Trends in Animal Manure Management Research: CRIS data base

Richard Hegg, National Program Leader
CSREES-USDA
rhegg@csrees.usda.gov

Symposium on the State of the Science of Animal Manure and Waste Management
San Antonio, TX
January 5-7, 2005

Introduction

Animal manure management is an important element in a sustainable livestock and poultry industry. This becomes even more critical as the livestock and poultry production facilities become larger and more concentrated. This paper summarizes some of the trends of animal manure management research that are in the USDA Current Research Information System (CRIS) from 1997 – 2003. These trends include such topics as funding sources, regional changes, animal species, and research topics. There was a large increase in CRIS reported funding for animal waste management projects for the years 1997 to 2003. The total annual funding increased from about $30 million in 1997 to over $67 million in 2001, then a decrease to $62 million by 2003. About 42-50 percent of this funding came from state appropriated funds and about 22-30 percent from CSREES administered funds. Based on a species classification the highest number of projects were conducted on poultry, followed by dairy, swine, beef, and then aquaculture. Based on the ten topic classifications the highest number of projects was conducted on land application, followed by treatment/storage/collection and then water quality. The Southern region and North Central region have the most projects, which is reflective of the number of animal feeding operations that are in those regions.

CSREES

This is a brief background on the Cooperative State Research, Education, and Extension Service (CSREES). CSREES is the federal link with:

Land Grant institutions in each state, territory, and the District of Columbia
More than 130 colleges of agriculture
59 agricultural experiment stations
57 cooperative extension services
63 schools of forestry
18 1890 historically black land grant institutions and Tuskegee University
27 colleges of veterinary medicine
42 schools and colleges of family and consumer sciences
31 1994 Native American land grant institutions
160 Hispanic-Serving institutions

In cooperation with its Land grant partners and customers, CSREES provides the focus to advance a global system of research, extension and higher education in the food and agricultural sciences and related environmental and human sciences. There are over 9500 scientists conducting research at 59 state agricultural experiment stations. There are over 9600 local extension educators working in most of the 3150 counties in the U.S.

Problem Areas of Research

The following research problem areas have been compiled by CSREES scientists who are part of the Animal Waste Working Group and various other state and federal sources, which include the various commodity organizations. These research problem areas/categories were used to classify the Current Research Information System (CRIS) projects summarized in this report (http://cris.csrees.usda.gov/).

1. Mortalities

Dead animals (mortalities) are a normal part of any livestock or poultry operation. Problem areas for investigation include possible effects of age and size for processing (e.g., rendering, composting) of dead livestock (dairy, beef and swine) and poultry production and processing; treatment technologies to safely dispose of dead animals to prevent spread of diseases; development of treatment technologies to prevent air, soil or water pollution; recovery of value-added products; and, storage techniques.

2. Animal By-products

Processing of the manure to produce a material that has added benefits, both economically and environmentally, will help the animal production industry. Problem areas for investigation include: composted material for use as a soil amendment; combining animal production and processing of waste with other organic wastes to produce a value-added product; anaerobic digestion to produce fuel (methane); production of amino acids and other feed ingredients from animal manures; and, production of pharmaceuticals.

3. Water Quality

Surface and ground water quality can be affected by improper storage, transport and utilization of animal manures. Problem areas for investigation include: preventing runoff of land applied manure from entering surface water supplies; infiltration of water-containing pollutants reaching ground water supplies; chemical and physical mechanisms for operation of filter strips and buffer strips; modeling movement of manure nutrients in soil; tillage practices to reduce the transfer of manure nutrients to surface or ground waters; cropping practices to minimize water pollution; pre-treatment processes of animal manures to reduce potential for water contamination; and, treatment of animal manures to allow direct stream discharge as in municipal facilities.

4. Air Quality

Problem areas for investigation include: health effects of odors, gases and particulates on confined animals and workers in the confined facilities; health effects of odors, gases and particulates on persons living near animal confinement facilities; psychological effects of

odors on farm workers and neighbors; development of standards for odor measurements; model atmospheric deposition of the various forms of nitrogen; chemical and biological methods that will control the generation of odors and gases; air dispersion models for gases; mechanisms to control odors and particulates that are discharged from exhaust air of animal confinement facilities; modify animal feeds to reduce the dust emissions from these feeds; determine the mechanisms whereby dust particles absorb odors; spatial and construction techniques in building design to reduce the production of odors; treatment techniques to reduce odors and gases from lagoons or storage structures; techniques to reduce odors and gases from land applied agricultural waste waters; and the impact of state and federal regulations (Clean Air Act, and CERCLA).

5. Nutrition

Problem areas for investigation include: mechanisms by which enzymes will allow livestock and poultry to better utilize the nutrients in the feed; principles for developing grains and forages that will reduce nutrient content of the manure; genetic potential of livestock and poultry for reducing manure output (better feed utilization efficiency); processes that will reduce the nitrogen and phosphorous content of manure; determine the appropriate crude and equivalent protein content of feeds that will allow efficient animal growth and reducing the pollution potential of the manure; reducing the use of feed supplements; re-evaluating current dietary need for species and phase feeding to reduce output; and principles for altering livestock and poultry diets that will reduce the odor potential of manure.

6. Land Application

Problem areas for investigation include: effects of handling, storage, and application systems on nutrient content of manure; estimating nutrient availability; processes by which manure affects soil physical, chemical, and biological properties; mechanisms by which manure affects crops; economics of manure as a nutrient source; processes which modulate runoff control measures; potential for ground water contamination; and development of crops that better utilize manure nutrients.

7. Treat/Store/Collect

Mechanical, biological and chemical treatment technologies need to be developed to reduce the pollution potential of animal manures. Problem areas for investigation include processes to increase the effectiveness of lagoons for waste treatment; principles of aeration for odor control; anaerobic digestion of solids and liquids; cost efficient methane production; composting; co-composting with municipal wastes; aerobic and anaerobic treatment to control nitrogen losses to the atmosphere; liquid-solid separation as a treatment technology; and, mechanisms by which animal wastes can bio-remediate hazardous wastes,

8. Pathogens/ Pharmaceuticals

One of the many potential sources of pathogens is animal manures. Some of the organisms that are of concern include: Escherichia coli, Salmonella, Giardia, Campylobacter, and Cryptosporidium parvum. Problem areas for investigation include: survival rate of organisms under various environmental conditions (e.g., time,

temperature, and moisture); mechanisms of transmission from animal to animal; animal to man and man to animal; technologies and practices to reduce pathogen transmission; mechanisms of survival; and, movement of pathogens in soil and water. The fate and transport of manure from livestock and poultry which were fed various pharmaceuticals is an emerging area of investigation. Determining the effect of these pharmaceutical residuals in the water and with the plants/crops that received the manure is necessary.

9. Social

Problem areas for investigation include: characterization of social interactions within a community regarding the effect of concentrated animal feeding operations; economic factors of large and small scale animal production for rural communities; recognition of impact of societal demand for cheap food on structure of agriculture; processes for developing regulations based on social and scientific factors; how public perception is formed regarding animal production; fairness and consistency of regulation enforcement; and, role of local communities in establishing regulations.

10. Economics

Problem areas for investigation include: economic impact of regulations; economics of small, medium, and large operations; economic considerations when deciding to focus on regulations for animal agriculture versus a comprehensive approach to pollution problems; determining the economic value of air, water, and soil in determining the costs for implementing waste management practices; role of local, state or federal policies as they affect the economics of waste management; public financing for installing environmental practices; and, determining the costs for various treatment practices.

USDA-ARS

The USDA Agricultural Research Service (ARS) has initiated the ARS Manure and Byproduct Utilization National Program. ARS is a research arm of USDA that operates through laboratories and offices throughout the U.S. In contrast to CSREES, where the state partners carry-out the research, extension and educational programs ARS conducts "in-house" research at various locations throughout the U.S. that is directed by a centralized process at the national level. A workshop held in 2004 by ARS developed a new set of research priorities for this national program using the input of numerous stakeholders. The four identified research priorities were: 1) nutrient component, 2) emissions, 3) pathogens, and 4) byproducts. This same workshop was used to assess progress of the last 5 years towards the previous set of research goals. The ARS web site provides detailed information about projects underway.
http://www.ars.usda.gov/research/programs/programs.htm?NP_CODE=206

Land Grant University research/extension projects

This report is a summary of animal waste management research, and was generated by searching the Current Research Information System (CRIS) data base of USDA for projects that had a component of animal waste management. A search was done for years of 1997-2003 and resulted in nearly 400 projects underway each year at the Land Grant Universities and other institutions. These projects were funded by USDA formula funds (Hatch projects), federal grants, states, and private sources. For each of the identified

projects the abstract and progress report was reviewed and classified by the author according to animal species (dairy, beef, swine, poultry, aquaculture, other species, and unspecified) and according to category (mortalities, animal by-products, water quality, air quality, nutrition, land application, treatment/storage/collection, pathogens, social, and economic). An estimate was made for each project as to the percent effort by animal species and program area based on the objectives and progress report. These percentages were then multiplied by the funding allocated to each project by funding source. This search did not necessarily "hit" every project in the CRIS system because of using a key word search, which may have missed some projects. There may also be animal waste projects underway at universities funded by non-federal funds which are not in the CRIS data base and therefore would not be included in the summary.

There are four regional areas used by CSREES for administrative purposes. The North East (NE) region consists of DE, MA, MD, NH, NJ, NY, PA, RI, VT, and WV. The North Central (NC) region consists of IL, IN, IA, KS, MI, MN, MO, ND, NE, OH, SD, and WI. The Southern (S) region consists of AL, AR, FL, GA, KY, LA, MS, NC, OK, PR, SC, TN, TX, VA, and VI. The Western (W) region consists of AZ, CA, CO, GUAM, HI, ID, MT, NM, OR, AND UT.

Table 1 gives a summary of the number of animal manure management projects and expenditures for each of the four regions for the fiscal years of 1997-2003. The S and NC regions have the most projects, which is reflective of the number of animal feeding operations that are in those regions. The S region has experienced an increase in projects from 163 in 1997 to 225 in 2003, a 38 percent increase. Although there has been a decrease from the peak of 230 in 2001 to the 225 in 2003. For the NC region there were in 110 projects in 1997 and again a strong increase to 168 in 2003, a 53 percent increase. The NE and W regions have had smaller increases in the number of projects, with 57 to 91 for the NE and 52 to 74 for the W. The expenditures from all sources of funds have shown steady increases over the five years (1997-2001) for each of the regions. There has been a decrease in funding since 2001, from $67.2 million to $61.7 million in 2003. The amount per region compares closely with the number of projects. The total expenditures nearly doubled from 1997 to 2000, with $30.8 and $60 (million) respectively. The largest increase in expenditures occurred from 1998 to 1999 when the amount went from $35.5 to $50.4 million.

Table 2 summarizes the waste management research by species and the number of scientist years allocated towards these projects over the 1997-2003 time periods. This table also includes the total funding by species by year. Only four species (dairy, beef, swine, and poultry) are summarized because they have by far the largest number of projects. Aquaculture always had fewer projects (normally about 35) that had aspects that dealt with waste management and therefore are not included in Table 2.

Some of the projects involve more than one animal species; therefore the total number of projects classified by animal species is more than the actual project number. As will be discussed later in this report there were a large number of project progress reports that did not specify which animal species was used in the project. Therefore they are not included in Table 2. The species with the highest number of projects was poultry and the number increased each year. Poultry production is carried out in confinement structures and therefore constant manure management is required which may be why poultry had the highest number of projects. The designation of poultry includes broilers, layers and turkeys. Dairy and swine are also housed in total or partial confinement production facilities, which mean well planned manure management techniques are required. The number of dairy projects increased from 93 in 1997 to 137 in 2003, swine projects from 70 to 124, beef projects from 38 to 66, and poultry projects from 114 to 169 for those years. Thus, the number of projects increased over this time was greatest for poultry (55), then swine (54), then dairy (44), then and least for beef (28). There was essentially the same number of beef projects each year from 2000-2003. The lower number of beef projects probably reflect that beef production has fewer confinement operations in

comparison to dairy, swine and poultry. Beef animals raised in feedlot conditions require more manure management in contrast to beef cow-calf operations that utilize pastures for most of the year.

Table 2 also shows the number of scientist years that are committed to the reported projects and do not reflect extension effots. These numbers are based on the reports submitted by each state administrator as to the distribution of effort. The increased number of scientist years aligns very closely with the number of projects and expenditures. It is interesting to note that expenditures by species for 2000 was highest for swine ($15,351,000) even though there were fewer projects (111) compared to poultry ($13,817,00, 137 projects) and dairy ($13,296,000, 126 projects).

Table 3 also shows the distribution of projects by species from 1997 to 2003. The difference between Table 2 and Table 3 is that Table 3 includes the projects for aquaculture, other species, and projects in which no species was specified. It can be seen that aquaculture has a steady, but relatively low number of projects compared to dairy, swine and poultry. Those projects in which there was another species, such as goats or sheep, were less than 3. There were a very large number of projects in which the project summary did not mention which livestock or poultry species was involved. These numbers ranged from about 100 to 150 projects per year. The reader is reminded again that the total number of species related projects reflects a higher number than the actual projects because many projects involved more than one species.

Table 4 is a summary of the number of projects by category for the years 1997 thru 2003. The categories for which the most research is being done are land application, treatment/storage/collection, and water quality. It would be expected that there would be a lot of land application research because nearly all of the manure or waste water goes back to the land for utilization as a plant nutrient source. Typically, research on land applied manure will determine plant response to application rate, time of year, method of soil incorporation, frequency of application, and manure uses in combination with other nutrient sources. Land application accounted for 17-21 percent of the funding (Table 6) but always had the most number of projects of all the categories. The category of treatment/storage/collection includes research on such topics as aerobic treatment, anaerobic treatment, addition of chemicals, covered or uncovered storage, liquid-solid separation, transportation, etc. Treatment/storage/collection had the second highest number of projects after land application, but usually about the same funding expenditures as land application. The next highest number of projects was water quality. Water quality could include runoff from land applied manures, animal access to surface water supplies, infiltration into ground water supplies, buffer strips, etc. The next highest number of projects was related to nutrition i.e. the feeding of animals to control manure content or characteristics. Nutritional research is mostly the work of animal scientists who are researching methods to reduce the amount of manure, and particularly the amount of nitrogen and phosphorous excreted. These goals can be reached by diet manipulation and even modifying the main feed grains like corn and soybeans so the animal will be more efficient. The next highest number of projects was related to air quality. Air quality refers to the research on prevention and treatment of odors, gases,

and particulates from animal production facilities. This could range from dust problems at beef feedlots in the Texas Panhandle to odors from the exhaust air of swine buildings in North Carolina. The number of air quality projects increased every year with 39 in 1997 to 75 in 2003, or a 92 percent increase. The next highest number of projects was related to pathogens/pharmaceuticals. Research is being conducted on the fate and transfer of pathogens from animal manures. Pathogen transfer could be from the meat processing plant, from manure applied to crops for human consumption, or from runoff water that enters surface water supplies. Also included in the pathogen category was research on endocrine disruptors, pharmaceuticals, and similar potential contaminants. The number of pathogen projects increased from 36 in 1997 to 91 in 2003, or a 152 percent increase. Economics was the next highest category in number of projects with 21 in 1997 and increasing to 57 in 2003, or a 171 percent increase. Following economics were the categories of animal by-products, social, and mortalities.

The mortality management category refers to the disposal and handling of dead animals from production units. There are only a few projects that had a component of this in the research. Animal by-product management refers to the handling and treatment of animals after processing for meat. This is nearly always done at central processing facilities away from the animal production facilities. There are very few projects dealing with the social aspects of animal production, even though these are some of the most difficult problems facing the industry. Communities and neighbors of large animal production facilities are concerned about the potential reduction in the quality of life and changes in social structure and are trying to balance that with the increased economic base for the community. The category of economics is where research relates the cost of various management practices which is balanced against the benefits to the producer, community, or environment. Most social and economic research treats animal agriculture as the only factor influencing the rural structure. The situation is multi-faceted and includes the balance between a “cheap food” demand by society which favors large operations against future environmental and societal needs. In an ideal situation it is hoped that large operations can also provide environmental quality and a good rural community.

Tables 5 (by species) and 6 (by category) show the 2003 data for number of projects, scientist years, and source of funding. The 2003 data is representative for the preceding years of data (1997-2002). The largest source of reported funding is from state appropriations and this is generally around 45-50 percent. The next largest source of funding is from CSREES administered funds which ranged from 22-32 percent. CSREES administered funds include: Hatch (formula funds to the states), McIntire-Stennis (forestry research), NRI (Competitive Research Grant Office), Evans-Allen (1890 historically black institutions), Animal Health, Special Grants, SBIR grants (Small Business Innovation Research), and other CSREES administered programs (Initiative for Future Agriculture and Food Systems and Fund for Rural America). “Other USDA” refers to other USDA agencies besides CSREES or ARS and is usually less than 3 percent. “Other federal” refers to other departments or agencies such as NIH, DOE, EPA, etc. and the amount coming from these sources being usually less than 3 percent. “Self generated” funds refer to support that was generated from a variety of sources such

as workshop registrations, animal sales, meat sales, etc. The data from 1998-2003 show that "self-generated" funds were approximately 4 percent of the total. "Industry grants or agreements" refers to private funding sources and generally were about 6 percent of the total. The "Other non-federal" category would include funds from various commodity groups or organizations and were approximately 5-8 percent of the total. ARS research funds are not included in these tables.

There are a number of CSREES administered grants supporting animal manure management research. For example, in 2003 there were 49 grants and the distribution by species was as follows: dairy, 11 projects; beef, 7; poultry, 13; swine, 6; aquaculture, 7; and 14 projects did not specify the species of livestock or poultry.

Table 5 shows the data for the various species. It should be noted that many of the projects actually involved more than one species and therefore the count of the projects shown in column 2 of these tables is higher than the overall number of projects. For example, a project may include the application of swine and dairy manure to cropland to measure the effect of plant growth, runoff water quality, and loss of ammonia to the atmosphere. This project would be classified as involving two animal species (swine and dairy) and three categories (land application, water quality, and air quality). There are more than 100 projects per year that did not specify which animal species was involved in the manure research. For example, a project may have involved the effect of nutrients on some crop and one of the sources of nutrients was listed as animal manure, but no further information was available on the progress report. This large number of unspecified species projects accounted for a large portion of the funds over this time period (12-20 percent). Swine and poultry usually accounted for the largest portions of the funding 22-26 percent for each, followed by dairy with a range of 18 to 22 percent for the seven years under review. Beef manure research for the 1997-2003 period ranged from 7 to 12 percent of the total expenditures.

Current research is being conducted in a variety of program categories in order to better manage the animal manures in an economically and environmentally sound manner. Table 6 shows the number of projects, scientist years, and funding expenditures for 2003, respectively by category and is representative of the figures from 1997-2002.

SUMMARY

There was a large increase in CRIS reported funding for animal waste management projects for the years 1997 to 2003. The total annual funding increased from about $30 million in 1997 to over $67 million in 2001, then a decrease to $62 million by 2003. About 42-50 percent of this funding came from state appropriated funds and about 22-30 percent from CSREES administered funds. This summary report does not include the USDA-Agricultural Research Service funds on animal waste management. There are other projects conducted in the states that are not included in the CRIS system and they are not included in this report.

Based on a species classification the highest number of projects were conducted on poultry, followed by dairy, swine, beef, and then aquaculture. Based on the category classification the highest number of projects were conducted on land application, followed by treatment/storage/collection and then water quality. The Southern region and North Central region have the most projects, which is reflective of the number of animal feeding operations that are in those regions.

Table 1.

National Summary, Animal Manure Management Research by region
CRIS-USDA

	North Central		North East		Southern		Western		TOTAL
year	No. proj.	$x1000	No. proj.	$x1000	No. proj.	$x1000	No. proj.	$x1000	
1997	110	8675	57	3122	163	15908	52	3151	30856
1998	109	9591	61	4008	163	18750	58	3148	35497
1999	131	14120	66	4176	186	27351	66	4800	50447
2000	142	19779	65	4953	205	30536	61	4803	60071
2001	154	24811	79	6696	230	29474	71	6265	67246
2002	151	19365	82	8614	227	30901	71	6686	64756
2003	168	18998	91	6471	225	28884	74	7318	61672

Table 2.

Manure Management Research, CRIS
Fiscal Year 1997-2003 funds (thousands) and scientist years

	Dairy			Beef			Swine			Poultry		
year	projects	Scientist years	TOTAL FUNDS	projects	Scientist years	TOTAL FUNDS	projects	Scientist years	TOTAL FUNDS	projects	Scientist years	TOTAL FUNDS
1997	93	21.5	5875	38	6.6	2142	70	19.7	8173	114	26.7	10552
1998	99	23.4	9707	38	7.8	2650	75	25.9	12527	118	32.1	15436
1999	113	27	10075	58	10.2	5307	93	29.3	12553	131	34.4	12178
2000	128	25.2	13296	65	12.7	5723	111	29.6	15351	137	32.2	13817
2001	135	31.4	11386	64	15.8	7121	124	39.9	18253	159	36.8	15261
2002	129	32.2	11121	64	13.5	7342	122	35.6	14207	157	40.9	17070
2003	137	34.7	10580	66	14	7545	124	30.1	12771	169	46	14487

Current Research Information System
Animal Waste Management Research by Species

	1997	1998	1999	2000	2001	2002	2003
category	***projects**	***projects**	***projects**	***projects**	***projects**	***projects**	***projects**
Dairy	93	99	113	128	135	129	137
Beef	38	38	58	65	64	64	66
Swine	70	75	93	111	124	122	124
Poultry	114	118	131	137	159	157	169
Aquaculture	34	32	33	31	36	42	42
Other	1	1	3	3	3	3	3
Unspecified	103	96	112	111	138	141	153
total	453	459	543	586	659	658	694

*** the project number means that each of the projects mentioned the category, so the total number could be greater than the actual number of separate projects. A project could include more than one category.**

Current Research Information System
Animal Waste Management Research by Category

	1997	1998	1999	2000	2001	2002	2003
category	***projects**	***projects**	***projects**	***projects**	***projects**	***projects**	***projects**
Mortalities	6	4	1	3	6	8	6
Animal Byproducts	12	13	9	8	20	21	28
Water Quality	105	107	114	127	139	143	153
Air Quality	39	45	50	59	69	66	75
Nutrition	63	61	74	81	98	101	108
Land Application	172	165	198	215	229	230	235
Treat/Store/Collect	125	138	145	145	153	153	153
Pathogens/pharm.	36	36	48	56	72	83	91
Social	9	11	16	23	34	32	29
Economics	21	26	35	38	51	46	57
total	588	606	690	755	871	883	935

*** the project number means that each of the projects mentioned the category, so the total total number could be greater than the actual number of separate projects. A project could include more than one category.**

Current Research Information System
Animal Waste Management Research by Species
Fiscal Year 2003 funds (thousands) and scientist years

category	No. projects	Scientist years	CSREES admn	Other USDA	Other Federal	State approp.	Self Generate	Industry grants or agreement	Other non-federal	TOTAL FUNDS	Percent
Dairy	137	34.7	2,975	234	620	4,734	546	599	872	10,580	17.1
Beef	66	14	2,239	525	458	2,990	781	332	221	7,545	12.2
Swine	124	30.1	2,442	784	438	6,098	1,200	1,300	510	12,771	20.7
Poultry	169	46	3,984	588	665	6,548	540	1,317	845	14,487	23.5
Aquaculture	42	10.6	1,467	59	1,511	2,241	92	162	246	5,778	9.4
Other	3	0.1	43	8	-	17	-	-	29	97	0.2
Unspecified	153	28.5	2,648	464	997	4,587	282	1,096	398	10,471	17.0
TOTAL			15,798	2,662	4,689	27,215	3,441	4,806	3,121	61,729	
Percent			25.6	4.3	7.6	44.1	5.6	7.8	5.1		100.0

Current Research Information System
Animal Waste Management Research by Category
Fiscal Year 2003 funds (thousands) and scientist years

category	No. projects	Scientist years	CSREES admn	Other USDA	Other Federal	State approp.	Self Generate	Industry grants or agreement	Other non-federal	TOTAL FUNDS	Percent
Mortalities	6	1.1	63	22	-	189	-	38	7	319	0.5
Animal Byproducts	28	2	170	2	50	312	6	533	238	1,311	2.1
Water Quality	153	21.4	2,010	263	1,505	3,991	144	390	456	8,759	14.2
Air Quality	75	14.1	2,137	582	482	2,656	365	463	246	6,933	11.2
Nutrition	108	29.9	2,927	674	281	5,995	1,795	1,245	527	13,443	21.8
Land Application	235	36.5	2,552	715	1,297	5,429	436	719	831	11,979	19.4
Treat/Store/Collect	153	36.6	2,683	159	632	5,351	458	869	449	10,602	17.2
Pathogens/pharm.	91	16.3	1,723	179	337	2,434	192	440	292	5,597	9.1
Social	29	1.8	393	17	15	196	4	40	20	684	1.1
Economics	57	4.5	1,140	48	89	662	41	68	55	2,103	3.4
Total		164.2	15798	2661	4688	27215	3441	4805	3121	61,730	
Percent			25.6	4.3	7.6	44.1	5.6	7.8	5.1		

Current Research Information System

Animal Manure Research, 2003, leading states in funding

North Central Region

	# projects	CSREES admin.	State approp.	total ($x1000)
Minnesota	20	664	1328	3064
Indiana	22	355	931	2476
Ohio	19	598	1479	2464
Kansas	14	872	898	2409
Iowa	12	291	829	2209

Current Research Information System

Animal Manure Research, 2003, leading states in funding

North East Region

	# projects	CSREES admin.	State approp.	total ($x1000)
Pennsylvania	16	238	713	1281
Maryland	12	266	736	1128
New York	22	270	388	1013
Connecticut	1	12	106	321
Massachusetts	3	49	86	296

Current Research Information System

Animal Manure Research, 2003, leading states in funding

Southern Region

	# projects	CSREES admin.	State approp.	total ($x1000)
Texas	28	1330	2924	6440
North Carolina	40	853	2319	5056
Georgia	20	1067	1074	3043
Virginia	17	386	1204	2854
Tennessee	10	636	748	1473

Current Research Information System

Animal Manure Research, 2003, leading states in funding)

Western Region

	# projects	CSREES admin.	State approp.	total ($x1000)
Colorado	11	664	474	1689
Arizona	3	12	693	1330
California	14	440	516	1201
Utah	8	137	491	858
Washington	12	246	210	705

File cris/animal manure research, san antonio