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SOIL ORGANIC CARBON CONTENT IN RICE SOILS OF ARKANSAS AND LOUISIANA AND A COMPARISON TO NON-AGRICULTURAL SOILS; INCLUDING A BIBLIOGRAPHY FOR AGRICULTURAL SOIL CARBON.

by

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Abstract

Soil organic carbon contents for 9 million acres of agricultural soils used for rice and their non-agricultural predecessors have been tabulated. For the top soil layer (0 to 15 cm depth) approximately 0.7% carbon has been lost; for the next layer (15-30 cm) the agricultural soil has 0.3% more carbon than the non-agricultural soil. Thus the net carbon loss as a result of agricultural activities in these soils to a depth of approximately 0.3 meters is 0.4% or 5 tons per acre. It appears that the agricultural soils used for rice (and soybeans) in the Mississippi River Basin (Arkansas and Louisiana) are not the reservoir for the "missing" carbon. In fact, the conversion of these soils (some originally forested) to rice/soybean production has been a (small) net source of CO_2 to the atmosphere over the last 50 years.

Introduction

Global climate change is thought to be induced by anthropogenic activities that add greenhouse gases (such as carbon dioxide and methane) to the atmosphere in excess the "natural" steady state (IPCC 1994). Actually the steady-state has changed with time as shown by measurement of CO_2 and CH_4 in ice cores with ages as old as 100,000 years (Raynaud and others, 1993). The cycles of these greenhouse gases have been studied extensively but their exact non-atmospheric reservoirs are still somewhat uncertain. This is in part because there are so many varied sources and sinks for these gases. It is also because the carbon contents in soils and the biosphere that are their sources and sinks are averages of artificially designated groups rather than a continuium of the real world. Organic carbon stored (fixed) in soils that were covered/glaciated with ice has changed (increased) since the last ice age (Harden and others, 1993). Computer/mathematical modelling and dynamics of CO_2 transfer (uptake and emission) between the atmosphere, oceans, and biosphere gives results that are out of balance by 1.8 ± 1.4 G tons (1 Gt=1Pg, $G=10^9$, $P=10^{15}$) (Sundquist 1993) which amounts to 1% of the total budget. Using CO_2 and Carbon-13 isotopic measurements (Keeling et al, 1995) in the models seems to indicate that this "missing" (unaccounted) carbon may be in the northern terrestrial reservoir; that is, stored in northern temperate latitudes in soils or biomass (forests) (Deming and others, 1995; Sarmiento, 1993) while others are not sure if it is an oceanic or terrestrial sink (Francey and others, 1995).

This Report gives the data for agricultural rice soils in the Mississippi River basin in order to see if they might be part of the sink for this "missing" carbon. Carbon in soils has changed because of the extensive agricultural activities and other anthropogenic activities such as destruction (filling and draining) of natural wetlands. The effects of agriculture are usually to decrease the amount of carbon stored in soils due to exposure of organic matter to oxidation from plowing and also due to increased erosion. For the last century, the practices of modern agriculture have resulted in the loss of carbon stored in soils. Schlesinger (1995) summarizes this work and reports losses of 20 to 40% of the soil carbon when virgin lands are converted to agriculture. This loss is greatest during the first years of cultivation and slower after about 20 years and depends on how refractory the soil carbon is (Harrison and others, 1993). Current rates of loss are estimated to be 0.8 Pg per year (mostly in the tropics) (Schlesinger 1995; Houghton, 1995, Eswaran and others, 1995). However, because rice soils are flooded during part of the growth cycle, it was considered possible that this general loss of soil carbon might be reduced or might be different for these soils. This report concerns the extensive acreage where rice is grown in the Mississippi River Basin in Arkansas and Louisiana.

Location and acreage of rice soils.

Rice is grown on Gulf Coast Prairies and Southern Mississippi valley silty uplands in Louisiana (Fig. 1). Rice is grown on alluvial terrace clay and silt soils in eastern Arkansas (Fig. 2). These soils are not used exclusively for rice but are rotated between rice and soybeans, usually the cropping is 1 year rice 2 years soybeans. The total acreage for rice in Louisiana is 1.3 million acres. The total with soybeans is nearly double this giving the total acreage for these soils for Louisiana of 4.2 million acres. The total acreage for 1994 rice in Arkansas is 1.4 million acres with an additional acreage of 3.2 million in the same counties used for soybeans for a total of 4.6 million acres (or 4.6 x109 m^2). Thus, there are actually 9 million acres that are considered in this report. There are many specific soil types where rice is grown in Arkansas and Louisiana and their acreage by soil name and county (parish for Louisiana) are given on Tables 1 and 3.

World rice production area is estimated to be on 1310 to 1450 x 109 m^2 (Aselmann and Crutzen, 1989; Seiler and others, 1984), with approximately 50 $x10^9$ in U.S., Japan, and Europe and 11 x 10^9 in the US (Matthews, Fung and Lerner, 1991) of which approximately 4 x 10^9 is Louisiana and Arkansas (this report). The rest of the U.S. production is in Texas and California.

Carbon content of soils.

The carbon contents have been tabulated by the U.S. Dept. of Agriculture, Natural Resources Conservation Service (formerly Soil Conservation Service). Generally the measurement is by 5 inch or 10 cm depth intervals or by soil horizon/type/layers. The organic carbon is measured by LECO combustion or wet oxidation at the NRCS or State University labs (organic matter data is divided by 1.7 to convert to organic C). Tables 1, 2, 4,and 5 give the soil type, county /parish, parent material for Louisiana and organic C content for the top layer (usually 0-5 inches or 0-10 cm) for Louisiana and Arkansas and for the next deeper layer (usually 5-10 in.) for Arkansas. Tables 1-5 show the data sorted by soil type and by county (parish). Table 6 gives data for additional counties in Arkansas.

In general there are organic carbon data from most counties (parishes) and most soil types that have important contributions to the rice acreage. Although there is some variation between counties in Arkansas, only 2 counties are appreciably higher than the mean value. Likewise in Louisiana the variation between parishes is not greatly different from the mean value. What is noticeable is that the average organic carbon content is somewhat higher in Arkansas compared to Louisiana (by approx 0.2%). Likewise, the Arkansas forested soil is proportionally higher than the Louisiana forested soil (only 1 value). We do not have an explanation for these differences. Fortunately the *difference* between forested and agricultural soil is rather similar both in actual carbon % and as a ratio. Tables 2 and 4 also give the data for forest soils that are similar to the original soil before cultivation and for one soil that is currently not being cropped.

Tables 2 and 4 summarize the organic carbon contents for the soils. For Arkansas the organic carbon content of the surface soil layer used for rice cultivation (generally 0 to 5 inches but ranging from 3 inches to 9 inches) is 0.77 to 1.75%, with an average of 1.06% (Tables 4 and 5). Additional data on table 6 increase the average by 0.07% to 1.13% for the surface soil layer (and by 0.12 to 0.62 for the next deeper layer). For Louisiana, the organic carbon content of the surface soil layer used for rice cultivation (generally 0 to 5 inches but ranging from 3 inches to 9 inches) is 0.41 to 2.01%, with an average of 0.81%. The forested soils of Arkansas have an average of 1.92% and one forested soil in Louisiana has 1.42% organic carbon (Tables 1 and 4).

Thus the forested soils have 1.8 (Arkansas) and 1.75 (Louisiana) times as much organic carbon as the agricultural soils for the top soil layer. Another way to report this is that the rice soils store only approximately 0.56 or 56% of the original organic carbon (stored when there was a forest on the land before it was cleared for agricultural purposes). The difference (forest and agriculture) for these soils in Arkansas (1.92-1.06) is 0.84% organic carbon; for Louisiana, the difference (1.42-0.81) is 0.61 % organic carbon for the topsoil layer.

Loss of stored carbon can be calculated by these differences. We use 0.7 % C loss because it is near the average of the losses for Arkansas and Louisiana and because the acres of soils in the two states are nearly equal. We calculate that for 0.7% C lost from 1m x 1m to a depth of 15 cm (the top layer) is 1.05 kg C (for convenience we use a density of 1, although 1.2 or 1.3 may be a better value). This is equal to 4.2 tons per acre (1050 ton per km^2). For the 9 million acres of rice soils in Louisiana and Arkansas this is 38 million tons of carbon <u>lost</u>. If this loss was over the last 38 years it would be an average of 1 million tons of carbon <u>lost</u> per year.

This calculation of soil carbon can be performed on the next (deeper) soil layer (5 or 6 to 10 or 12 inches). Table 5 also gives this data and the agricultural soil has an average of 0.68% which is higher than the forested soil that has 0.37%. Thus the difference is 0.3% carbon that is <u>stored</u>. thus the overall carbon change in these agricultural soils (to 10 to 12 inches) is a net loss of 0.7-0.3 or 0.4%. Therefore the above calculation of net loss from these soils (to 30 cm) is more like 4.9 tons per acre.

Discussion: Rice soil carbon loss in a global context

To put this in a world carbon context is necessary to see if this is a significant source or sink for carbon (or carbon dioxide). The missing unaccounted C amounts to about 1.4 ± 0.8 Gt (1 GT is 10^9 tons) per year (Sunquist, 1993). Over approximately the last 50 years, the loss of carbon from the Louisiana and Arkansas rice soils (to a depth of 0.3 meter) is approximately 44x 10^6 tons or 1 million tons per year. This is approximately 1×10^3 (or 1 thousand) times less carbon than the missing C and is, in any case, a net addition of CO_2 to the atmosphere (rather than uptake). For a further comparison the amount of excess CO_2 added to the atmosphere since 1750 is 170 GT (Sundquist,1993) or 0.7 Gt per year (average rate). Therefore the contribution of Louisiana and Arkansas rice soils could account for only a small fraction (.001) of this addition (and only over the last 50 years)

Conclusions

It appears that the agricultural soils used for rice (and soybeans) in the Mississippi River Basin (Arkansas and Louisiana) are not the reservoir for the "missing" carbon. In fact, the conversion of these soils (some originally forested) to rice/soybean agriculture has resulted in a (small) net source of CO_2 to the atmosphere over the last 50 years.

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Table 1. Louisiana rice soils sort by Parish

Parish	Series	Acres		%C	%C additional data		
Acadia	Acadia	33000		0.786			
Acadia	Crowley	183000		0.797	0.725	0.71	1.04
Acadia	Jeneret	19000		1.16	1.06	0.62	
Acadia	Judice	11000		1.66			
Acadia	Midland	27000		0.77			
Acadia	Mowata	9000		0.77			
Acadia	Patouvil	38000		1.09			
	tot		320000				
Allen	Acadia	3000					
Allen	Crowley	20000		0.87			
Allen	Mamou	2000					
	tot		25000				
Calcasu	Acadia	14000		0.56			
Calcasu	Crowley	28000		2.01 ?			
Calcasu	Judice	13000		1.37			
Calcasu	Midland	14000					
Calcasu	Morey	69000					
Calcasu	Mowata	79000					
	total		217000				
Evangln	Acadia	5000					
Evangln	Crowley	45000		0.73			
Evangln	Mamou	6000					
Evangln	Midland	8000					
Evangln	Mowata	41000					
Evangln	Patouvil	16000					
	total		121000				
JefDavs	Acadia	6000					
JefDavs	Crowley	100000		1.12	1.28		
JefDavs	Judice	12000		1.3			
JefDavs	Midland	39000		0.6			
JefDavs	Kaplan	65000					
JefDavs	Morey	14000		0.58			
JefDavs	Mowata	15000					
	total		251000				
StLandry	Acadia	1000					
StLandry	Crowley	14000		0.88			
StLandry	Jeneret	19000		0.41			
StLandry	Judice	1000					
StLandry	Mamou	1000		0.47			
StLandry	Mowata	6000		0.56	1.06?		
StLandry	Patouvil	25000		0.75	0.93	0.93	0.75
	total		67000				
Vermilon	Acadia	1000					
Vermilon	Crowley	46000					
Vermilon	Jeneret	22000		0.83			
Vermilon	Judice	21000					
Vermilon	Midland	29000		1.04			
Vermilon	Mowata	27000					
Vermilon	Patouvil	46000					
Vermilon	Kaplan	1500					
	total		193500				
Cameron	Crowley	8000					
Cameron	Judice	4000		%C			
Cameron	Kaplan	7000		0.76			
Cameron	Midland	11000					
Cameron	Morey	30000		0.8			
Cameron	Mowata	15000		0.8			
	total		75000				
Lafayet	Crowley	3000		0.9			
Lafayet	Judice	3000					
Lafayet	Mowata	3000					
Lafayet	Patovil	24000					
	total		33000				

State total acres=1302500
overall avg= 0.812% C

Table 2. Louisiana rice soils sort by soil series

Parish	Series	Acres	%C	additional data		
StLandry	Patouvil	25000	0.75	0.93	0.93	0.75
Acadia	Patouvil	38000	1.09			
Vermilon	Patouvil	46000				
Evangln	Patouvil	16000				
JefDavs	Mowata	15000				
StLandry	Mowata	6000	0.56	0.62		
Calcasu	Mowata	79000				
Evangln	Mowata	41000				
Cameron	Mowata	15000	0.8			
Lafayet	Mowata	3000				
Acadia	Mowata	9000	0.77			
Vermilon	Mowata	27000				
Calcasu	Morey	69000				
JefDavs	Morey	14000	0.58			
Cameron	Morey	30000	0.8			
Vermilon	Morey	22000	0.8314			
Evangln	Midland	8000				
Cameron	Midland	11000				
JefDavs	Midland	39000	0.6			
Vermilon	Midland	29000	1.04			
Acadia	Midland	27000	0.77			
Calcasu	Midland	14000				
StLandry	Mamou	1000	0.47			
Evangln	Mamou	6000				
Allen	Mamou	2000				
JefDavs	Kaplan	65000				
Vermilon	Kaplan	1500				
Cameron	Kaplan	7000	0.76			
Cameron	Judice	4000				
StLandry	Judice	1000				
Lafayet	Judice	3000				
Acadia	Judice	11000	1.66			
Vermilon	Judice	21000				
JefDavs	Judice	12000	1.3			
Calcasu	Judice	13000	1.37			
StLandry	Jeneret	19000	0.41			
Acadia	Jeneret	19000	1.16	1.06	0.62	
Allen	Crowley	20000	0.87			
Vermilon	Crowley	46000				
Evangln	Crowley	45000	0.73			
Lafayet	Crowley	3000	0.9			
Calcasu	Crowley	28000	2.01			
Acadia	Crowley	183000	0.797	0.725	0.71	1.04
Cameron	Crowley	8000				
StLandry	Crowley	14000	0.88			
JefDavs	Crowley	100000	1.12	1.28		
Acadia	Acadia	33000	0.786			
Allen	Acadia	3000				
StLandry	Acadia	1000				
Evangln	Acadia	5000				
JefDavs	Acadia	6000				
Vermilon	Acadia	1000				
Calcasu	Acadia	14000	0.56			

Table 3. Arkansas rice acreage by county. (from Arkansas Agriculture Experiment Station Report Series 330).

RICE: ACREAGE, YIELD AND PRODUCTION BY COUNTIES, 1994 CROP

District and County	Acreage Planted	Acreage Harvested	Yield per Acre Harvested	Production
	Acres	Acres	Pounds	Hundredweight
District 3				
Clay	74,000	74,000	5,662	4,190,000
Craighead	78,000	78,000	5,750	4,485,000
Greene	52,000	51,000	5,608	2,860,000
Independence	9,000	8,000	5,188	415,000
Jackson	82,000	82,000	5,707	4,680,000
Lawrence	74,000	73,000	5,781	4,220,000
Mississippi	20,000	19,000	5,632	1,070,000
Poinsett	111,000	110,000	5,946	6,540,000
Randolph	25,000	25,000	5,680	1,420,000
White	25,000	25,000	5,280	1,320,000
Total	550,000	545,000	5,725	31,200,000
District 4				
Yell	2,000	2,000	5,500	110,000
Other counties	3,000	3,000	5,000	150,000
Total	5,000	5,000	5,200	260,000
District 5				
Faulkner	4,000	4,000	5,750	230,000
Pulaski	6,000	6,000	5,583	335,000
Other Counties	5,000	4,000	4,125	165,000
Total	15,000	14,000	5,214	730,000
District 6				
Arkansas	125,000	123,000	6,057	7,450,000
Crittenden	27,000	26,000	5,654	1,470,000
Cross	102,000	101,000	5,881	5,940,000
Lee	40,000	39,000	5,577	2,175,000
Lonoke	80,000	78,000	5,936	4,630,000
Monroe	44,000	43,000	5,686	2,445,000
Phillips	24,000	23,000	5,283	1,215,,000
Prairie	72,000	72,000	5,924	4,265,000
St. Francis	48,000	48,000	5,417	2,600,000
Woodruff	58,000	57,000	5,281	3,010,000
Total	620,000	610,000	5,771	35,200,000
District 7				
Lafayette	7,000	7,000	4,429	310,000
Little River	2,000	1,500	4,333	65,000
Miller	12,000	11,500	5,044	580,000
Other Counties	1,000	1,000	4,500	45,000
Total	22,000	21,000	4,762	1,000,000
District 8				
Other counties	3,000	3,000	5,000	150,000
Total	3,000	3,000	5,000	150,000
District 9				
Ashley	24,000	23,000	5,261	1,210,000
Chicot	48,000	48,000	5,448	2,615,000
Desha	46,000	45,000	5,700	2,565,000
Drew	19,000	18,000	5,889	1,060,000
Jefferson	52,000	52,000	5,625	2,925,000
Lincoln	36,000	36,000	5,625	2,025,000
Total	225,000	222,000	5,586	12,400,000
STATE TOTAL	1,440,000	1,420,000	5,700	80,940,000

Table 4. Arkansas rice soils   sort by county plus acreage

soil	parent	county	acres	top lyr org C%	year	notes	top lyr depth		second %C	layr depth
Ovrcp	alv ter	Wodrf	58000	0.9	1990		0-4in	"	0.23	4-8in
Ovrcp	alv ter	Wodrf		1.12	1990		0-3	Holc	0.8	3-8in
Calhn	loes ter	StFran	48000	0.88	1988		0-5in	"	0.74	5-11
Stuttg	alv ter	Prairie	72000	0.87	1979		"	Pleis T	0.82	5-10
Calhn	loes ter	Poinst	111000	1.06	1986			"	0.43	5-11
Stuttg	alv ter	Lonoke	80000	1.05	1979		0-6in	"	0.62	6-11
Hilmn	loes ter	Green	52000	0.55	1989		0-6in	Pleis	0.42	6-14
Hilmn	loes ter	Green		0.82	1989			Pleis	0.46	5-10
Hilmn	loes ter	Green		0.92	1989			"	0.48	5-12
Frstdl	alv ter	Green		1.75	1989			Holoc	0.62	5-12
Frstdl	alv ter	Green		1.55	1989			"	1.4	5-8
Frstdl	alv ter	Green		1.2	1989		0-4in	Holc	1.27	4-9in
Ovrcp	alv ter	Green		0.77	1990		0-4in	"	0.21	4-10in
Ovrcp	alv ter	Green		1.02	1990		0-5in	"	0.6	5-8
Ovrcp	alv ter	Green		0.8	1990		0-6in	"	0.65	6-8
Kobel	alv cl	Clay	74000	1.79	1979		0-5in		0.75	5-25
Dewt	alv ter	Ark	125000	1.05	1991		0-10cm		0.6	" "
Dewt	alv ter	Ark		1.12	1991		0-8cm	"	0.82	8-15c "
Dewt	alv ter	Ark		1.08	1991	rc?:	0-5	"	1.01	5-10 rice?
Stutt	alv ter	Ark		0.84	1992	ric?	0-7in	"	0.42	7-17in
Stuttg	alv ter	Ark		0.8	1991		0-8cm	"	0.66	8-25c "
Dewt	alv ter	Ark		1.13	1991		0-10cm		0.71	10-20cm
Imnl	alv ter	Ark		1.19	1991		0-9in	Pleis	0.99	9-16
Imnl	alv ter	Ark		1.06	1991		0-5cm	"	0.81	5-13c "
Ethl	alv ter	Ark		1.2	1991		0-10cm	"	0.63	10-23 soy last
Ethl	alv ter	Ark		1.03	1991	ric?	0-5in	"	0.51	5-13 rice?
			avg.=	1.06				avg.=	0.6792	
idle fiel (CRP)										
Ethl	alv ter	Ark		0.86	1991	idl	0-17cm	"	0.26	17-33cm
Hardwood timber										
Dewt	alv ter	Prairie		1.15	1989	hwd	0-10cm		0.28	10-32cm
Ethl	alv ter	Prair		2.98	1989	hwh	0-12cm	"	0.38	12-33
Dewt	alv ter	Prair		1.64	1989	hwd	0-12cm		0.46	12-34cm

other big producers

Jackson	82000
Craighd	78000
Cross	102000
Lawrnc	74000
Jefrsn	52000

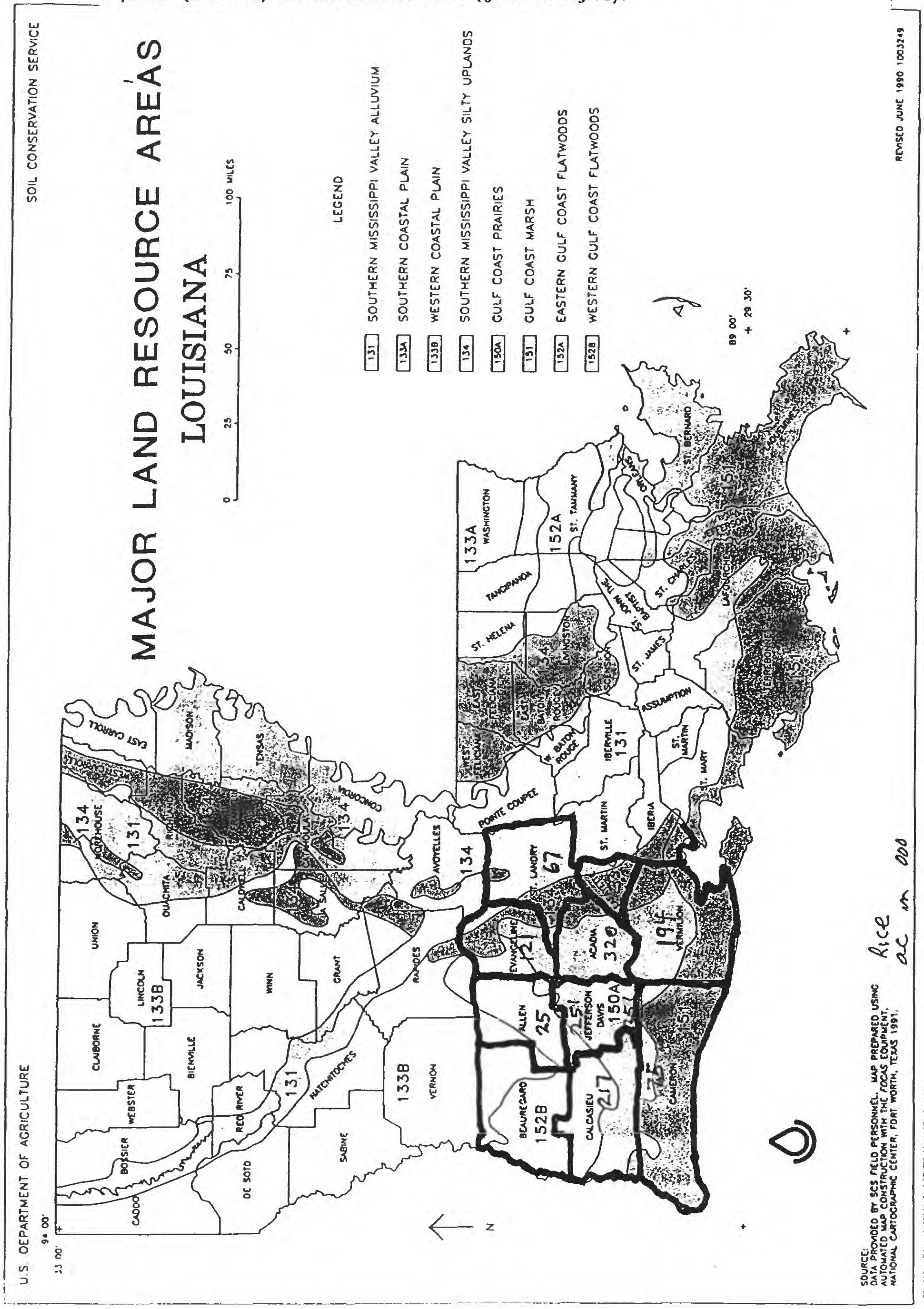
Table 5. Arkansas rice soils   sort by soil type

soil	parent	county	top layr org C%	year	notes	top layer depth		second layer %C	depth	
Stuttg	alv ter	Prairie	0.87	1979		0-5 in	Pleis T	0.82	5-10 in.	
Stuttg	alv ter	Lonoke	1.05	1979		0-6in	"	0.62	6-11	
Stuttg	alv ter	Ark	0.8	1991		0-8cm	"	0.66	8-25cm	
Stutt	alv ter	Ark	0.84	1992	ric?	0-7in	"	0.42	7-17in	
Ovrcp	alv ter	Wodrf	0.9	1990		0-4in	"	0.23	4-8in	
Ovrcp	alv ter	Wodrf	1.12	1990		0-3	Holc	0.8	3-8in	
Ovrcp	alv ter	Green	0.8	1990		0-6in	"	0.65	6-8	
Ovrcp	alv ter	Green	1.02	1990		0-5in	"	0.6	5-8	
Ovrcp	alv ter	Green	0.77	1990		0-4in	"	0.21	4-10in	
Kobel	alv cl	Clay	1.79	1979		0-5in		0.75	5-25 in.	
Imnl	alv ter	Ark	1.19	1991		0-9in	Pleis	0.99	9-16 in	
Imnl	alv ter	Ark	1.06	1991		0-5cm	"	0.81	5-13cm	
Hilmn	loes ter	Green	0.92	1989		"	"	0.48	5-12 cm	
Hilmn	loes ter	Green	0.82	1989		"	Pleis	0.46	5-10 cm	
Hilmn	loes ter	Green	0.55	1989		0-6in	Pleis	0.42	6-14 cm	
Frstdl	alv ter	Green	1.2	1989		0-4in	Holc	1.27	4-9in	
Frstdl	alv ter	Green	1.55	1989		"	"	1.4	5-8 in.	
Frstdl	alv ter	Green	1.75	1989		"	Holoc	0.62	5-12	
Ethl	alv ter	Ark	1.03	1991	ric?	0-5in	"	0.51	5-13	rice?
Ethl	alv ter	Ark	1.2	1991		0-10cm	"	0.63	10-23	soy last
Dewt	alv ter	Ark	1.13	1991		0-10cm		0.71	10-20cm	
Dewt	alv ter	Ark	1.12	1991		0-8cm	"	0.82	8-15cm	"
Dewt	alv ter	Ark	1.05	1991		0-10cm		0.6	" "	estC, CO3
Dewt	alv ter	Ark	1.08	1991	rice?	0-5 in.	"	1.01	5-10	rice?
Calhn	loes ter	StFran	0.88	1988		0-5in	"	0.74	5-11	
Calhn	loes ter	Poinst	1.06	1986			"	0.43	5-11	
		avg.=	1.0596				avg.=	0.6792		
Ethl	alv ter	Ark	0.86	1991	idle	0-17cm	"	0.26	17-33cm	
Hardwood timber										
Ethl	alv ter	Prair	2.98	1989	hwh	0-12cm	"	0.38	12-33 cm	
Dewt	alv ter	Prair	1.64	1989	hwd	0-12cm		0.46	12-34cm	
Dewt	alv ter	Prairie	1.15	1989	hwd	0-10cm		0.28	10-32cm	
		avg.=	1.9233				avg.=	0.3733		

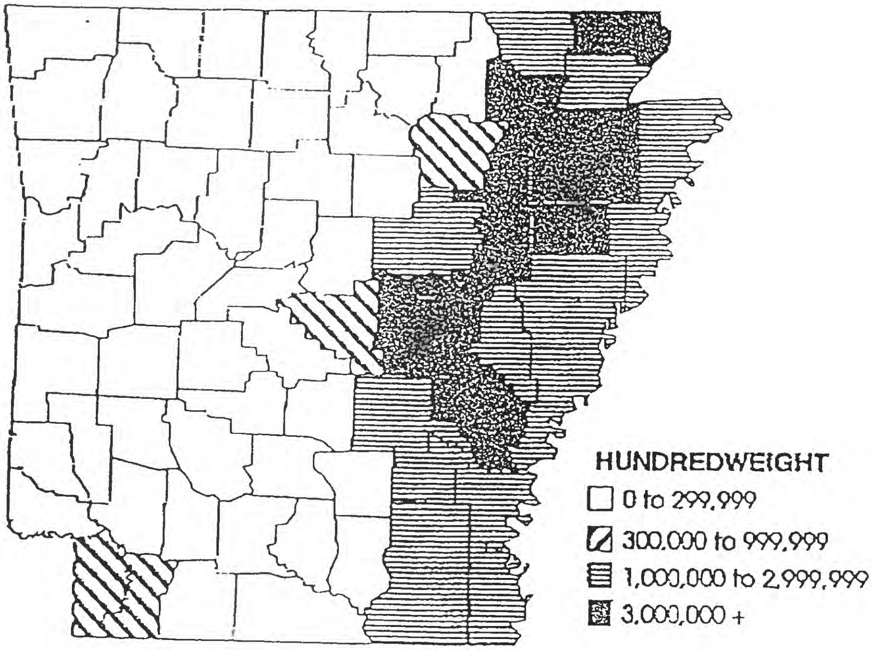
Table 6. Additional data from Arkansas

soil	parent	county	top layer org C%	top layer depth	second layer org C%	second layer depth	year
Galowy	terr	Cross	2.26	0-5in	0.23	5-12in	1963
Zachry	fldpln	Cross	1.05	0-5	0.47	5-15	1963
Henry	terr	Cross	0.87	0-7	0.58	7-10	1963
Colns	fldpln	Cross	0.7	0-3	0.47	3-7	1963
Lafayet	ter	Cross	0.7	0-6	0.17	6-13	1963
Henry	ter	Cross	0.81	0-4	0.12	4-17	1963
Grnda	ter	Cross	0.76	0-4	0.4	4-8	1963
Jkprt	alvter	Jcksn	2.03	0-4	0.93	4-31	1970
Jkprt	alvter	Jcksn	2.03	0-5	1.22	5-27	1970
Frstdl	fldpln	Jcksn	1.16	0-7	0.76	7-14	1970
Frstdl	fldpln	Jcksn	1.98	0-6			1970
Calhn	ter	Craghd	1.34	0-6	0.35	6-14	1974
Hilmn	ter	Craghd	0.87	0-8	0.29	8-16	1974
	table 6 average=		1.27		0.5		
	tab. 5+6 avg.=		1.13		0.62		

Figure 1. Louisiana resource areas and soil types modified to show rice areas by parish (outlined) and thousands of acres (given on figure).



1994 RICE PRODUCTION
80,940,000 CWT.



1994 SOYBEAN PRODUCTION
115,600,000 BUSHELS

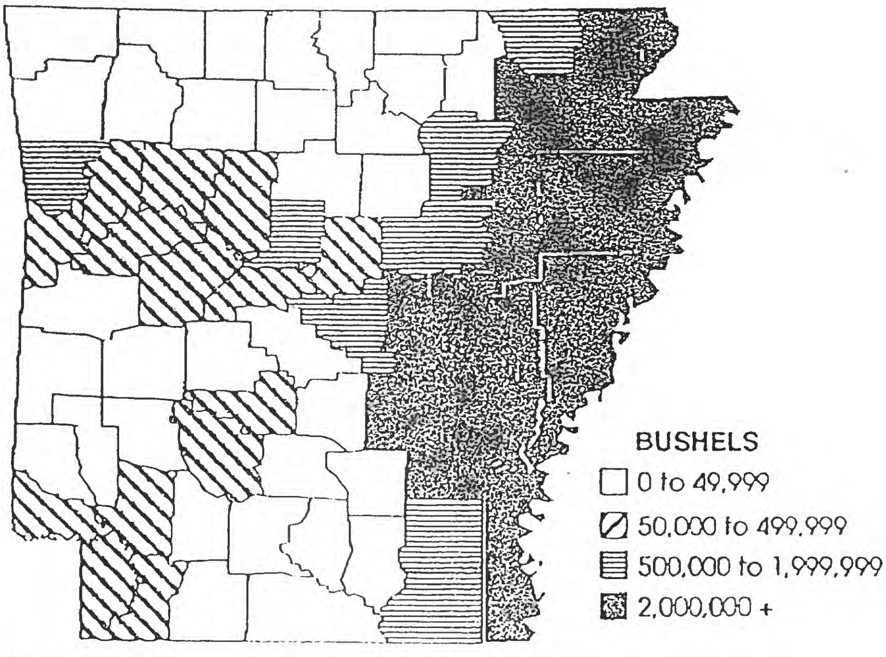


Figure 2. Arkansas maps of rice and soybean yields by county. (from Arkansas Agriculture Experiment Station Report Series 330).