	0.08	0.08	0.07	0.06	0.07	0.08	0.05	0.05
Louisiana	1.08	1.01	1.23	1.05	1.23	1.13	1.06	1.16	1.23	1.23	1.27	1.09
Texas	0.94	0.91	0.93	0.79	0.94	0.84	0.79	0.69	0.75	0.69	0.71	0.57

[1] + < 0.005.

Appendix Table B-8 Estimated ratios for nitrogen fixing crops and crop residue

Crop	Residue/ crop ratio	Residue dry matter fraction	Residue nitrogen fraction
Soybeans	2.1	0.87	0.023
Peanuts	1	0.86	0.0106
Dry edible beans	1.55	0.87	0.0062
Dry edible peas	1.55	0.87	0.0062
Austrian winter peas	1.55	0.87	0.0062
Lentils	1.55	0.87	0.0062
Wrinkled seed peas	1.55	0.87	0.0062
Alfalfa	0	0.85	NA
Corn	1	0.91	0.0058
Wheat	1.3	0.93	0.0062
Barley	1.2	0.93	0.0077
Sorghum	1.4	0.91	0.0108
Oats	1.3	0.92	0.007
Rye	1.6	0.9	0.0048
Millet	1.4	0.89	0.007
Rice	1.4	0.91	0.0072

Source: EPA (2003a).

Appendix Table B-9 Aboveground biomass nitrogen in nitrogen-fixing crops, 1990-2001

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
						Gg N						
Soybeans	4,240.95	4,374.38	4,823.18	4,117.14	5,537.77	4,787.73	5,241.39	5,920.65	6,035.74	5,843.60	6,072.72	6,365.07
White clover	2,734.67	2,734.67	2,734.67	2,734.67	2,734.67	2,734.67	2,734.67	2,734.67	2,734.67	2,734.67	2,734.67	2,734.67
Alfalfa	1,730.44	1,728.66	1,642.00	1,662.28	1,683.07	1,745.70	1,641.88	1,655.39	1,707.70	1,739.90	1,641.90	1,646.21
Red clover	513.00	513.00	513.00	513.00	513.00	513.00	513.00	513.00	513.00	513.00	513.00	513.00
Birdsfoot trefoil	99.00	99.00	99.00	99.00	99.00	99.00	99.00	99.00	99.00	99.00	99.00	99.00
Dry edible beans	97.75	101.93	68.27	66.00	87.40	92.65	84.26	88.66	91.83	99.88	79.73	58.99
Peanuts	84.34	115.31	100.28	79.40	99.41	81.02	85.69	82.84	92.77	89.63	76.43	99.23
Arrowleaf clover	66.78	66.78	66.78	64.70	62.61	60.52	58.44	56.35	54.26	52.18	48.00	50.09
Crimson clover	20.54	20.54	20.54	19.29	18.04	16.79	15.54	14.29	13.03	11.78	10.53	9.28
Dry edible peas	7.16	11.22	7.65	9.94	6.81	14.39	8.06	17.36	17.91	14.41	10.56	11.41
Wrinkled seed peas	2.78	2.79	1.62	2.56	2.28	3.16	1.65	2.06	2.03	1.99	2.05	1.93
Lentils	2.64	5.04	4.73	6.06	5.60	6.71	4.02	7.26	5.85	7.21	9.14	8.75
Austrian winter peas	0.38	0.42	0.30	0.47	0.15	0.36	0.31	0.35	0.31	0.18	0.22	0.29

Source: EPA (2003a).

Appendix Table B-10 Nitrogen in crop residues applied to soils

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
						Gg N						
Soybeans	1,982.30	2,044.67	2,254.45	1,924.43	2,588.46	2,237.88	2,449.92	2,767.43	2,821.22	2,731.41	2,838.51	2,975.16
Corn	957.32	901.91	1,143.46	764.71	1,212.70	892.89	1,114.01	1,110.90	1,177.49	1,137.90	1,196.36	1,147.10
All wheat	501.19	363.56	452.91	439.99	426.14	400.75	418.13	455.60	467.69	422.10	409.88	359.43
Sorghum	180.33	183.97	275.24	168.02	203.12	144.27	250.15	199.28	163.54	187.21	148.00	161.84
Barley	71.09	78.19	76.63	67.02	63.12	60.51	66.08	60.60	59.29	47.20	53.67	42.03
Rice	51.49	53.36	60.89	52.30	65.36	59.68	57.44	65.78	69.18	74.87	68.60	88.85
Oats	39.12	26.67	32.18	22.61	25.03	17.62	16.76	18.29	18.15	15.99	16.36	12.78
Peanuts	13.41	18.33	15.94	12.62	15.81	12.88	13.62	13.17	14.75	14.25	12.15	15.78
Dry edible beans	11.05	11.52	7.72	7.46	9.88	10.47	9.53	10.02	10.38	11.29	9.01	6.67
Millet	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	1.30	3.43
Rye	1.61	1.54	1.81	1.63	1.79	1.59	1.41	1.28	1.92	1.74	1.33	1.10
Dry edible peas	0.81	1.27	0.87	1.12	0.77	1.63	0.91	1.96	2.03	1.63	1.19	1.29
Wrinkled seed peas	0.31	0.32	0.18	0.29	0.26	0.36	0.19	0.23	0.23	0.22	0.23	0.22
Lentils	0.30	0.57	0.53	0.68	0.63	0.76	0.45	0.82	0.66	0.81	1.03	0.99
Austrian winter peas	0.04	0.05	0.03	0.05	0.02	0.04	0.04	0.04	0.04	0.02	0.02	0.03

Source: EPA (2003a).

Appendix Table B-11 State estimates of soil carbon changes in cropland and grazing land in 1997 by major activity categories

State	Plowout of grassland to annual cropland[1]	Cropland management	Other cropland[2]	Cropland converted to hayland[3]	Hayland management	Cropland converted to grazing land[3]	Grazing land management	CRP	Manure application	Cultivation of organic soils	Net soil carbon emissions
					Tg CO_2 eq.						
Alabama	0.37	(0.11)	(0.04)	(0.26)	0.00	(0.62)	0.00	(0.29)	(0.53)	0.04	(1.45)
Alaska	n.d.[5]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Arizona	0.22	0.00	(0.04)	(0.15)	0.00	(0.04)	0.00	(0.04)	(0.19)	0.00	(0.23)
Arkansas	0.81	(0.22)	(0.81)	(0.11)	0.04	(0.37)	(0.11)	(0.15)	(0.88)	0.00	(1.80)
California	1.14	(0.04)	(0.48)	(0.55)	0.00	(0.48)	0.04	(0.11)	(1.72)	2.35	0.15
Colorado	0.77	(0.15)	0.00	(0.55)	(0.04)	(0.26)	0.00	(1.25)	(0.53)	0.00	(2.00)
Connecticut	0.04	0.00	0.00	(0.07)	0.00	0.00	0.00	0.00	(0.04)	0.04	(0.04)
Delaware	0.04	(0.04)	0.00	0.00	0.00	0.00	0.00	0.00	(0.15)	0.00	(0.15)
Florida	0.33	(0.04)	(0.22)	(0.07)	0.00	(0.48)	0.11	(0.07)	(0.23)	10.74	10.07
Georgia	0.29	(0.07)	(0.04)	(0.26)	0.00	(0.48)	0.00	(0.18)	(0.76)	0.07	(1.42)
Hawaii	0.00	0.00	(0.04)	0.00	0.00	(0.04)	0.00	0.00	n.d.	0.29	0.22
Idaho	1.10	(0.07)	0.00	(1.03)	(0.04)	(0.26)	(0.04)	(0.59)	(0.34)	0.07	(1.19)
Illinois	3.08	(0.48)	(0.04)	(1.58)	0.00	(0.51)	0.04	(0.59)	(0.53)	0.84	0.24
Indiana	1.61	(0.55)	(0.04)	(0.88)	(0.04)	(0.44)	0.00	(0.26)	(0.61)	1.98	0.78
Iowa	4.44	(0.11)	0.00	(1.91)	0.00	(0.59)	0.04	(0.77)	(1.49)	1.87	1.48
Kansas	2.05	(0.99)	0.00	(1.32)	0.00	(0.70)	0.00	(1.54)	(0.88)	0.00	(3.37)
Kentucky	0.95	(0.11)	(0.07)	(0.84)	(0.04)	(0.77)	0.00	(0.11)	(0.15)	0.00	(1.14)
Louisiana	1.14	(0.22)	(1.03)	(0.07)	0.00	(0.37)	(0.07)	(0.11)	(0.04)	0.07	(0.70)
Maine	0.11	0.00	0.00	(0.11)	0.00	(0.07)	(0.04)	0.00	(0.08)	0.00	(0.19)
Maryland	0.18	(0.04)	0.00	(0.15)	0.00	(0.07)	0.00	0.00	(0.08)	0.00	(0.15)
Massachusetts	0.07	0.00	0.00	(0.07)	0.00	0.00	(0.04)	0.00	(0.19)	0.07	(0.15)
Michigan	2.09	(0.07)	(0.07)	(1.72)	(0.07)	(0.51)	0.00	(0.15)	(0.46)	3.12	2.14
Minnesota	4.62	0.00	(0.04)	(3.01)	(0.11)	(0.55)	0.04	(0.95)	(1.18)	5.24	4.06
Mississippi	0.88	(0.22)	(0.66)	(0.22)	0.00	(0.62)	0.00	(0.40)	(0.42)	0.04	(1.63)
Missouri	1.91	(0.44)	(0.26)	(1.14)	0.11	(0.84)	0.15	(0.70)	(0.65)	0.04	(1.82)
Montana	1.91	(0.59)	0.00	(1.28)	(0.07)	(0.48)	0.00	(1.80)	(0.08)	0.11	(2.28)
Nebraska	3.08	(0.66)	0.00	(2.09)	(0.04)	(0.33)	0.04	(0.99)	(1.03)	0.00	(2.02)
Nevada	0.11	0.00	0.00	(0.18)	(0.04)	(0.07)	0.04	0.00	(0.04)	0.00	(0.18)
New Hampshire	0.04	0.00	0.00	(0.07)	0.07	0.00	0.00	0.00	0.00	0.04	0.07
New Jersey	0.11	(0.04)	0.00	(0.11)	0.00	(0.04)	0.00	0.00	(0.04)	0.04	(0.07)
New Mexico	0.26	0.00	0.00	(0.22)	0.00	(0.18)	0.00	(0.22)	(0.23)	0.00	(0.60)
New York	1.61	(0.04)	(0.04)	(2.27)	(0.04)	(0.26)	(0.04)	0.00	(0.61)	0.48	(1.20)
North Carolina	0.22	(0.07)	(0.04)	(0.22)	0.00	(0.33)	0.00	(0.11)	(1.26)	1.06	(0.75)
North Dakota	3.15	(1.28)	0.00	(2.27)	0.00	(0.33)	0.04	(2.71)	(0.11)	0.22	(3.30)
Ohio	1.87	(0.40)	(0.04)	(1.47)	(0.04)	(0.40)	0.00	(0.22)	(0.53)	1.25	0.02
Oklahoma	0.88	(0.44)	0.00	(0.40)	0.00	(0.99)	(0.07)	(0.77)	(0.46)	0.00	(2.26)
Oregon	0.33	(0.04)	(0.04)	(0.44)	0.00	(0.18)	(0.07)	(0.29)	(0.15)	0.18	(0.70)
Pennsylvania	1.21	(0.07)	(0.04)	(1.43)	0.00	(0.18)	(0.04)	0.00	(0.80)	0.07	(1.28)
Rhode Island	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Carolina	0.15	(0.04)	0.00	(0.15)	0.04	(0.18)	0.00	(0.07)	(0.19)	0.62	0.18
South Dakota	4.07	(0.18)	0.00	(2.90)	(0.04)	(0.44)	0.07	(1.39)	(0.31)	0.07	(1.04)
Tennessee	0.70	(0.07)	(0.18)	(0.59)	(0.07)	(0.77)	(0.11)	(0.11)	(0.15)	0.00	(1.36)
Texas	3.01	(0.59)	(0.37)	(0.33)	0.00	(3.41)	0.00	(2.13)	(1.53)	0.00	(5.34)
Utah	0.29	0.00	0.00	(0.55)	(0.04)	(0.15)	0.00	(0.15)	(0.15)	0.00	(0.74)
Vermont	0.07	0.00	0.00	(0.11)	0.00	0.00	(0.04)	0.00	(0.11)	0.00	(0.19)
Virginia	0.37	(0.07)	0.00	(0.40)	0.00	(0.33)	(0.04)	(0.07)	(0.34)	0.40	(0.49)
Washington	0.51	(0.15)	(0.11)	(0.51)	(0.04)	(0.18)	(0.07)	(0.81)	(0.27)	0.22	(1.40)
West Virginia	0.26	0.00	0.00	(0.37)	0.00	(0.11)	(0.04)	0.00	(0.08)	0.00	(0.33)
Wisconsin	4.84	0.00	0.00	(3.92)	(0.07)	(0.40)	0.04	(0.15)	(1.30)	2.93	1.96
Wyoming	0.51	(0.07)	0.00	(0.62)	(0.04)	(0.29)	0.00	(0.37)	(0.04)	0.00	(0.92)
Totals	57.82	(8.84)	(4.69)	(38.98)	(0.59)	(19.10)	(0.18)	(20.61)	(21.97)	34.58	(22.52)

See next page for footnotes

Footnotes for Appendix Table B-11

Parentheses indicate net sequestration.

[1] Losses from annual cropping systems due to plow-out of pastures, rangeland, hayland, set-aside lands, and perennial/horticultural cropland (annual cropping systems on mineral soils, e.g., corn, soybean, cotton, and wheat).

[2] Perennial/horticultural cropland and rice cultivation.

[3] Gains in soil carbon sequestration due to land conversions from annual cropland into hay or grazing land.

[4] Total does not include change in soil organic carbon storage on federal lands, including those that were previously under private ownership, and does not include carbon storage due to sewage sludge applications.

[5] No data.

Appendix Table B-12 U.S. soil groupings, based on the IPCC categories and dominant taxonomic soil, and reference carbon stocks

IPCC Inventory soil categories	USDA Taxonomic soil orders	Climate regions					
		CTD	CTM	WTD	WTM	STD	STM
		Metric tons C/ha					
High clay activity mineral soils	Vertisols, mollisols, inceptisols, aridisols, and high base status alfisols	42 (n=133)	65 (n=526)	37 (n=203)	51 (n=424)	42 (n=26)	57 (n=12)
Low clay activity mineral soils	Ultisols, oxisols, acidic alfisols, and many entisols	45 (n=37)	52 (n=113)	25 (n=86)	40 (n=300)	39 (n=13)	47 (n=7)
Sandy soils	Any soils with greater than 70% sand and less than 8% clay (often Entisols)	24 (n=5)	40 (n=43)	16 (n=19)	30 (n=102)	33 (n=186)	50 (n=18)
Volcanic soils	Andisols	124 (n=12)	114 (n=2)	124 (n=12)	124 (n=12)	124 (n=12)	128 (n=9)
Spodic soils	Spodosols	86 (n=20)	74 (n=13)	86 (n=20)	107 (n=7)	86 (n=20)	86 (n=20)
Aquic soils	Soils with aquic suborder	86 (n=4)	89 (n=161)	48 (n=26)	51 (n=300)	63 (n=503)	48 (n=12)
Organic soils	Histosols	NA[1]	NA[1]	NA[1]	NA[1]	NA[1]	NA[1]

Source: Carbon stocks estimated from pedon data in the NSSC database [USDA NRCS (1997)] for top 30 cm of the soil profile; sample size provided in parentheses.

[1] Carbon stocks are not needed for organic soils.

Appendix Table B-13 Management factors for the U.S. and the IPCC default values

	IPCC default	U.S. factor
Land use change		
Cultivated[1]	1	1
General uncultivated[1,2]	1.4	1.3 (±0.04)
Set-aside[1]	1.25	1.2 (±0.03)
Improved pasture lands[3]	1.1	1.1
Wetland rice production[3]	1.1	1.1
Tillage		
Conventional till	1	1
Reduced till	1.05	1.02 (±0.03)
No-till	1.1	1.13 (±0.03)
Input		
Low	0.9	0.94 (±0.01)
Medium	1	1
High	1.1	1.07 (±0.03)

[1] Factors in the IPCC (IPCC/UNEP/OECD/IEA 1997) documentation were converted to represent changes in SOC storage from a cultivated condition rather than a native condition.
[2] Default factor was higher for aquic soils at 1.7, but the U.S. analysis showed no significant differences between aquic and non-aquic soils and so a single U.S. factor was estimated for all soil types.
[3] A U.S. specific factor was not estimated for land or management leading to additional carbon storage because of few studies addressing the impact of legume mixtures, irrigation, or manure applications for pasture lands in the United States, or the impact of wetland rice production in the United States.

Appendix Table B-14 Land use and management categories

		IPCC Category	
General land use category	**Specific management sub-categories**	**Mineral soils**	**Organic soils**
Agricultural (cropland and grazing land)	Irrigated crops	High input cultivation	Cultivated crops
	Continuous row crops	Medium input cultivation	Cultivated crops
	Continuous small grains	Medium input cultivation	Cultivated crops
	Continuous row crops and small grains	Medium input cultivation	Cultivated crops
	Row crops in rotation with hay and/or pasture	High input cultivation	Cultivated crops
	Small grains in rotation with hay and/or pasture	High input cultivation	Cultivated crops
	Row crops and small grains in rotation with hay and/or pasture	High input cultivation	Cultivated crops
	Vegetable crops	Low input cultivation	Cultivated crops
	Low residue annual crops (e.g., tobacco or cotton)	Low input cultivation	Cultivated crops
	Small grains with fallow	Low input cultivation	Cultivated crops
	Row crops and small grains with fallow	Low input cultivation	Cultivated crops
	Row crops with fallow	Low input cultivation	Cultivated crops
	Miscellaneous crop rotations	Medium input cultivation	Cultivated crops
	Continuous rice	Improved land[1]	Undrained
	Rice in rotation with other crops	Improved land[1]	Undrained
	Continuous perennial or horticultural crops	Improved land[1]	Pasture/forest
	Continuous hay	Uncultivated land (general)	Pasture/forest
	Continuous hay with legumes or irrigation	Improved land[1]	Pasture/forest
	CRP	Uncultivated land (set-aside)	Undrained
	Rangeland	Uncultivated land (general)	Undrained
	Continuous pasture	Uncultivated land (general)	Pasture/forest
	Continuous pasture with legumes or irrigation	Improved land[1]	Pasture/forest
	Aquaculture[2]	Not estimated	Not estimated
Non-agricultural[3]	Forest	Uncultivated land (general)	Pasture/forest
	Federal	Uncultivated land (general)	Undrained
	Water[2]	Not estimated	Not estimated
	Urban land[2]	Not estimated	Not estimated
	Miscellaneous[2,4]	Not estimated	Not estimated

Source: (USDA NRCS 2000).
[1] Improved land increases SOC storage above the levels found in general land-use changes.
[2] Assume no change in carbon stocks when converting to or from these land uses because of a lack of information about the effect of these practices on SOC storage.
[3] Some non-agricultural land is included in the inventory because it was an agricultural land use in 1992 or 1997.
[4] Includes a variety of land uses from roads, beaches, and marshes to mining and gravel pits.

Appendix Table B-15 Tillage percentages for each management category in the U.S. by climate zones, with adjustments for long-term adoption of no-till agriculture

	1982			1992			1997		
System	No till[1]	Red. till[2]	Conv. till[3]	No till[1]	Red. till[2]	Conv. till[3]	No till[1]	Red. till[2]	Conv. till[3]
STD									
Continuous cropping rotations†	0	3	97	0	4	96	0	15	85
Rotations with fallow ‡	0	0	100	0	2	98	0	5	95
Low residue ag. *	0	3	97	0	4	96	0	10	90
STM									
Continuous cropping rotations†	0	0	100	0	20	80	1	10	89
Rotations with fallow ‡	0	0	100	0	10	90	1	10	89
Low residue ag. *	0	3	97	0	4	96	0	5	95
WTD									
Continuous cropping rotations†	0	0	100	0	10	90	1	15	84
Rotations with fallow ‡	0	3	97	0	15	85	2	20	78
Low residue ag. *	0	3	97	0	1	99	0	0	100
WTM									
Continuous cropping rotations†	0	6	94	10	30	60	12	28	60
Rotations with fallow ‡	0	6	94	5	30	65	8	27	65
Low residue ag. *	0	9	91	1	10	89	2	13	85
CTD									
Continuous cropping rotations†	0	3	97	2	25	73	8	12	80
Rotations with fallow ‡	0	6	94	4	25	71	12	13	75
Low residue ag. *	0	0	100	1	2	97	2	6	92
CTM									
Continuous cropping rotations†	0	11	89	5	30	65	3	17	80
Rotations with fallow ‡	0	11	89	5	30	65	3	27	70
Low residue ag. *	0	0	100	1	2	97	1	7	92

[1] No-till includes CTIC survey data designated as no-tillage.
[2] Reduced-till includes CTIC survey data designated as ridge tillage, mulch tillage, and reduced tillage.
[3] Conventional till includes CTIC survey data designated as intensive tillage and conventional tillage.
† Medium and high input rotations (based on the IPCC categories) found in Table B-14. CTIC survey data for corn, soybeans, and sorghum were used in this category.
‡ Rotations with fallow found in Table B-14. CTIC survey data on fallow and small grain cropland were used in this category.
* Low input rotations found in Table B-14, with the exception of rotations with fallow. CTIC survey data on cotton were used in this category; tillage rates are assumed to be the same for low residue crops and vegetables in rotation.

Appendix Table B-16 Carbon loss rates from organic soils under agricultural management in the U.S. and the IPCC default rates

Region	Cropland	Pasture/Forest
	Metric tons C/ha-yr	
CTD & CTM	11.2±2.5	2.8±0.51
WTD & WTM	14.0±2.5	3.5±0.81
STD & STM	14.0±3.3	3.5±0.81

[1] There were not enough data available to estimate a U.S. value for C losses from managed pastures and forests. Consequently, estimates are 25% of the values for cropland, which was an assumption used for the IPCC default organic soil C losses on pasture/forest lands.