2014 Explanatory Notes

AGRICULTURAL RESEARCH SERVICE

Contents

Purpose Statement

The Agricultural Research Service (ARS) was established on November 2, 1953, pursuant to authority vested in the Secretary of Agriculture by 5 U.S.C. 301 and Reorganization Plan No. 2 of 1953, and other authorities.

ARS is the principal in-house research agency of the U.S. Department of Agriculture (USDA). Congress first authorized Federally supported agricultural research in the Organic Act of 1862, which established what is now USDA. That statute directed the Commissioner of Agriculture "to acquire and preserve in his department all information he can obtain by means of books and correspondence, and by practical and scientific experiments." The scope of USDA's agricultural research programs has been expanded and extended more than 60 times since the Department was created.

ARS research is authorized by the Department of Agriculture Organic Act of 1862 (7 U.S.C. 2201 note); Agricultural Research Act of 1935 (7 U.S.C. 427); Research and Marketing Act of 1946 (P.L. 79-733), as amended (7 U.S.C. 427, 1621 note); Food and Agriculture Act of 1977 (P.L. 95-113), as amended (7 U.S.C. 1281 note); Food Security Act of 1985 (P.L. 99-198) (7 U.S.C. 3101 note); Food, Agriculture, Conservation, and Trade Act of 1990 (P.L. 101-624) (7 U.S.C. 1421 note); Federal Agriculture Improvement and Reform Act of 1996 (P.L. 104-127); and Agricultural Research, Extension, and Education Reform Act of 1998 (P.L. 105-185). ARS derived most of its objectives from statutory language, specifically the "Purposes of Agricultural Research, Extension, and Education" set forth in Section 801 of FAIR.

The ARS mission is to conduct research to develop and transfer solutions to agricultural problems of high national priority and to provide information access and dissemination to: ensure high-quality, safe food, and other agricultural products; assess the nutritional needs of Americans; sustain a competitive agricultural economy; enhance the natural resource base and the environment; and provide economic opportunities for rural citizens, communities, and society as a whole.

ARS is committed to addressing the Department's priorities:

- Assist rural communities to create prosperity so they are self-sustaining, repopulating, and economically thriving.
- Ensure our national forests and private working lands are conserved, restored, and made more resilient to climate change, while enhancing our water resources.
- Help America promote agricultural production and biotechnology exports as America works to increase food security.
- Ensure that all of America's children have access to safe, nutritious, and balanced meals.

The agency's research programs – New Products/Product Quality/Value Added; Livestock/Crop Production; Food Safety; Livestock/Crop Protection; Human Nutrition; and Environmental Stewardship – are described under the "Status of Program" section.

Geographic Dispersion of Offices and Employees

ARS' Headquarters Offices are located in the Washington, D.C. metropolitan area. The agency's research is organized under 18 national programs. Field activities are managed through eight area offices. Research is conducted at field locations in the United States, the District of Columbia, Puerto Rico, the Virgin Islands, and several foreign countries. Much of the work is conducted in direct cooperation with State Agricultural Experiment Stations, other State and Federal agencies, and private organizations.

As of September 30, 2012, there were 5,847 permanent, full-time employees including 493 in the Headquarters offices and 5,354 in field offices.

GAO Audits (Completed)

GAO-12-108, 1/20/2012, Science, Technology, Engineering, and Mathematics Education: Strategic Planning Needed to Better Manage Overlapping Programs across Multiple Agencies.

GAO-12-257, 3/9/2012, Food Safety: Preslaughter Interventions Could Reduce E. coli in Cattle.

GAO-12-260, 2/27/2012, Renewable Energy: Federal Agencies Implement Hundreds of Initiatives.

GAO-12-417R, 4/12/2012, Justice and Law Enforcement: Limited Data Available on USDA and Interior Attorney Fee Claims and Payments.

GAO-12-779, 7/25/2012, Federal Real Property: Strategic Partnerships and Local Coordination Could Help Agencies Better Utilize Space.

GAO-12-843, 8/30/2012, Solar Energy: Federal Initiatives Overlap but Take Measures to Avoid Duplication.

GAO Audits (In Progress)

320886, Feed the Future Initiative.

361302, Pesticides and Food Safety.

361355, Federal Efforts to Rapidly Detect Highly Contagious Animal Diseases.

361362, Duplication of Agricultural Research Efforts.

361379, Federal Wind Energy Initiatives, Duplication, and Overlap.

361388, Energy-Water Nexus Capping Report.

460612, High Containment Laboratories: GAO Assessment of Commissioned Reports on Biosafety and Biosecurity.

460619, Duplication of Federal Inspections of High Containment Laboratories.

542196, Enhanced Use Leases.

830842, Cost Savings in Federal Government Satellite Programs.

OIG Audits (Completed)

50401-0001-11, 11/15/2011, Department of Agriculture’s Consolidated Financial Statements for Fiscal Years 2011 and 2010.

50501-01-IT, 8/15/2011, USDA's Management and Security Over Wireless Handheld Devices.

50501-2-12 , 11/15/2011, FY 2011 Federal Information Security Management Act Audit.

50601-0001-16, 9/27/2012, Section 632(a) Transfer of Funds from USAID to USDA.

OIG Audits (In Progress)

02601-1-CH, Adequacy of Controls over the Release of Sensitive Data.

50024-0003-13, Review of Travel Card Data.

50024-01-13, Review of the Department's US-Bank Purchase and Travel Charge Card Data.

50099-11-HY, Implementation of Research Misconduct Policy Within the USDA.

50099-84-HY, USDA Response to Colony Collapse Disorder.

50401-03-11, Department of Agriculture's Consolidated Financial Statements for Fiscal Years 2012 and 2011.

50501-0003-12, FY 2012 Federal Information Security Management Act Audit.

50501-1-12, USDA's Security over Domain Name Systems Services.

50601-01-22, Effectiveness of the Department's Recent Efforts to Entrance Agricultural Trade.

50601-10-AT, Follow-up Report on the Security of Biological Agents at U.S. Department of Agriculture Laboratories.

50601-17-TE, Controls over Importation of Transgenic Plants and Animals.

50601-6-TE, Controls over Plant Variety Protection and Germplasm Storage.

50703-01-HQ, Oversight and Control of USDA ARRA Activities.

50703-02-13, Analysis of Jobs Reported for American Recovery and Reinvestment Act (USDA) www.FederalReporting.gov, Data Quality Review.

Available Funds and Staff Years (SY)
(Dollars in thousands)

Item	2011 Actual		2012 Actual		2013 Estimate		2014 Estimate	
	Amount	SY	Amount	SY	Amount	SY	Amount	SY
Salaries and Expenses:								
Discretionary Appropriations	$1,135,501	7,529	$1,094,647	6,986	$1,101,346	6,986	$1,124,003	6,986
Buildings and Facilities:								
Discretionary Appropriations	-	-	-	-	-	-	155,000	-
Rescission	-231,853	-	-	-	-	-	-	-
Transfers In	131	-	111	-	-	-	-	-
Adjusted Appropriation	903,779	7,529	1,094,758	6,986	1,101,346	6,986	1,279,003	6,986
Balance Available, SOY	263,180	-	16,943	-	14,217	-	-	-
Other Adjustments (Net)	3,435	-	2,383	-	-	-	-	-
Total Available	1,170,394	7,529	1,114,084	6,986	1,115,563	6,986	1,279,003	6,986
Lapsing Balances	-1,856	-	-5,218	-	-	-	-	-
Balance Available, EOY	-16,943	-	-14,217	-	-	-	-	-
Subtotal Obligations, ARS	1,151,595	7,529	1,094,649	6,986	1,115,563	6,986	1,279,003	6,986
Obligations under other USDA appropriations: 1/								
Agricultural Marketing Service	307	1	130	1	130	1	130	1
Agriculture & Food Research Initiative (AFRI)	4,095	16	3,512	12	3,512	12	3,512	12
Animal & Plant Health Inspection Service	16,108	65	15,085	53	15,085	53	15,085	53
Departmental Administration	222	1	1,839	7	1,839	7	1,839	7
Economic Research Service	3,407	13	3,265	12	3,265	12	3,265	12
Food, Nutrition & Consumer Services	1,468	6	1,589	6	1,589	6	1,589	6
Food Safety & Inspection Service	3,281	13	2,915	10	2,915	10	2,915	10
Foreign Agricultural Service	7,567	30	4,082	14	4,082	14	4,082	14
Forest Service	1,527	6	1,333	5	1,333	5	1,333	5
Hazardous Waste	3,402	14	3,088	11	3,088	11	3,088	11
National Agricultural Statistics Service	4,683	19	4,351	15	4,351	15	4,351	15
National Institute of Food and Agriculture	15,899	63	22,531	82	22,531	82	22,531	82
Natural Resources Conservation Service	3,627	14	3,602	13	3,602	13	3,602	13
Risk Management Agency	158	1	-	-	-	-	-	-
Specialty Crops Research Initiative (SCRI, NIFA)	2,123	8	-	-	-	-	-	-
Misc., Other USDA Funds	935	4	533	2	533	2	533	2
Total, Other USDA	68,809	274	67,855	243	67,855	243	67,855	243
Total, Agriculture Appropriations	1,220,404	7,803	1,162,504	7,229	1,183,418	7,229	1,346,858	7,229

Available Funds and Staff Years (SY)
(Dollars in thousands)

Item	2011 Actual		2012 Actual		2013 Estimate		2014 Estimate	
	Amount	SY	Amount	SY	Amount	SY	Amount	SY
Other Federal Funds: 1/								
Agency for International Development.	2,802	11	10,504	37	10,504	37	10,504	37
Department for International Development.....	-	-	415	1	415	1	415	1
Department of Defense.....	5,945	24	7,245	26	7,245	26	7,245	26
Department of Energy.....	1,491	6	1,416	5	1,416	5	1,416	5
Department of Health & Human Services.....	8,448	33	7,721	27	7,721	27	7,721	27
Department of Homeland Security.....	3,519	14	4,195	15	4,195	15	4,195	15
Department of State.....	1,181	5	1,165	4	1,165	4	1,165	4
Department of the Interior.....	1,815	7	2,062	7	2,062	7	2,062	7
Department of Treasury.....	116	1	-	-	-	-	-	-
Environmental Protection Agency.....	401	2	734	3	734	3	734	3
National Aeronautics & Space Administration.....	1,143	5	1,682	6	1,682	6	1,682	6
National Oceanic and Atmospheric Administration.....	-	-	133	1	133	1	133	1
Strategic Environmental Research Development Program (SERDP).....	513	2	649	2	649	2	649	2
Misc., Other Federal Funds.....	140	1	135	-	135	-	135	-
Total, Other Federal.....	27,514	111	38,056	134	38,056	134	38,056	134
Non-Federal Funds: 1/								
Arizona, University of.....	106	1	-	-	-	-	-	-
Arkansas, University of.....	155	1	251	1	251	1	251	1
Auburn University.....	131	1	-	-	-	-	-	-
Baylor College of Medicine.....	146	1	-	-	-	-	-	-
Binational Agricultural Research & Development (BARD)....	224	1	324	1	324	1	324	1
California, State of.....	1,366	5	2,049	7	2,049	7	2,049	7
California, University of.....	1,558	6	2,077	7	2,077	7	2,077	7
Citrus Research and Development Foundation.....	-	-	1,949	7	1,949	7	1,949	7
City of Sioux Falls Public Works.....	240	1	-	-	-	-	-	-
Cornell University.....	483	2	506	2	506	2	506	2
Cotton Incorporated.....	680	3	782	3	782	3	782	3
Dade County Department of Environmental Resource Management.....	-	-	113	-	113	-	113	-
Danforth Plant Science Center.....	167	1	217	1	217	1	217	1
Delaware, University of.....	142	1	266	1	266	1	266	1
Florida Citrus Packers Association.....	161	1	-	-	-	-	-	-

Available Funds and Staff Years (SY)
(Dollars in thousands)

Item	2011 Actual		2012 Actual		2013 Estimate		2014 Estimate	
	Amount	SY	Amount	SY	Amount	SY	Amount	SY
Non-Federal Funds: (continued)								
Florida Citrus Production Research Advisory Council	110	1	224	1	224	1	224	1
Florida Citrus Research and Development Foundation	1,465	6	-	-	-	-	-	-
Florida, State of	1,133	4	779	3	779	3	779	3
Florida, University of	407	2	389	1	389	1	389	1
Food and Agricultural Organization of the United Nations (FAO)	155	1	-	-	-	-	-	-
Georgia, University of	437	2	486	2	486	2	486	2
Hispanic Serving Institutions National Program	1,275	5	1,153	4	1,153	4	1,153	4
Idaho, University of	255	1	-	-	-	-	-	-
Illinois, University of	200	1	238	1	238	1	238	1
Indian River Citrus League	-	-	102	-	102	-	102	-
Iowa, State of	122	1	-	-	-	-	-	-
Iowa State University	490	2	1,084	4	1,084	4	1,084	4
Kansas Bioscience Authority	478	2	-	-	-	-	-	-
Kansas State University	167	1	263	1	263	1	263	1
Kentucky, University of	-	-	312	1	312	1	312	1
Louisiana State University	-	-	231	1	231	1	231	1
Maryland, University of	189	1	134	-	134	-	134	-
Massachusetts, University of	110	1	284	1	284	1	284	1
Michigan State University	258	1	196	1	196	1	196	1
Minnesota, University of	550	3	391	1	391	1	391	1
Mississippi Soybean Association	-	-	119	-	119	-	119	-
National Cattlemen's Beef Association	130	1	109	-	109	-	109	-
National Pork Board	126	1	229	1	229	1	229	1
Nebraska Community Foundation	139	1	-	-	-	-	-	-
Nebraska, State of	157	1	-	-	-	-	-	-
Nebraska, University of	170	1	116	-	116	-	116	-
North Carolina State University	101	1	360	1	360	1	360	1
North Carolina, University of	285	1	-	-	-	-	-	-
North Dakota State University	275	1	212	1	212	1	212	1
Ohio State University	133	1	195	1	195	1	195	1
Ocean Spray Cranberry	180	1	-	-	-	-	-	-
Oregon State University	126	1	194	1	194	1	194	1
Pennsylvania State University	300	1	310	1	310	1	310	1
Quarters Deductions	-	-	119	-	119	-	119	-
Revocable Permits & Easements	1,045	-	568	2	568	2	568	2
Sale of Animals & Personal Property (Proceeds)	985	-	1,519	5	1,519	5	1,519	5

Available Funds and Staff Years (SY)
(Dollars in thousands)

Item	2011 Actual		2012 Actual		2013 Estimate		2014 Estimate	
	Amount	SY	Amount	SY	Amount	SY	Amount	SY
Non-Federal Funds: (continued)								
South Dakota State University	674	3	565	2	565	2	565	2
South Florida Water Management District	395	2	459	2	459	2	459	2
South Illinois University	-	-	117	-	117	-	117	-
Tahoe Regional Planning Agency (TRAP)	-	-	117	-	117	-	117	-
Texas A&M University	176	1	-	-	-	-	-	-
Texas Agrilife	-	-	138	-	138	-	138	-
Texas Agrilife Research & Extension Center	484	2	242	1	242	1	242	1
Texas State Soil and Water Conservation Board	-	-	224	1	224	1	224	1
Texas Tech University	-	-	130	-	130	-	130	-
Travel and Miscellaneous Reimbursements	403	-	546	2	546	2	546	2
United Soybean Board	4,836	18	9,914	36	9,914	36	9,914	36
Virginia Polytechnic Institute	116	1	170	1	170	1	170	1
Washington State University	315	1	261	1	261	1	261	1
Washington Tree Fruit Research Commission	239	1	413	1	413	1	413	1
Misc., Non-Federal Funds	3,964	12	3,582	13	3,582	13	3,582	13
Total, Non-Federal Funds	29,114	113	35,728	125	35,728	125	35,728	125
Miscellaneous Contributed Funds:	25,212	132	24,466	108	24,466	108	24,466	108
Total, ARS	1,302,244	8,159	1,260,754	7,596	1,281,668	7,596	1,445,108	7,596

1/ All funding received is in support of agricultural research.

Permanent Positions by Grade and Staff Year Summary

Item	2011 Actual			2012 Actual			2013 Estimate			2014 Estimate		
	Head-quarters	Field	Total	Head-quarters	Field	Total	Head-quarters	Field	Total	Head-quarters	Field	Total
SES.....	16	26	42	14	25	39	15	24	39	15	24	39
GS/GM-15.....	50	623	673	51	619	670	51	619	670	51	619	670
GS/GM-14.....	64	643	707	57	613	670	57	613	670	57	613	670
GS/GM-13.....	133	557	690	128	487	615	128	487	615	128	487	615
GS-12.....	111	413	524	123	331	454	123	331	454	123	331	454
GS-11.....	37	601	638	58	539	597	58	539	597	58	539	597
GS-10.....	1	10	11	2	4	6	2	4	6	2	4	6
GS-9.....	46	1,035	1,081	61	943	1,004	61	943	1,004	61	943	1,004
GS-8.....	25	394	419	21	350	371	21	350	371	21	350	371
GS-7.....	48	719	767	57	641	698	57	641	698	57	641	698
GS-6.....	31	308	339	23	238	261	23	238	261	23	238	261
GS-5.....	14	187	201	12	144	156	12	144	156	12	144	156
GS-4.....	8	43	51	9	30	39	9	30	39	9	30	39
GS-3.....	-	17	17	1	10	11	1	10	11	1	10	11
GS-2.....	-	11	11	-	8	8	-	8	8	-	8	8
GS-1.....	-	-	-	-	1	1	-	1	1	-	1	1
Other Graded Positions.....	4	-	4	4	-	4	4	-	4	4	-	4
Ungraded Positions.....	-	528	528	-	477	477	-	477	477	-	477	477
Total Perm. Positions.....	588	6,115	6,703	621	5,460	6,081	622	5,459	6,081	622	5,459	6,081
Unfilled EOY..	119	104	223	128	106	234	128	106	234	128	106	234
Total Perm. Full-Time Employment, EOY.....	469	6,011	6,480	493	5,354	5,847	494	5,353	5,847	494	5,353	5,847
Staff Year Est..	500	7,659	8,159	490	7,106	7,596	490	7,106	7,596	490	7,106	7,596

Size, Composition and Cost of Motor Vehicle Fleet

The 2014 Budget Estimates propose the replacement of 4 passenger motor vehicles**.** These acquisitions will replace existing vehicles without additions to the fleet. Due to the timing of vehicle receipt and sales through the exchange/sale process, there may be an overlap in the vehicle receipt, replacement, and disposal inventory. However, ARS is not adding to the overall fleet.

Professional research and technical personnel primarily use the ARS motor vehicle fleet in conjunction with research studies and technical assistance. To conduct daily work, research personnel travel between agricultural research sites, State agricultural experiment stations, farms, ranches, commercial firms, and others. Most of these sites are in rural locations and require a high degree of mobility. Use of common carriers is not feasible. Studies of cost requirements between private and government vehicles show that it is more economical to use government vehicles than to reimburse employees for the use of private vehicles.

It is ARS policy to pool vehicle use to keep the number of vehicles to a minimum. ARS requires quarterly vehicle operational reports and makes periodic surveys to determine the extent of vehicle use. During the biennial physical inventory process, ARS works to ensure inactive vehicles are removed from the inventory according to Federal property management regulations. ARS program managers are responsible for managing budgets and program needs to fulfill the agency's research mission. Replacement is based on program management, vehicle mileage/age, and funding. By Federal regulation, minimum replacement standards for passenger vehicles are three years or 60,000 miles, and for light trucks are six years or 60,000 miles. All proposed replacement vehicles exceed minimum standards.

The composition of the ARS fleet is primarily light duty trucks. Multi-purpose vehicles enable research personnel to move equipment and transport personnel. Past practices have allowed ARS to decrease the number of passenger vehicles. However, it may be necessary to replace light duty vans with more fuel-efficient passenger vehicles to help reduce fuel costs. ARS will continue to review its fleet for opportunities to realign the fleet where it is necessary, without affecting the mission. The agency continues to review inventory information to accurately classify the fleet.

Size, Composition, and Annual Operating Costs of Vehicle Fleet

Fiscal Year	Number of Vehicles by Type *								Annual Operating Costs ($ in 000) **
	Sedans and Station Wagons	Light Trucks, SUVs,		Medium Duty Vehicles	Ambu-lances	Buses	Heavy Duty Vehicles	Total Number of Vehicles	
		4x2	4x4						
2011	256	1,722	538	943	-	2	55	3,516	3,550
Change	-	-1	-6	-4	-	-	-	-11	+213
2012	256	1,721	532	939	-	2	55	3,505	3,763
Change	-1	+8	-4	-3	-	-	-	-	+226
2013	255	1,729	528	936	-	2	55	3,505	3,989
Change	-	-	-	-	-	-	-	-	+239
2014	255	1,729	528	936	-	2	55	3,505	4,228

* These numbers include vehicles that are owned by the agency and leased from GSA.

** Excludes acquisiton costs and gains from sale of vehicles as shown in FAST.

Proposed Language Changes

The estimates include appropriation language for this item as follows:

Salaries and Expenses:

For necessary expenses of the Agricultural Research Service and for acquisition of lands by donation, exchange, or purchase at a nominal cost not to exceed $100, and for land exchanges where the lands exchanged shall be of equal value or shall be equalized by a payment of money to the grantor which shall not exceed 25 percent of the total value of the land or interests transferred out of Federal ownership, $1,124,003,000: Provided, That appropriations hereunder shall be available for the operation and maintenance of aircraft and the purchase of not to exceed one for replacement only: Provided further, That appropriations hereunder shall be available pursuant to 7 U.S.C. 2250 for the construction, alteration, and repair of buildings and improvements, but unless otherwise provided, the cost of constructing any one building shall not exceed $375,000, except for headhouses or greenhouses which shall each be limited to $1,200,000, and except for 10 buildings to be constructed or improved at a cost not to exceed $750,000 each, and the cost of altering any one building during the fiscal year shall not exceed 10 percent of the current replacement value of the building or $375,000, whichever is greater: Provided further, That the limitations on alterations contained in this Act shall not apply to modernization or replacement of existing facilities at Beltsville, Maryland: Provided further, That appropriations hereunder shall be available for granting easements at the Beltsville Agricultural Research Center: Provided further, That the foregoing limitations shall not apply to replacement of buildings needed to carry out the Act of April 24, 1948 (21 U.S.C. 113a): Provided further, That funds may be received from any State, other political subdivision, organization, or individual for the purpose of establishing or operating any research facility or research project of the Agricultural Research Service, as authorized by law.

Lead-Off Tabular Statement

SALARIES & EXPENSES

2013 Estimate	$1,101,346,000
Budget Estimate, 2014	1,124,003,000
Change in Appropriation	+22,657,000

Summary of Increases and Decreases
(Dollars in thousands)

	2011 Actual	2012 Change	2013 Change	2014 Change	2014 Estimate
Discretionary Appropriations:					
Product Quality/Value Added	$105,037	-$4,496	+$850	-$16,050	$85,341
Livestock Production	81,388	-5,334	+465	-3,871	72,648
Crop Production	232,242	-3,235	+1,402	-955	229,454
Food Safety	106,789	-579	+650	+12,326	119,186
Livestock Protection	79,353	-3,187	+466	+3,674	80,306
Crop Protection	203,207	-9,397	+1,186	-15,525	179,471
Human Nutrition	85,440	-2	+523	+9,503	95,464
Environmental Stewardship	200,963	-11,929	+1,157	+28,959	219,150
National Agricultural Library	21,343	-424	-	+4,596	25,515
Repair and Maintenance	17,468	-	-	-	17,468
Total, Appropriation or Change	1,133,230	-38,583	+6,699	+22,657	1,124,003

Project Statement
Adjusted Appropriations Detail and Staff Years (SY)
(Dollars in thousands)

Program	2011 Actual		2012 Actual		2013 Estimate		Inc. or Dec.			2014 Estimate	
	Amount	SY	Amount	SY	Amount	SY	Amount		SY	Amount	SY
Salaries and Expenses											
Discretionary Appropriations:											
Product Quality/Value Added	$105,037	835	$100,541	759	$101,391	759	-$16,050	(1)	-16	$85,341	743
Livestock Production	81,388	450	76,054	416	76,519	416	-3,871	(2)	-2	72,648	414
Crop Production	232,242	1,743	229,007	1,637	230,409	1,637	-955	(3)	-	229,454	1,637
Food Safety	106,789	787	106,210	783	106,860	783	+12,326	(4)	+17	119,186	800
Livestock Protection	79,353	499	76,166	456	76,632	456	+3,674	(5)	+5	80,306	461
Crop Protection	203,207	1,276	193,810	1,161	194,996	1,161	-15,525	(6)	-4	179,471	1,157
Human Nutrition	85,440	279	85,438	279	85,961	279	+9,503	(7)	-	95,464	279
Environmental Stewardship	200,963	1,539	189,034	1,390	190,191	1,390	+28,959	(8)	-	219,150	1,390
National Agricultural Library	21,343	121	20,919	105	20,919	105	+4,596	(9)	-	25,515	105
Repair and Maintenance	17,468	-	17,468	-	17,468	-	-		-	17,468	-
Subtotal	1,133,230	7,529	1,094,647	6,986	1,101,346	6,986	+22,657		-	1,124,003	6,986
Funds included for Homeland Security	[35,715]	-	[35,721]	-	[35,721]	-	-		-	[35,721]	-
Total Adjusted Appropriation	1,133,230	7,529	1,094,647	6,986	1,101,346	6,986	+22,657		-	1,124,003	6,986
Rescissions and Transfers (Net)	2,271	-	-	-	-	-	-		-	-	-
Total Appropriation	1,135,501	7,529	1,094,647	6,986	1,101,346	6,986	+22,657		-	1,124,003	6,986
Transfers In:											
Congressional Relations	131	-	111	-	-	-	-		-	-	-
Rescission	-2,271	-	-	-	-	-	-		-	-	-
Bal. Available, SOY	5,219	-	6,845	-	8,970	-	-8,970		-	-	-
Recoveries/Adj, Other (Net)	3,122	-	2,380	-	-	-	-		-	-	-
Total Available	1,141,702	7,529	1,103,983	6,986	1,110,316	6,986	+13,687		-	1,124,003	6,986
Lapsing Balances	-1,856	-	-5,218	-	-	-	-		-	-	-
Bal. Available, EOY	-6,845	-	-8,970	-	-	-	-		-	-	-
Total Obligations	1,133,001	7,529	1,089,795	6,986	1,110,316	6,986	+13,687		-	1,124,003	6,986
Staff Years:											
Direct		7,529		6,986		6,986					6,986
Other		630		610		610					610
Total, Staff Year Estimate		8,159		7,596		7,596					7,596

Project Statement
Obligations Detail and Staff Years (SY)
(Dollars in thousands)

Program	2011 Actual		2012 Actual		2013 Estimate		Inc. or Dec.		2014 Estimate	
	Amount	SY	Amount	SY	Amount	SY	Amount	SY	Amount	SY
Salaries and Expenses										
Discretionary Obligations:										
Product Quality/Value Added….	$104,780	835	$100,021	759	$101,391	759	-$16,050 (1)	-16	$85,341	743
Livestock Production……	81,189	450	75,660	416	76,519	416	-3,871 (2)	-2	72,648	414
Crop Production……	231,804	1,743	227,581	1,637	230,409	1,637	-955 (3)	-	229,454	1,637
Food Safety……	106,789	787	106,210	783	106,860	783	+12,326 (4)	+17	119,186	800
Livestock Protection……	79,159	499	75,772	456	76,632	456	+3,674 (5)	+5	80,306	461
Crop Protection……	202,710	1,276	192,807	1,161	194,996	1,161	-15,525 (6)	-4	179,471	1,157
Human Nutrition……	85,440	279	85,438	279	85,961	279	+9,503 (7)	-	95,464	279
Environmental Stewardship……	200,471	1,539	188,056	1,390	190,191	1,390	+28,959 (8)	-	219,150	1,390
National Agricultural Library….	22,047	121	20,690	105	20,919	105	+4,596 (9)	-	25,515	105
Repair and Maintenance……	17,116	-	17,319	-	17,468	-	-	-	17,468	-
Subtotal.....	1,131,505	7,529	1,089,554	6,986	1,101,346	6,986	+22,657	-	1,124,003	6,986
Misc. Fees/Supplementals……	1,496	-	241	-	8,970	-	-8,970	-	-	-
Funds included for										
Homeland Security.....	[35,715]	-	[35,721]	-	[35,721]	-	-	-	[35,721]	-
Total Obligations.....	1,133,001	7,529	1,089,795	6,986	1,110,316	6,986	+13,687	-	1,124,003	6,986
Lapsing Balances.....	1,856	-	5,218	-	-	-	-	-	-	-
Bal. Available, EOY.....	6,845	-	8,970	-	-	-	-	-	-	-
Total Available.....	1,141,702	7,529	1,103,983	6,986	1,110,316	6,986	+13,687	-	1,124,003	6,986
Transfers In:	-131	-	-111	-	-	-	-	-	-	-
Rescission.....	2,271	-	-	-	-	-	-	-	-	-
Bal. Available, SOY.....	-5,219	-	-6,845	-	-8,970	-	+8,970	-	-	-
Other Adjustments (Net).....	-3,122	-	-2,380	-	-	-	-	-	-	-
Total Appropriation.....	1,135,501	7,529	1,094,647	6,986	1,101,346	6,986	+22,657	-	1,124,003	6,986
Staff Years:										
Direct		7,529		6,986		6,986				6,986
Other		630		610		610				610
Total, Staff Year Estimate		8,159		7,596		7,596				7,596

Proposed FY 2014 Program Increases and Decreases
(Dollars in Millions)

	New Prod/ Prod Quality	Livestock Production	Crop Production	Food Safety	Livestock Protection	Crop Protection	Human Nutrition	Environ. Stewardship	NAL	Repair and Maintenance	Grand Total
FY 2013 Base	101.391	76.519	230.409	106.860	76.632	194.996	85.961	190.191	20.919	17.468	1,101.346
Reductions:											
Base Reductions	-19.451	-7.452	-14.637	-0.650	-4.893	-26.237	-0.523	-23.328	-2.700	0.000	-99.871
Extramural Reductions	-2.292	-9.440	-3.626	-3.478	-0.221	-6.560	-4.115	-2.320	0.000	0.000	-32.052
Subtotal	-21.743	-16.892	-18.263	-4.128	-5.114	-32.797	-4.638	-25.648	-2.700	0.000	-131.923
Increases:											
Pay Costs	0.693	0.378	1.496	0.715	0.416	1.060	0.254	1.268	0.096	0.000	6.376
Bioenergy	5.000										5.000
Livestock Production		9.012									9.012
Crop Production			6.787								6.787
Food Safety				15.739							15.739
Livestock Protection					6.621						6.621
Crop Protection						16.212					16.212
Human Nutrition							13.887				13.887
Environmental Stewardship								39.946			39.946
National Agricultural Library									6.000		6.000
Improve Agricultural Sustainability		2.724	3.912		1.751			1.613			10.000
Reduce Vulnerability to Climate Change		0.907	4.503					4.590			10.000
Earth Science Priorities			0.350					4.650			5.000
Earth Observation and Environmental Data			0.260					2.540	1.200		4.000
Subtotal	5.693	13.021	17.308	16.454	8.788	17.272	14.141	54.607	7.296	0.000	154.580
Total Changes	-16.050	-3.871	-0.955	12.326	3.674	-15.525	9.503	28.959	4.596	0.000	22.657
Grand Total, FY 2014 Budget	85.341	72.648	229.454	119.186	80.306	179.471	95.464	219.150	25.515	17.468	1,124.003

Justification of Increases and Decreases

The President's 2014 Budget requests $1.124 billion for ARS' Salaries and Expenses account, an increase of $23 million from the agency's 2013 Annualized Continuing Resolution budget level.

The 2014 budget includes $148.2 million in new and expanded initiatives -- $40 million for research related to earth sciences; $37 million to collect, manage, analyze, and share huge quantities of research data across the agency's entire food and agricultural research spectrum; and a reintroduction of $71.2 million in program initiatives proposed in the 2013 budget request. These initiatives respond to the Office of Science and Technology Policy's challenge and priority to develop the research tools and infrastructure needed to handle the "big data" revolution and accelerate the pace of discovery to improve crop and animal production and health, food safety and security, human nutrition, bioenergy, agricultural sustainability, and global climate change. The proposed increases include additional funding in support of a joint REE/FNCS request (i.e., $11,000,000 for ARS and $5,000,000 for FNCS) to provide scientific nutrition evidence for USDA's food assistance programs. Enhanced resources for the agency's food consumption survey, food composition database, and "Dietary Reference Intakes" are critical to carrying out USDA's food assistance programs and updating the *Dietary Guidelines for Americans*. In addition, pay costs of $6.4 million are proposed. ARS' 2014 budget also includes $125.2 million in program reductions, comprised of $93.2 million in decreases to ongoing base research projects and $32 million in decreases to extramural research projects. The savings resulting from these reductions will be used to finance the agency's proposed high priority research initiatives. These reductions also include the closure of six ARS laboratories/locations and the consolidation of those resources with other existing ARS laboratories and locations. The costs associated with the relocation or separation of the approximately 102 employees impacted by the closures/consolidations, and the disposal of associated property is estimated to range from $10 to $12 million. ARS' 2014 budget does not include funding for the potential closures/consolidations.

New Products/Product Quality/Value Added

(1) A decrease of $16,050,000 for New Products/Product Quality/Value Added research ($101,391,000 available in 2013).

ARS' New Products/Product Quality/Value Added research program is directed toward: (1) improving the efficiency and reducing the cost for the conversion of agricultural products into biobased products and biofuels; (2) developing new and improved products to help establish them in domestic and foreign markets; and (3) providing higher quality, healthy foods that satisfy consumer needs in the United States and abroad.

ARS' research program is carried out at numerous locations where agency scientists frequently collaborate with researchers from other Federal/State governments, academia, and private industry. Their research supports USDA's Strategic Goal 1: Assist Rural Communities to Create Prosperity So They Are Self-Sustaining, Repopulating, and Economically Thriving.

ARS' base research programs respond and provide solutions to the Nation's most important agricultural problems. Much of the research the agency carries out, in its nationwide network of laboratories, is national or international in scope. Base funding for the program will continue to finance the critical New Products/Product Quality/Value Added research program. Continuing the base funding and limiting reductions is essential to ensuring the continued success of the program.

The funding change is requested for the following items:

a) An increase of $693,000 for pay costs which includes $102,000 for annualization of the fiscal year 2013 pay raise and $591,000 for the anticipated fiscal year 2014 pay raise.

Funding for pay costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Absorption of these costs reduces the number of scientists and support personnel essential for conducting the agency's research programs. If pay costs are not fully funded, ARS will be

unable to fill critical positions and will have to reduce spending for much needed laboratory equipment, supplies, and other materials.

b) An increase of $5,000,000 to Enhance the Economic Viability of Bioenergy.

Need for Change

Current market conditions, such as unexpectedly low average fuel prices and high prices for corn grain and soybean oil, are squeezing the profitability of grain-based ethanol and oilseed-based biodiesel biorefineries (i.e., first generation biorefineries). These challenges are so significant that revenues have dropped below variable costs for some biorefiners, forcing them to close their facilities and lay off employees.

Research is critical to the economic viability of the bioenergy industry in the face of fuel or feedstock price volatility. This research would: (1) increase the economic value of biorefinery co-products and/or (2) produce higher value industrial products as alternatives to fuels.

Outcomes

The risk of biorefinery shutdowns resulting from low or negative margins will be significantly reduced, thereby attracting more capital to investments in biorefining capacity. More and higher value biobased products will be marketed worldwide. This will enable biorefiners to manufacture and sell a variety of value added products. Research will emphasize flexible biorefining technologies that will enable the production of biofuel as well as marketable non-fuel products. This will allow biorefiners to respond to product demands, modify product mix, and lower their exposure to market risks.

Means to Achieve Change

- Increase the profitability of oilseed-based and carbohydrate-based biorefineries by expanding the number of product streams. Research will overcome the technical barriers related to the production of value added co-products. Efficient chemical and biochemical processing technologies will be developed to separate, purify, and derivatize components in various process streams ($5,000,000).

c) A decrease of $19,451,000 from ongoing research projects to support higher priority research initiatives.

The 2014 budget recommends selected high priority research initiatives which address the Administration's science and technology priorities and the Department's Strategic Goals. To finance these initiatives, within limited resources, some existing projects are proposed for reduction or termination given that they are: (1) mature where the research objectives have been mainly accomplished; (2) duplicative or can be accomplished more effectively elsewhere in ARS; (3) marginal or below threshold funding for program viability or sustainability; (4) conducted in substandard or inadequate infrastructure and future costs are prohibitive; (5) lacking a critical mass of scientists/support personnel for an effective program; or (6) are carried out by other research institutions. The savings achieved from these reductions/terminations will be redirected to finance the higher priority agricultural research initiatives identified in the 2014 budget, and will improve program and operational efficiencies.

CA, Albany – Improved Utilization of Ag. Products through Identification of Nitrogen-Containing Bioactive (-$893,000)
CA, Albany – Optimization of the Nutritional, Functional, and Sensory Properties of Raw and Processed Legumes, Grains, and Specialty Crops (-$892,000)
CA, Albany – Processing Technologies to Prevent Weight Gain and Obesity Related Metabolic Diseases (-$893,000)
IL, Peoria – Bio-Based Lubricants from Farm-Based Raw Materials (-$629,000)
IL, Peoria – Modification of Natural Polymers by Novel Processes (-$955,000)
IL, Peoria – Novel Technologies for Producing Renewable Chemicals and Polymers from Carbohydrates Derived from Agricultural Feedstocks (-$1,708,000)
IL, Peoria – Novel Technology for Renewable Resource Utilization (-$1,708,000)

LA, New Orleans – Engineering Enzymatic Redirection of Natural Crop Oil Production to Industrial Oil Production (-$1,664,000)
LA, New Orleans – Primary and Secondary Prevention of Peanut and Tree Nut Allergy (-$519,000)
LA, New Orleans – Reducing Astringency, Bitterness, and Undesirable Flavors of Polyphenolic-Rich Fruit Juices and Functional Beverages (-$1,139,000)
MD, Beltsville – Evaluation and Maintenance of Flavor, Nutritional, and Other Quality Attributes of Fresh and Fresh-Cut Produce (-$1,984,000)
MD, Beltsville – Genetic and Biochemical Mechanisms Determining Fresh Produce Quality and Storage Life (-$1,181,000)
MD, Beltsville – Optical and Mechanical Instrumentation for Quality Assessment of Small Grains (-$360,000)
PA, Wyndmoor – Biobased Industrial Products from Food Animal Processing By-Products (-$743,000)
PA, Wyndmoor – Environmentally Friendly Processes and New Applications for Animal Hides and Leather (-$1,892,000)
PA, Wyndmoor – Production and Value Enhancement of Biosurfactants and Biopolymers Derived from Agricultural Lipids and Co-products (-$1,018,000)
PA, Wyndmoor – Wool and Keratin from Wool for Biobased Value-Added Products (-$423,000)

Note: There is an adjustment (-$850,000) to the Annualized Continuing Resolution.

d) A decrease of $2,292,000 in ongoing extramural research projects.

Need for Change

Under ARS' New Products/Product Quality/Value Added program, selected extramural research projects are proposed for termination, given that the research conducted is carried out by other institutions including universities and land grant institutions. The savings achieved from these reductions/terminations will be redirected to finance the higher priority agricultural research initiatives identified in the 2014 budget.

MS, Oxford – Natural Products (-$2,259,000)
NM, Las Cruces – Long Staple Cotton (-$33,000)

Livestock Production

(2) A decrease of $3,871,000 for Livestock Production research ($76,519,000 available in 2013).

ARS' Livestock Production research program is directed toward: (1) safeguarding and utilizing animal genetic resources, associated genetic and genomic databases, and bioinformatic tools; (2) developing a basic understanding of the physiology of livestock and poultry; and (3) developing information, tools, and technologies that can be used to improve animal production systems. The research is heavily focused on the development and application of genomics technologies to increase the efficiency and product quality of beef, dairy, swine, poultry, aquaculture, and sheep systems. Areas of emphasis include increasing efficiency of nutrient utilization, increasing animal well-being and reducing stress in production systems, increasing reproductive rates and breeding animal longevity, developing and evaluating non-traditional production systems (e.g., organic and natural), and evaluating and conserving animal genetic resources.

ARS' research program is carried out at numerous locations where agency scientists frequently collaborate with researchers from other Federal/State governments, academia, and private industry. Their research supports USDA's Strategic Goal 1: Assist Rural Communities to Create Prosperity So They Are Self-Sustaining, Repopulating, and Economically Thriving; and Strategic Goal 3: Help America Promote Agricultural Production and Biotechnology Exports as America Works to Increase Food Security.

ARS' base research programs respond and provide solutions to the Nation's most important agricultural problems. Much of the research it carries out, in its nationwide network of laboratories, is national or international in scope.

Base funding for the program will continue to finance the critical Livestock Production research program. Continuing the base funding and limiting redirections is essential to ensuring the continued success of the program.

The funding change is requested for the following items:

a) An increase of $378,000 for pay costs which includes $56,000 for annualization of the fiscal year 2013 pay raise and $322,000 for the anticipated fiscal year 2014 pay raise.

Funding for pay costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Absorption of these costs reduces the number of scientists and support personnel essential for conducting the agency's research programs. If pay costs are not fully funded, ARS will be unable to fill critical positions and will have to reduce spending for much needed laboratory equipment, supplies, and other materials.

b) An increase of $5,000,000 Using Data to Achieve Improved Feed Efficiency and Reduced Antimicrobial Resistance in Livestock.

Need for Change

The international demand for food animal products is increasing along with the real costs of production for U.S. food animal products. Food security is also a critical and growing priority around the world. These increasing pressures and demands require improvements in U.S. food animal production and production efficiencies to ensure a sustainable food source. To address these challenges specific research programs are needed to improve genomic technologies for food animals and their enteric microbiota to identify and select phenotypic traits for reducing pathogens, preventing antibiotic resistance, and achieving feed and nutrient use efficiency.

Agricultural research has moved into a new era, where a single scientist can create more data in three months than could previously be analyzed in a career; genome sequence, gene expression, phenotypic, environmental and metagenomic data is vast and growing. The current challenges in managing, understanding, and applying these data will increase by orders of magnitude within the next several years. Furthermore, data in biological sciences are complex with layers of variation and complexity. The variation, interaction, and inter-relatedness inherent in agricultural data require development of new tools and processes to analyze research results, conduct advanced meta-analyses and apply discoveries to production improvements. The greatest scientific achievements are no longer limited to the scientists who design the most creative experiments; they will also be made by scientists who are most creative in analyzing data.

Programmatically joint agricultural informatics efforts are needed to coordinate the acquisition, analysis, and interpretation of large data sets gathered by ARS laboratories and collaborators. By working together virtually with the National Agricultural Library (NAL), and crop and natural resources scientists, animal researchers will be able to link many kinds of data sets in order to develop hypotheses answering a wide variety of problems. Specifically, these efforts will contribute toward an understanding of the distribution of environmental factors both spatially and temporally (predicted), and their relationships to genomics of livestock, poultry, pests, and associated microorganisms. Coordinated agricultural informatics will integrate large data sets generated by many aspects of agricultural research.

These improved programs, resources, and technologies along with added critical expertise will support existing research programs in genetics and biology, and will enhance and empower connections among ARS' plant, animal, natural resources, and food sciences. Valuable animal genomic and performance information and existing animal populations in ARS will be more fully leveraged and exploited. This data combined with environmental records, nutritional background, and ultimately nutritional quality of the animal protein product will provide a significant understanding of these relationships. Collaborative institutions and partnerships potentially include all animal programs across ARS, and numerous collaborative land grant universities, 1890 universities, and industry groups. Furthermore, this initiative will take advantage of "big data" program developments at the National Science Foundation (NSF), and National Institutes of Health (NIH).

The requested funding increase will leverage existing ARS and other Federal agency "big data" expertise, infrastructure, and will enhance linkages and collaborative opportunities with interagency and intergovernment institutions including: NAL, National Institute of Food and Agriculture (NIFA) Coordinated Agricultural Project (CAP) Grants, NSF's iPlant Collaborative and XCEDE (formerly the TeraGrid), Department of Energy (DOE) Knowledgebase and Joint Genome Institute (JGI), NSF/NIH/Biotechnology and Biologic Sciences Research Council (BBSRC)/NIFA Evolutionary Ecology of Infectious Diseases, Elixir (UK), European Bioinformatics Institute (EMBL-EBI)/Wellcome Trust Sanger Institute Ensemble Genomes (UK), and the US-EU Biotechnology Research Task Force-Animal Biotechnology Working Group.

Outcomes

The proposed increase will result in:

- Increased genetic progress for economically valuable traits in food animals including feed utilization efficiency; animal well-being and adaptability; animal health and viability; and reduced antimicrobial resistance.
- Improved bioinformatic (information integration and analysis) capacity which will add significant value to existing and future research, and empower the development of additional insights and innovation from existing resources.
- Improved technologies and support for development and enhancement of comprehensive animal performance measures across ARS which will increase scientific innovation for measuring performance and new insight into underlying mechanisms through coordination of multifactorial data sets.
- Improved scientific program efficiency and collaborative opportunities for scientists in ARS and improved collaboration between ARS locations, industry stakeholders, and other research agencies in collaboration with related efforts, in ARS' Crop Production/Protection programs, NSF iPlant-iAnimal, etc., which will significantly improve the productivity and impact of ARS' programs in food animal genomics.

Means to Achieve Change

- Provide better characterization of genomic variation and development of comprehensive performance measures and association of genome to production traits for food animals and their associated microbiota to identify and select phenotypic traits for reducing pathogens, preventing antibiotic resistance, and achieving feed and nutrient use efficiency ($5,000,000). ARS will:
  - Identify and characterize genetic variation, and sequence variants associated with performance attributes.
  - Conduct detailed analyses of host and pathogen interactions and symbiotic microbial relationships. Improve metagenomic analyses of health and production traits in food animals.
  - Develop new tools and resources via virtual animal databases for analyzing "big data" from the increasing use of next generation DNA/RNA sequencing for genotyping-by-sequencing analyses.
  - Improve bioinformatic support and data analysis and curation for food animal projects and programs across ARS in collaboration with NAL and ARS' crop, natural resources, and human nutrition scientists. Develop bioinformatic tools and resources for animal genomic databases for mapping the critical pathways linking genotype to phenotype (traits). Develop access to high performance computing and visualization resources that leverage high resolution, high information content "big data" from next generation DNA/RNA, and metagenomic sequencing and other genotyping pipelines.
  - Develop qualitative comprehensive agricultural animal phenotype and genetic resource databases that enable scientists to accelerate genetic improvement for new and existing traits.

c) An increase of $4,012,000 to Enhance Livestock Production in the United States.

Need for Change

World hunger is a major threat to global stability. Population increases over the next 40 years are projected to occur most rapidly in regions of the world that are currently the most food stressed. One of the keys to meeting the demands of the growing population will be improving the productivity of animals.

Improving productivity depends on having the tools to optimize the interaction between the genetic potential of animals and the production environment. Until recently it was impossible to directly study the genes responsible for important traits like productivity or nutrient efficiency. These challenges are beginning to be met by exploiting the inherent potential in genomes by enabling the unraveling of complex traits such as production efficiency. The development of high resolution genome sequences for animals are providing the necessary infrastructure to conduct genomic selection. Animal breeders have enhanced the genetic potential of key livestock, poultry, fish and shellfish.

By matching animals with their environment through the best design for dairies, feedlots, and aquaculture systems, producers have some control over the environments imposed on the production system. Among the traits most important for addressing world hunger will be feed efficiency (i.e., the most efficient use of feed by livestock). This is because research to improve feed efficiency will increase productivity by reducing the level of inputs required and optimizing use of inputs to reduce outputs such as animal waste.

The funding requested for animal production projects will enhance current programs. Across all species genetic improvement is critical to improving production systems. This funding enhancement will strengthen the program in genetic improvement by enhancing selective breeding efforts through incorporation of genomic information. Optimizing nutrient utilization is key to reducing feed inputs and waste outputs. Building databases that connect DNA sequence and performance data are key to the next generation of production and efficiency advances. Developing systems, with animals reared in synchrony with their environments will maximize production efficiencies. For example, research is needed to increase the efficiency of ruminant forage utilization in concert with ecosystem services that conserve and enhance forage resources. Aquaculture, too, requires efforts to tailor fish to a water reuse type of system, with consistent water quality, low disease risk, and high efficiency of waste capture. These improvements will drive commercial growth of aquaculture and enhance sustainability of animal production generally.

Outcomes

The impact of improving the utilization of feed by livestock could result in $1.8 billion in savings to the beef, cattle, and swine industries. In addition, research to improve the efficiency of feed will safeguard food security by improving the adaptability and sustainability of animals which will ensure the availability of agricultural products to consumers worldwide. Improvements in the nutritional value of animal products will provide higher quality food for all consumers.

Optimal matching of forage management to animal genetics and production systems will enable profitable and sustainable use of grasslands, erodible lands, and marginally productive lands. Integrated systems will increase the forage efficiency of ruminant species, leveraging these resources in sustainable programs that improve the efficiency of forage utilization and preserve and enhance ecosystem integrity.

Emerging genomic technologies will increase the efficiency of nutrient utilization of livestock, poultry, and aquatic animal production systems which will positively impact sustainability through reduced feed input, waste, and odor production.

Means to Achieve Change

- Develop Integrated Production Systems that Incorporate Enhanced Germplasm and Pest/Pathogen/Water/Nutrient Management Strategies to Improve Production Efficiencies and Product Quality in Farm Animals ($4,012,000). ARS will:
  - Identify germplasm that is suitable for pasture-raised beef and traditional feedlot production systems, and improve production efficiency and product quality in these animals.
  - Enhance Atlantic salmon germplasm to improve production efficiency, reproduction, resistance to pathogens, and product quality.
  - Identify and develop new value added catfish products.

d) An increase of $2,724,000 to Improve Agricultural Sustainability.

Note: See the "Crop Production" section.

e) An increase of $907,000 to Reduce the Vulnerability of Agriculture to Climate Change.

Note: See the "Environmental Stewardship" section.

f) A decrease of $7,452,000 from ongoing research projects to support higher priority research initiatives.

The 2014 budget recommends selected high priority research initiatives which address the Administration's science and technology priorities and the Department's Strategic Goals. To finance these initiatives, within limited resources, some existing projects are proposed for reduction or termination given that they are: (1) mature where the research objectives have been mainly accomplished; (2) duplicative or can be accomplished more effectively elsewhere in ARS; (3) marginal or below threshold funding for program viability or sustainability; (4) conducted in substandard or inadequate infrastructure and future costs are prohibitive; (5) lacking a critical mass of scientists/support personnel for an effective program; or (6) are carried out by other research institutions. The savings achieved from these reductions/terminations will be redirected to finance the higher priority agricultural research initiatives identified in the 2014 budget, and will improve program and operational efficiencies.

AL, Auburn – Nutrition and Feed Development for Warm Water Aquaculture (-$604,000)
LA, New Orleans – Bioremediation of Geosmin and MIB (-$748,000)
MD, Beltsville – Identification of Biomarkers for Pre- and Post-Weaning Growth in Swine (-$1,079,000)
MI, East Lansing - Using the Genome to Understand Immunogenetics of Poultry (-$1,445,000)
NE, Clay Center – Characterizing and Managing Animal Stress/Well-Being in Livestock Production (-$907,000)
NE, Clay Center – Strategies to Improve Heifer Selection and Heifer Development (-$1,041,000)
OK, El Reno - Development and Assessment of a System to Produce Grass-Fed Beef for the Southern Great Plains (-$1,163,000)

Note: There is an adjustment (-$465,000) to the Annualized Continuing Resolution.

g) A decrease of $9,440,000 in ongoing extramural research projects.

Need for Change

Under ARS' Livestock Production program, selected extramural research projects are proposed for termination, given that the research conducted is carried out by other institutions including universities and land grant institutions. The savings achieved from these reductions/terminations will be redirected to finance the higher priority agricultural research initiatives identified in the 2014 budget.

KY, Lexington – Improved Forage Livestock Production (-$922,000)
MD, Beltsville – Bovine Genetics (-$221,000)
MS, Mississippi State – Broiler Production in the Mid-South (-$415,000)
MS, Stoneville – Aquaculture Research - National Warmwater Aquaculture Center (-$833,000)
MS, Stoneville – Aquaculture - Warmwater Aquaculture (-$2,147,000)
MS, Stoneville – Biotechnology Research to Improve Crops and Livestock (-$697,000)
MS, Stoneville – National Warmwater Aquaculture Center (Catfish Health) (-$217,000)
MS, Stoneville – Warmwater Aquaculture (-$285,000)
NE, Clay Center – Livestock Genome Mapping Initiative (-$343,000)
WV, Leetown – Aquaculture Systems (Rainbow Trout) (-$467,000)
WV, Leetown – Aquaculture (Trout Genome) (-$503,000)
WV, Leetown – Coldwater Aquaculture (-$1,810,000)
WI, Madison – Aquaculture Research - Great Lakes Research (-$580,000)

Crop Production

(3) A decrease of $955,000 for Crop Production research ($230,409,000 available in 2013).

ARS' Crop Production research program focuses on developing and improving ways to reduce crop losses while protecting and ensuring a safe and affordable food supply. The program concentrates on effective production strategies that are environmentally friendly, safe to consumers, and compatible with sustainable and profitable crop production systems. Research activities are directed at safeguarding and utilizing plant genetic resources and their associated genetic, genomic, and bioinformatic databases that facilitate selection of varieties and/or germplasm with significantly improved traits. Research activities attempt to minimize the impacts of crop pests while maintaining healthy crops and safe commodities that can be sold in markets throughout the world. The agency is conducting research to discover and exploit naturally occurring and engineered genetic mechanisms for plant pest control, develop agronomic germplasm with durable defensive traits, and transfer genetic resources for commercial use. ARS provides taxonomic information on invasive species that strengthens prevention techniques, aids in detection/identification of invasive pests, and increases control through management tactics that restore habitats and biological diversity.

ARS' research program is carried out at numerous locations where agency scientists frequently collaborate with researchers from other Federal/State governments, academia, and private industry. This research supports USDA's Strategic Goal 1: Assist Rural Communities to Create Prosperity So They Are Self-Sustaining, Repopulating, and Economically Thriving, and Strategic Goal 3: Help America Promote Agricultural Production and Biotechnology Exports as America Works to Increase Food Security.

ARS' base research programs respond and provide solutions to the Nation's most important agricultural problems. Much of the research the agency carries out, in its nationwide network of laboratories, is national or international in scope. Base funding for the program will continue to finance the critical Crop Production research program. Continuing the base funding and limiting reductions is essential to ensuring the continued success of the program.

The funding change is requested for the following items:

a) An increase of $1,496,000 for pay costs which includes $220,000 for annualization of the fiscal year 2013 pay raise and $1,276,000 for the anticipated fiscal year 2014 pay raise.

Funding for pay costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Absorption of these costs reduces the number of scientists and support personnel essential for conducting the agency's research programs. If pay costs are not fully funded, ARS will be unable to fill critical positions and will have to reduce spending for much needed laboratory equipment, supplies, and other materials.

b) An increase of $4,503,000 to Reduce the Vulnerability of Agriculture to Climate Change.

Note: See the "Environmental Stewardship" section.

c) An increase of $3,912,000 to Improve Agricultural Sustainability.

Note: This initiative is divided among several program areas, i.e., here and under Livestock Production ($2,724,000), Livestock Protection ($1,751,000), and Environmental Stewardship ($1,613,000).

Need for Change

It is projected that agriculture will face increasingly uncertain climate conditions in the future at the same time that an increasing world population demands increased quantity and quality of agricultural products. Much of U.S. agricultural production has been predicated on the availability of plentiful irrigation water and plant nutrients, and a relatively stable climate. Increasing competition for water, mined plant nutrients, and energy supplies used to produce nitrogen fertilizers, along with an expected increase of climatic extremes of temperature and precipitation

requires agricultural production systems to produce under less than ideal conditions and to increasingly rely on previously underutilized ecosystem services such as a robust soil ecosystem. In addition, the need for research to address the goals of sustainable intensification, including enhanced climate resiliency in crop and animal systems is increasing. Programs are needed to address these issues as priorities evolve to sustainably ensure food security for a growing population.

Expanding genetic improvement focused on animal system adaptability and performance is a high priority for the animal industries. Additional focus is needed to increase genetic progress for economically important traits such as feed efficiency, health and disease resistance, parasite resistance, product quality, and healthfulness in response to production pressures including climate change and increasing ambient temperatures.

New fertilizer technologies are in their infancy and research will determine where and how they can be used effectively and efficiently.

This initiative focuses on sustainable agriculture and climate resiliency -- on taking a comprehensive and proactive approach to finding solutions to some of the biggest challenges facing our ability to ensure sustainable food production while adapting to changing climates. The initiative will include a multi-disciplinary, geographically inclusive, cross agency approach.

Outcomes

More knowledge of the effects of genetics, environment, and management practices on food quality and nutritional content will provide information needed by breeders to produce germplasm that delivers high quality fruits and vegetables to local communities. New fruit and vegetable varieties will be bred for new uses including cultivation in small farm and non-traditional growing areas. Farmers will be able to tailor management strategies with new crop varieties for specific locations to ensure that the crops meet the needs of local communities using sustainable practices. Crops with superior product quality will encourage consumers to eat healthy foods and create increased demand for high quality regional crop products.

Improvements in feed efficiency alone could result in approximately $2 billion in savings annually to the swine and beef cattle industries and would result in additional significant reductions in carbon footprints for these industries. Similar opportunities exist for other food animal industries through reduced feed inputs, lower volumes of wastes produced, and reduced production of green house gases. Improved health outcomes will also greatly improve production yields and efficiency.

A more robust and resilient suite of varieties, breeds, and agricultural management systems will be developed to produce consistent quantities and qualities of products under increasingly variable conditions.

More efficient fertilizer use will enable increased yields with better nutritional content, while reducing impacts on the environment by optimal rather than excess application, and reducing input amounts and costs for producers.

Producers challenged with a shrinking supply of water and land will be provided improved crop varieties that require less water and that have increased production efficiency. Increased production efficiency and higher yields will strengthen rural economies, promote efficient use of arable lands, and increase farm gate value.

Means to Achieve Change

- Develop integrated programs to increase the sustainability of food animal and crop production systems ($3,912,000). ARS will:
  - Increase the rate of genetic improvement for economically valuable traits relating to health, parasite resistance, production efficiencies, and animal adaptability.
  - Develop new crop varieties and management systems that use less water and require reduced nutrients.
  - Increase the effectiveness and reduce the cost of programs that keep cattle fever ticks out of the United States.

- Determine the effect of nutrients and materials delivered through the feed on growth, feed palatability, stress and immune response, and disease resistance in aquaculture.
- Develop feeding strategies to improve nutrient retention, production, product quality, and disease resistance of fish.
- Develop strategies for sustained biomass production using new fertilizer technologies including mixes of inorganic and organic materials for their effects on yields, reduced input costs, and enhanced environmental quality.
- Develop local and regional food production systems:
  - Develop improved fruit and vegetable varieties with extended growing seasons adapted for local and regional climates with appealing taste and quality.
  - Develop and optimize management practices to maximize soil health and environmental quality while minimizing food safety risks in systems utilizing organic soil additives, such as manure and compost.
  - Evaluate nutrient content of fresh market produce grown under varying management and environmental conditions, i.e., greenhouse, organic, conventional.

Note: Some of the activities listed above will be carried out under the Livestock Production/Protection and Environmental Stewardship areas.

d) An increase of $3,206,000 to Enhance Floral and Nursery Research.

Need for Change

Floral and nursery crops collectively constitute the third largest value farm crop in the United States. It is a multi-billion dollar segment of the U.S. economy at wholesale, and about 15 percent of total U.S. crop receipts. But the profitability, sustainability, and economic vitality of this critical segment of U. S. crop agriculture is threatened by various factors. Improved product quality is needed to enhance the competitiveness of U.S. producers through improved nursery and floral products, production practices, and new approaches for mitigating environmental concerns. Virulent pests and diseases, including those imported as a result of increased global trade, cause great economic and environmental damage, and require effective control. Enhanced environmental stewardship requires reduced use of chemicals, increased biological pest controls, environmental remediation, reduced runoff, use of byproducts from production, and more sustainability in the use of materials and waste products.

Outcomes

An integrated, multi-locational floral and nursery crop research initiative will focus ARS multidisciplinary research teams – leveraged by complementary industry resources – on floral and nursery crops to: improve environmental and resource management strategies; develop superior pest (i.e., insect, disease, and weed) control strategies; and refine nursery and floricultural production system practices. A stronger floriculture and nursery crop industry will strengthen U.S. rural and suburban economies by providing better technologies to growers across the United States.

Means to Achieve Change

- Floral and Nursery Crop Research Initiative ($3,206,000). ARS will:
  - Develop more effective systems for producing disease free floricultural propagating material and for monitoring plant health status.
  - Devise innovative methods of minimizing run-off of nutrients and waste water from nursery crop production systems by optimizing water and nutrient inputs, application, and onsite management.
  - Improve integrated pest management systems for floricultural bedding plant production.
  - Characterize and develop the means to control major fungal and oomycete diseases which cause economic losses and quarantine restrictions for nursery crop production.
  - Identify, test, and optimize alternative substrates for pot production of nursery crops, especially in the southeastern United States.
  - Develop more effective means for detecting, diagnosing, and controlling major viral and bacterial diseases of floricultural crops.

e) An increase of $3,000,000 for Research on Maize, Other Cereals, and Perennial Grasses to Provide Better Data Analysis to Accelerate Crop Yields for Food, Feed, and Bioenergy.

Need for Change

ARS researchers and university collaborators are making groundbreaking research discoveries and are developing innovative new crop breeding approaches that exploit new genome sequence data. This progress must be accelerated by leveraging current Federal funding in "big data" infrastructure to extend research solutions to additional food and agricultural research problems, particularly for maize, small grains, and perennial grasses grown for bioenergy.

Maize has the greatest molecular and phenotypic diversity of any major crop species. This diversity is key to future maize improvement. Extensive genomic profiling of 100,000 diverse maize genotypes must be combined with a range of field trials to determine the phenotypic impacts of individual polymorphisms. Access to maize germplasm information, genetic maps, genome sequences, and trait data is provided by Germplasm Resources Information Network (GRIN), Panzea, MaizeGDB, and Gramene. Tools for data integration across this system, access to high performance computing, new statistical and computational models, and advanced genetic resources must be developed for the genetic improvement of maize as well as other crops, which will be made available in the public domain.

Wheat and other cereals (i.e., barley, oats, and rye) are vulnerable to fungal diseases including cereal rusts (Ug99) and scab (Fusarium head blight). All have large complex genomes that have yet to be fully sequenced and assembled. ARS wheat, barley, and oat research is conducted in cooperation with and support from the Triticeae Coordinated Agricultural Project (T-CAP) funded by NIFA, and in cooperation with the International Wheat Genome Sequencing Consortium (IWGSC). Sufficient capacities for data management, data analysis, and open access to data are critical to the success of these initiatives. ARS has generated and provides completely open access to significant volumes of field-based phenotypic data and high throughput genotypic data for wheat and other cereals (i.e., lines, varieties, landraces, and wild relatives) through its national genetic and genomic database system. Access to germplasm information, genetic maps, genome sequences, and trait data is provided by GRIN, GrainGenes, The Triticeae Toolbox (T3) database, and Gramene, which are all highly utilized by the crop research community. Enhanced resource integration and access to high performance computing resources for cereal crop research needs to be developed with the iPlant Collaborative project, an ARS collaborator, through the University of Arizona, and the Texas Advanced Computing Center (TACC) with funding from NSF.

Perennial grasses (i.e., switchgrass, sugarcane, and miscanthus) are being bred for increased yield, disease, drought and cold resistances, and enhanced conversion to biofuels. Also, food-producing perennial grains have potential as an alternative for annual crops where water resources are limited. Database support for open access to perennial grass genotyping information and trait evaluation data under diverse environments is needed to advance public efforts to provide enhanced perennial grass germplasm.

Requested support will enhance interagency and intergovernmental linkages, e.g., NSF's iPlant Collaborative and XSEDE (formerly the TeraGrid); DOE Knowledgebase and Joint Genome Institute (JGI); DOE/USDA Biomass Genomics Research program, along with new funding initiatives from BBSRC (Biotechnology and Biological Sciences Research Council); Elixir (UK); European Bioinformatics Institute (EMBL-EBI)/Wellcome Trust Sanger Institute Ensembl Genomes (UK); and INRA (i.e., the French public agricultural research institute).

Outcomes

The proposed increase will result in:

- Enhanced database tools and resources at MaizeGDB, Gramene, GrainGenes, Panzea, iPlant, and partner databases that serve key customers/stakeholders in maize and other important crops.
- Genome-wide characterization of polymorphisms in maize, cereals, and perennial grass germplasm and their wild relatives.
- Field-based evaluation of the predictive value of polymorphism descriptors and models.
- Phenotypic analysis of maize, cereal, and perennial grass fitness traits across diverse environments.

- New statistical and computational models that enhance trait prediction based on genome sequence to accelerate the pace of maize, cereals, and perennial grass breeding.
- Development of a new workforce of postdoctoral fellows and graduate students for industry, government, and academia who are trained in quantitative genetics, bioinformatics, and crop breeding.
- Access to integrated datasets, advanced analytical tools, and high performance computing resources from multidisciplinary, multi-institutional projects on maize, cereals, and energy grasses developed in coordination with iPlant and TACC that accelerate the genetic improvement of these crops.

Means to Achieve Change

- Develop next generation trait prediction models for maize, other cereals, and perennial grasses that incorporate genotyping by sequencing, field-based phenotyping, and high performance computing and modeling for diverse environments ($1,500,000). ARS will:
  - Develop bioinformatic tools and resources for computationally mapping the path from genotype to phenotype (traits) including access to high performance computing and visualization resources that leverage high resolution, high information content "big data" from next generation DNA sequencing, and other genotyping pipelines.
  - Integrate development of cyberinfrastructure and bioinformatic tools for maize, other cereals, and perennial grasses with the NSF's iPlant Collaborative, Texas Advanced Computing Center (TACC), and European Molecular Biology Laboratory-European Bioinformatics Institute's (EMBL-EBI) EnsemblPlants.
  - Develop new tools and resources for crop databases that integrate and support maize research (i.e., MaizeGDB, Gramene, iPlant Collaborative) by analyzing "big data" from the increasing use of next generation DNA sequencing for genotyping by sequencing, and by annotating sequence diversity and the production of high resolution DNA markers for breeding.

- Develop a breeder friendly system interface to enable rapid analysis and understanding of genotype versus environment interactions for disease resistance and other complex traits ($1,000,000). ARS will:
  - Integrate cereal crop trait information, genetic maps, genome sequences, and genetic data from crop databases (i.e., GRIN, The Triticeae Toolbox (T3), GrainGenes, and Gramene) with bioinformatic tools, workflows, and high performance computing resources at iPlant to enable the development of statistical and computational models that enhance trait prediction and breeding.

- Provide database support for perennial grass genetic improvement to enhance biofuel production in collaboration with DOE's Knowledgebase and DOE's Biomass Research Centers ($500,000). ARS will:
  - Provide new database support for open access to perennial grass genotyping information, genetic maps, and trait evaluation data under diverse environments to advance public efforts to provide enhanced germplasm for biofuels production.

f) An increase of $581,000 for Crop Genetic Resources to Underpin Food Security.

Need for Change

There are widespread concerns about the global capacity to furnish expanding human populations with adequate food, feed, fiber, and fuel at affordable prices. Crop breeding and genomics are key tools for enhancing crop productivity. They depend on ready access to raw and improved genetic resources for success. Genetic resources are the foundation of our agricultural future. The U. S. National Plant Germplasm System (NPGS) genebanks contain the sources of resistance to biotic and abiotic stresses and new genes to improve the quantity and quality of our crops. To ensure that those genes are available for research and breeding, ARS must continue to acquire and conserve germplasm that contain them; develop new screening methods for identifying favorable traits; distribute germplasm where and when it is needed; and safeguard these collections for future generations.

Outcomes

The proposed research and expanded genetic resource management capacities will enhance the NPGS' ability to conduct genetic resource regeneration, characterization, and documentation to safeguard genetic resources which are difficult to handle. Information associated with the genetic resources will be maintained and delivered through enhanced information management systems administered by highly trained information technologists. Additional researchers will conduct research on priority objectives, such as long-term storage of clonally propagated crops and new applications of genomic technology to genetic resource management.

Means to Achieve Change

- Crop Genetic Resources for Food Security ($581,000). ARS will:
  - Expand operational capacity to multiply plant genetic resources, and describe and document their key genetic traits.
  - Enhance the capacity of the Germplasm Resources Information Network (GRIN-Global) to manage key data associated with the genetic resources.
  - Expand research to develop new means for long-term, ultra cold storage of crops propagated by tubers, roots, or cuttings, and wild crop relatives.
  - Increase capacity to apply leading edge genetic analyses to gene bank management.

g) An increase of $350,000 to Expand Research Capacity in the Earth Sciences.

Note: See the "Environmental Stewardship" section.

h) An increase of $260,000 for Earth Observation and Environmental Data Activities.

Note: See the "Environmental Stewardship" section.

i) A decrease of $14,637,000 from ongoing research projects to support higher priority research initiatives.

Need for Change

The 2014 budget recommends selected high priority research initiatives which address the Administration's science and technology priorities and the Department's Strategic Goals. To finance these initiatives, within limited resources, some existing projects are proposed for reduction or termination given that they are: (1) mature where the research objectives have been mainly accomplished; (2) duplicative or can be accomplished more effectively elsewhere in ARS; (3) marginal or below threshold funding for program viability or sustainability; (4) conducted in substandard or inadequate infrastructure and future costs are prohibitive; (5) lacking a critical mass of scientists/support personnel for an effective program; or (6) are carried out by other research institutions. The savings achieved from these reductions/terminations will be redirected to finance the higher priority agricultural research initiatives identified in the 2014 budget, and will improve program and operational efficiencies.

AR, Stuttgart – Response of Diverse Rice Germplasm to Biotic and Abiotic Stresses (-$2,640,000)
AZ, Maricopa – Physiological and Genetic Basis of Cotton Acclimation to Abiotic Stress (-$1,470,000)
CA, Albany – Molecular Genetics of Ethylene Biosynthesis (-$575,000)
CA, Parlier – Developing Sustainable Cropping Systems to Improve Water Productivity and Protect Water and Soil Quality in Irrigated Agriculture (-$262,000)
CA, Riverside – Integrated Field Scale Management Systems for Use of Degraded Waters (-$108,000)
CO, Ft. Collins – Spatial Modeling of Agricultural Watersheds: Water and Nutrient Management and Targeted Conservation Effects at Field to Watershed Scales (-$410,000)
GA, Dawson – Sustaining Peanut Cropping Systems Competitiveness (-$899,000)
Headquarters – Binational Agricultural Research and Development (-$524,000)
Headquarters – Cocoa, Coffee, and Alternative Crops Research (-$860,000)
Headquarters – Evaluation of Germplasm of Horticultural and Sugar Crops (-$83,000)
Headquarters – Staffing and Operation for National Clonal Repositories for Plant Germplasm (-$57,000)

MD, Beltsville – Enhancement of Blueberry, Strawberry, and Brambles through Molecular Approaches (-$925,000)
MS, Mississippi State – Development of Precision Agriculture Systems in Cotton Production (-$1,212,000)
MO, Columbia – Improving Irrigation Management for Humid and Sub-Humid Climates (-$150,000)
ND, Mandan – Integrated Agricultural Systems for the Northern Great Plains (-$100,000)
PR, Mayaguez – Characterization, Conversion, and Improvement of Common Bean Germplasm (-$347,000)
TX, Lubbock – Characterization and Enhancement of Plant Resistance to Water-Deficit and Thermal Stresses (-$2,513,000)
WA, Pullman – Increasing Inland Pacific Northwest Wheat Production Profitability (-$100,000)

Note: There is an adjustment (-$1,402,000) to the Annualized Continuing Resolution.

j) A decrease of $3,626,000 in ongoing extramural research projects.

Need for Change

Under ARS' Crop Production program, selected extramural research projects are proposed for termination, given that the research conducted is carried out by other institutions including universities and land grant institutions. The savings achieved from these reductions/terminations will be redirected to finance the higher priority agricultural research initiatives identified in the 2014 budget.

HI, Hilo – Sugarcane Research (-$433,000)
HI, Hilo – U.S. Pacific Basin Agricultural Research (-$113,000)
IA, Ames – Bioinformatics Institute for Model Plants (-$955,000)
IA, Ames – Michael Fields Agricultural Institute (-$176,000)
IN, West Lafayette – Genomics of Pest Resistance in Wheat (-$59,000)
MS, Stoneville – Kenaf and Medicinal Plants (-$501,000)
OH, Wooster – Greenhouse & Hydroponics Research (-$206,000)
OR, Corvallis – Hops (-$90,000)
OR, Corvallis – Viticulture Research (-$104,000)
MS, Poplarville – Small Fruits/Horticulture Research (-$829,000)
MS, Stoneville – Soybean Research in the South (-$160,000)

Food Safety

(4) An increase of $12,326,000 for Food Safety research ($106,860,000 available in 2013).

ARS' Food Safety research is designed to yield science-based knowledge on the safe production, storage, processing, and handling of plant and animal products, and on the detection and control of toxin producing and/or pathogenic bacteria and fungi, parasites, chemical contaminants, and plant toxins. All of ARS' research activities involve a high degree of cooperation and collaboration with USDA's Research, Education, and Economics agencies, as well as with Food Safety Inspection Service (FSIS), Animal and Plant Health Inspection Service (APHIS), Food and Drug Administration (FDA), Centers for Disease Control and Prevention (CDC), Department of Homeland Security (DHS), and the Environmental Protection Agency (EPA). The agency also collaborates in international research programs to address and resolve global food safety issues. Specific research efforts are directed toward developing new technologies that assist ARS stakeholders and customers, that is, regulatory agencies, industry, and commodity and consumer organizations, in detecting, identifying, and controlling foodborne diseases that affect human health.

ARS' research program is carried out at numerous locations where agency scientists frequently collaborate with researchers from other Federal/State governments, academia, and private industry. Their research supports USDA's Strategic Goal 4: Ensure that All of America's Children Have Access to Safe, Nutritious, and Balanced Meals.

ARS' base research programs respond and provide solutions to the Nation's most important agricultural problems. Much of the research the agency carries out, in its nationwide network of laboratories, is national or international in

scope. Base funding for the program will continue to finance the critical Food Safety research program. Continuing the base funding and limiting reductions is essential to ensuring the continued success of the program.

The funding change is requested for the following items:

a) An increase of $715,000 for pay costs which includes $105,000 for annualization of the fiscal year 2013 pay raise and $610,000 for the anticipated fiscal year 2014 pay raise.

Funding for pay costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Absorption of these costs reduces the number of scientists and support personnel essential for conducting the agency's research programs. If pay costs are not fully funded, ARS will be unable to fill critical positions and will have to reduce spending for much needed laboratory equipment, supplies, and other materials.

b) An increase of $6,000,000 to Improve Detection Technologies for Crops at High Risk of Infestation.

Need for Change

Grain crops, such as corn, cottonseed, and ground (peanuts) and tree nuts (pistachios, almonds) are subject to severe pre- and post-harvest contamination by mycotoxins, such as aflatoxins and fumonisins. A Centers for Disease Control and Prevention (CDC) report released in January 2013 reconfirmed that produce commodities (vegetables, fruits and nuts) are the largest source of foodborne illness in the U.S. Of foodborne illnesses associated with various commodities, 46 percent of all illnesses, 38 percent of hospitalizations, and 19 percent of deaths are related to contaminated produce. Intoxications from mycotoxins cause both acute sequelae, and chronic diseases (cancer) and death.

Produce associated outbreaks have now surpassed those from all other foods, including beef, poultry, and seafood. Equally troubling is that more people are affected since the average size of these outbreaks is much greater than previously observed. Produce outbreaks have been documented from both domestically grown and imported produce commodities during the past 15 years, although in the past five years domestically grown associated outbreaks associated with domestically grown produce have far surpassed outbreaks from imported produce.

In January 2013 under Section 105 of the Food Safety Modernization Act (FSMA) the Food and Drug Administration (FDA) released for public comment its proposed rule to establish science-based standards for growing, harvesting, packaging, and holding produce on domestic and foreign farms. The Act exempts certain farms and farmers who sell fresh produce at farmers markets. [The Act is the most sweeping reform of the Nation's food safety laws in more than 70 years.] The Act addresses preventing produce from becoming contaminated, rather than just responding to foodborne outbreaks after they have occurred.

The proposed FSMA rule specifically addresses certain elements relating to monitoring procedures; that is, the ability to rapidly and clearly detect, differentiate, and diagnose foodborne contaminants of concern in high risk produce. This requires a complete reevaluation of current detection technologies which are predicated on the ability to provide regulatory agencies, commodity organizations, and producers and processors the means to conduct these efforts.

Outcomes

The proposed increase will result in the development, validation, and subsequent implementation by regulatory agencies and industry of technologies that will provide the ability to identify and characterize foodborne contaminants in high risk produce related commodities and other crops at high risk of infestation. Rapid high throughput technologies for surveillance (monitoring), diagnosis (characterization) and elimination of contaminants at all sites in the farm-to-fork continuum will ensure the production, processing, and distribution of safer food, with the concomitant reduction of produce associated outbreaks of foodborne illness. Failure to reduce foodborne illnesses will lead to increased litigation, economic failure for the produce industry, and potentially forced regulations at the Federal level. Additionally, monitoring activities will provide an analytic insight into

understanding the link between human and animal foodborne pathogens. Using detection technologies will assist in filling the information gap relative to microbial ecology and epidemiology, and a systems approach to increasing the safety of the food supply.

Means to Achieve Change

- Improve detection methods for crops at high risk of infestation. ARS will:
  - Develop detection technologies for grain, in particular corn, nut, and fruit crops. Technologies will be developed for both pre- and post-harvest use using genomics of plant pathogens to identify unique characterization traits. Secondary metabolic volatiles unique for the growth of toxigenic strains of plant pathogens will be identified and these will be used to develop electronic, "real-time" sensors ($3,322,000).
  - Develop detection technologies for post-harvest use for fruit, vegetable, and nut crops. Development will focus on technologies that can be used to evaluate the effectiveness of processing interventions, such as infrared, energy efficient blanching, dehydration, pasteurization, peeling, microwave, solar, ultrasonic, and pulsed electric field processing in reducing pathogen load without reduction in nutritional quality. These technologies can be implemented as a monitor of food safety via process control. New or improved technologies will be developed to detect, identify, and characterize nitrogen containing plant metabolites and/or allergens from different foods to obtain information regarding their relative potency and their impact on product safety for the consumer ($2,678,000).

c) An increase of $5,239,000 to Develop Food Safety Intervention Technologies to Reduce Pathogens and Evaluate Alternatives to Antibiotics.

Need for Change

Food safety remains an essential priority in the U.S. and throughout the world. Despite continued food safety research and activities, foodborne outbreaks occur and changing pathogens emerge. Foodborne outbreaks remain as a major cause of morbidity, mortality, and economic devastation. In 2011, the CDC released new estimates that show 47.8 million illnesses and 3,037 deaths were caused by contaminated food consumed in the U.S. The current estimates strongly underscore the continued need for further research in food safety. Further, the full cost burden is estimated to be $152 billion per year. Recent activities within the World Health Organization and USDA's Economic Research Service are focusing on the burden of foodborne illness.

The research priorities relating to potential intervention and control strategies for foodborne pathogens have changed and become more focused. The implementation of the new FSMA in 2011 emphasizes the importance of intervention and prevention strategies in U.S. grown and imported foods. This Act is supported by consumers, public health advocates, and major industry groups as a necessary advancement for mandatory recall powers and national/international inspections. Although the Act addresses the FDA needs and issues, ARS can provide critical research to guide FDA's policies and guidelines, particularly in fresh produce and related commodities.

New and alternative post-harvest food processing technologies have the ability to inactivate microorganisms to varying degrees. However, some interventions result in adverse functional and/or sensory properties, significantly reducing food quality. Quality and safety are intimately associated, especially considering the change in consumer demands for more fresh (minimally processed) and natural food products. Many new technologies used alone are too costly, too energy expensive, and cannot guarantee safety to be of practical use. Therefore, research involving processing technologies that are unlikely to be implemented by industry will have limited or no value and impact.

The need for more fresh (minimally processed) and natural food products could be achieved in part by revisiting the under-utilized "hurdle effect" which in and of itself is a minimal processing technology that exploits interactions between preservation treatments. Intelligent application of hurdle technology could readily be combined with current and alternative processing technologies.

The reduction of antimicrobial resistance remains a high priority for agriculture, veterinary medicine, and public health. Research emphases within the food safety program include alternatives to antibiotics; the development and evaluation of intervention strategies against foodborne pathogens and their effects on resistance; and understanding

the mechanisms of resistance development, persistence, and transmission. These areas of emphasis address current action items in the Interagency Task Force on Antimicrobial Resistance Action Plan. Alternative approaches for the control and prevention of foodborne pathogens in food animals include vaccines (e.g., vaccine for *E .coli* in cattle and *Salmonella* spp., in swine and poultry), altered management practices, genetics, and immune modulators. The development and evaluation of novel products (such as pre- and pro-biotics, bacteriolysins, and natural, generally responded as safe ingredients) in food animals began as an intervention for the reduction of foodborne pathogens. These approaches may reduce the need for antibiotic use in food animals.

A major focus of ARS' research program is the role of management practices and the environment on the development, persistence, and transference of antimicrobial resistant organisms and resistance genes in food animals from production to processing. For example, producers are moving toward more free range and organic production, yet data are sparse on the effects of these production practices on foodborne pathogens and on antimicrobial resistance. Answers have remained elusive because of the complexity of risk factors and the population ecology that may increase the possibility of resistance. With the shift in production practices, this important research is timely.

Outcomes

Post-harvest operations of all sizes (i.e., large to very small) provide an opportunity to remove or inactivate pathogens and their toxins acquired during the production and processing phases. Pathogens may develop resistance to antimicrobials from traditional measures used for pathogen control. Successful technologies and strategies to eliminate, reduce, or suppress human pathogens are needed for foods and food types associated with foodborne illnesses, or at risk of becoming vehicles for human pathogens. Development of individual or combinations for new or innovative intervention technologies for minimal processing will be based on understanding their modes of action and effects on the microbial ecology of a food product. Inadequate suppression of spoilage could create an opportunity for human pathogen growth and toxin production. Interventions, control, and management strategies will be identified and evaluated to help facilitate better guidance and policy decisions by Federal regulatory agencies. This research will enable producers to implement changes that are cost effective and provide outcomes such as reduced risk of foodborne pathogen contamination.

The effects of the production practices (i.e., organic, free range, and conventional) will be evaluated on the prevalence of antimicrobial resistance pathogens and genes in food animals. The range of production practices also affects foodborne pathogen load. This information will provide critical information to FSIS on potential pre-harvest strategies, and on antimicrobial resistance for the FDA and industry.

Means to Achieve Change

- Identify and Evaluate Specific Intervention Strategies through the Food Production Chain ($4,076,000). ARS will:
  - Evaluate, develop, and validate through laboratory, pilot plant processing, and commercial processing facilities the effect of single and combinations of intervention technologies (multi-target approach) on pathogen reduction. Also, ensure that lethality/intervention treatments do not negatively impact product quality. In developing these post-harvest intervention options, ensure that they are viable for small and very small regulated plants.

- Antibiotic Resistance ($1,163,000). ARS will:
  - Evaluate the role of alternatives to antibiotics and the role of management practices and the environment on the prevalence of antimicrobial resistance and emerging pathogens in food animals.

d) An increase of $3,000,000 to Enhance Food Safety in the United States.

Need for Change

Consumption of fresh fruits and vegetables continues to increase in the United States. Ready-to-eat and fresh and/or minimally processed fruits and vegetables are ideally suited for a health conscious, fast paced society. Unfortunately, this trend towards a more healthy diet through the consumption of fresh cut produce has coincided

with an increased number foodborne illnesses and deaths associated with produce contaminated with enteric pathogens such as *E. coli* O157:H7, other Shiga-toxin producing *E. coli,* and *Salmonella*. The number of foodborne illnesses associated with fresh produce has increased dramatically, with over 80 major outbreaks since 1996. The Center for Science in the Public Interest now ranks leafy greens at the top of the "FDA Top Ten" riskiest foods. Of more concern, are that produce associated outbreaks have now surpassed those from all other foods, including beef, poultry, and seafood. Equally troubling is that more people are affected since the average size of these outbreaks is larger than outbreaks from other foods. Produce outbreaks have been documented from both domestically grown and imported produce during the past 10 years, although in the past five years domestically grown associated outbreaks have far surpassed imported produce.

Although produce related outbreaks have increased, illnesses due to animal products are still a major concern nationally and internationally. *E.coli* O157:H7 is a known human infectious agent globally; over 60,000 infections occur annually in the U.S. However, other non-O157 Shiga-Toxin-Escherichia coli (STECs) including O26, O45, O103, O111, O121, and O145 are responsible for over 100,000 cases of illness each year. This has led the USDA's Food Safety Inspection Service (FSIS) to now implement regulations that consider these non-O157 serogroups as adulterants in certain animal products. Pressure is also mounting on the FDA to consider these non-O157 serotypes as adulterants in their regulated products. The genetic predisposition of these various STECs with regards to virulence and pathogenicity is very difficult to determine. Indeed it has been suggested that the true number of illnesses caused by STECs could be grossly underestimated. For example, only about 4 percent of clinical laboratories routinely screen for non-O157 STEC. The mechanism of how STECs become virulent with increased pathogenicity for humans is a major international concern. Similarly, *Salmonella* is a pathogen of significant importance in worldwide animal production. An increased understanding of the mechanisms behind its survival and ability to cause disease are critical.

Determining the cause of the outbreaks is time consuming and the tracing of potential contaminated food is cumbersome. Many factors may play a role such as an aging population that is susceptible to foodborne illness, an increase in international trade, a more complex supply chain, changes in consumption habits, and travel and immigration. More critical, however, are the need for improved surveillance and detection of foodborne illness, improvements in epidemiological investigation, and increasingly better methods to identify pathogens. The recent *E.coli* O104:H4 and O26 incidents in Europe, other STECs, *Listeria*, and *Salmonella* incidents in the United States provide examples of the complexity of foodborne outbreaks and the pathogens that cause them. The outbreaks highlight the need for an alternative approach, as it was determined, particularly for the *E. coli* O104 that the pathogen evolved through genetic exchange leading to a chimeric genome that was far more pathogenic than either of the parent organisms. Without the use of next generation sequencing technologies, the cause of the *E. coli* O104 and O26, and *Salmonella* Saintpaul outbreaks would never have been determined.

Genetic exchange constantly occurs in bacterial pathogens resulting in extensive genetic flexibility that enables strain specific adaptation, persistence, and re-emergence or antimicrobial resistance in the environment, animals, and foods. Having the ability to rapidly and clearly detect, differentiate, and diagnose pathogens requires complete re-evaluation of current detection technologies which are predicated on an understanding of genome evolution. Understanding how new pathogens develop requires the ability to monitor changes in real time so that decisions can be implemented rapidly and effectively.

This systematic effort in collecting and evaluating pathogens and genes throughout the produce and animal related production system requires collaborative efforts that are representative of domestic and international food production and multi-disciplinary approaches from participating microbiologists, epidemiologists, molecular biologists, and food scientists.

Outcomes

The proposed increase will enable identification and characterization of strain differences, virulence, pathogenicity, and host-pathogen interactions for foodborne pathogens by using molecular data with epidemiologic data, providing an analytic insight into strain evolution both domestically and internationally. The availability of data from microbial sequencing will enable the development of rapid high throughput technologies for surveillance (monitoring) and diagnosis (characterization) of pathogens at all sites in the farm-to-fork continuum, including the

use of soil amendments. Understanding how pathogen adaptation, virulence, and pathogenicity can be altered will allow the development of improved or alternative mitigation and intervention strategies. Using genetic technologies will assist in filling the information gap relative to microbial ecology and epidemiology, and provide a systems approach to increasing the safety of the food supply. This same approach will provide important information on the evolution of persistence and transmission in the food supply chain. Knowing where pathogens persist in the continuum and their genetic predisposition will provide data for risk modeling, the development of improved risk assessments, and better Good Agricultural Practices and Good Manufacturing Practices (GAP/GMPs) and regulations. Sequence data will be publically available ensuring that regulatory agencies and industry nationally and internationally have the ability for faster and better approaches.

This food safety initiative will be a collaborative effort among academia, industry, and other Federal partners (i.e., FSIS and FDA). It reaches beyond U.S. stakeholders; it will include several international government agencies, organizations, and universities. The outcome will have international and national impact.

Means to Achieve Change

- Develop/utilize emerging next generation sequencing technologies and sophisticated molecular methods for identifying and characterizing strain differences, virulence, and pathogenicity mechanisms, and host-pathogen interactions for fresh produce and animal related foodborne pathogens. These molecular data with epidemiologic data could provide an analytic insight into strain evolution, and an understanding of the link between foodborne pathogens both internationally and domestically ($3,000,000). ARS will:
  - Develop and implement sequencing and genomic comparisons of high priority foodborne pathogens (specifically *E. coli* STECs and *Salmonella*) and maintain extensive collections of molecular and matched epidemiologic data for collaborations.

e) An increase of $1,500,000 to Control Antimicrobial Resistance in Foodborne Pathogens in the United States.

Need for Change

There is continuing concern over antimicrobial resistance and its impact on animal and human health. Research is focused on how resistance evolves, persists, and how resistance in the animal population may be transmitted to humans. Foodborne pathogens that are resistant or carry resistance genes have been identified for more research. Research is needed in developing pre-harvest and post-harvest strategies in food animals that decrease antimicrobial resistance and its potential persistence and transmission to the environment and humans. Developing and evaluating alternatives to antibiotics and their impact on resistance and food safety is critical. The emergence of the use of next generation sequencing technologies and other genomic methods provide researchers with important research tools. For example, resistant organisms may emerge because of clonal or genetic dissemination. Having the ability to rapidly and clearly detect, differentiate, and diagnose resistant foodborne pathogens requires a complete reevaluation of current detection technologies which are predicated on an understanding of genome evolution.

Outcomes

Using genetic technologies will help identify and characterize strain differences and the transfer of resistance genes, whether they alter virulence and pathogenicity and determine the effect of resistance on host-pathogen interactions. This information will help in identifying alternatives to antibiotics, such as novel strategies to change immune systems, prebiotics, and changes in production and management practices. Filling in the information gap related to microbial ecology and epidemiology, and resistance will provide new alternatives to antibiotic use. Understanding how pathogen adaptation, virulence, and pathogenicity can be altered will enable the development of improved or alternative mitigation and intervention strategies. In addition, this initiative will enhance and strengthen ongoing collaborative efforts among USDA, FDA, industry, and academia by leveraging current animal sampling projects to collect more effectively strain and sequencing data for antimicrobial resistance. The outcome of this initiative will have international and national impact.

Means to Achieve Change

- Develop/utilize emerging next generation sequencing technologies and sophisticated molecular methods for identifying and characterizing strain differences, virulence, and pathogenicity mechanisms, and host-pathogen interactions for foodborne pathogens. These molecular data with epidemiologic data could provide an analytic insight into strain evolution and understanding the link between human and animal foodborne pathogens both internationally and domestically ($1,500,000). ARS will:
  - Develop and implement sequencing, genomic, and molecular analysis, and sensitivity testing through government, industry, and university collaborative projects for evaluating the evolution, transfer, and persistence of antimicrobial resistance in foodborne pathogens with the outcome of identifying intervention or control strategies.

f) A decrease of $4,128,000 in ongoing extramural research projects.

Need for Change

Under ARS' Food Safety program, selected extramural research projects are proposed for termination, given that the research conducted is carried out by other institutions including universities and land grant institutions. The savings achieved from these reductions/terminations will be redirected to finance the higher priority agricultural research initiatives identified in the 2014 budget.

KY, Bowling Green – Waste Management (-$289,000)
LA, New Orleans – Hyperspectral Imaging Technique (-$494,000)
MS. Stoneville – Center for Food Safety and Postharvest Technology (-$1,012,000)
PA, Wyndmoor – Food Safety Engineering (-$1,683,000)

Note: There is an adjustment (-$650,000) to the Annualized Continuing Resolution.

Livestock Protection

(5) An increase of $3,674,000 for Livestock Protection research ($76,632,000 available in 2013).

ARS's Livestock Protection research program is directed at protecting and ensuring the safety of the Nation's agriculture and food supply through improved disease detection, prevention, control, and treatment. Basic and applied research approaches are used to solve animal health problems of high national priority. Emphasis is given to methods and procedures to control animal diseases. The research programs have ten strategic objectives: (1) establish ARS laboratories into a fluid, highly effective research network to maximize use of core competencies and resources; (2) access specialized high containment facilities to study zoonotic and emerging diseases; (3) develop an integrated animal and microbial genomics research program; (4) establish centers of excellence in animal immunology; (5) launch a biotherapeutic discovery program providing alternatives to animal drugs; (6) build a technology driven vaccine and diagnostic discovery research program; (7) develop core competencies in field epidemiology and predictive biology; (8) develop internationally recognized expert collaborative research laboratories; (9) establish a best-in-class training center for our Nation's veterinarians and scientists; and (10) develop a model technology transfer program to achieve the full impact of ARS research discoveries. ARS animal research program includes eight core components: (1) biodefense research, (2) animal genomics and immunology, (3) zoonotic diseases, (4) respiratory disease, (5) reproductive and neonatal diseases, (6) enteric diseases, (7) parasitic diseases, and (8) transmissible spongiform encephalopathies.

ARS' research program is carried out at numerous locations where agency scientists frequently collaborate with researchers from other Federal/State governments, academia, and private industry. Their research supports USDA's Strategic Goal 4: Ensure that All of America's Children Have Access to Safe, Nutritious, and Balanced Meals.

ARS' base research programs respond and provide solutions to the Nation's most important agricultural problems. Much of the research the agency carries out, in its nationwide network of laboratories, is national or international in

scope. Base funding for the program will continue to finance the critical Livestock Protection research program. Continuing the base funding and limiting reductions is essential to ensuring the continued success of the program.

The funding change is requested for the following items:

a) An increase of $416,000 for pay costs which includes $61,000 for annualization of the fiscal year 2013 pay raise and $355,000 for the anticipated fiscal year 2014 pay raise.

Funding for pay costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Absorption of these costs reduces the number of scientists and support personnel essential for conducting the agency's research programs. If pay costs are not fully funded, ARS will be unable to fill critical positions and will have to reduce spending for much needed laboratory equipment, supplies, and other materials.

b) An increase of $4,121,000 to Enhance Animal Health in the United States.

Need for Change

Increasing world food consumption and demand are major threats to global stability. Population increases over the next 40 years are projected to occur most rapidly in regions of the world that are currently the most food stressed. One of the keys to meeting the demands of the growing population will be ensuring the health of livestock and preventing public health risks, such as antibiotic resistance or the spread of zoonotic diseases.

Concerns over antibiotic resistance are driving policies to restrict the use of antibiotics on animal farms worldwide. The availability of alternative strategies to prevent and treat animal diseases on the farm will directly impact global food security and global health. Consequently, there is a growing concern that the potential development of antibiotic resistant strains within food animal production facilities and among foodborne bacteria could seriously compromise current medical interventions and public health. Thus, continued reliance on antibiotics in animal production may result in new restrictions, including the international trade of food animal products.

The restriction of antibiotics is not limited to countries with intensive animal production system as these restrictions may also adversely affect the production of livestock and poultry in developing countries. There is also increasing scientific evidence that implicates certain antibiotics with disrupting the normal flora of the gut, yielding negative consequences on the innate immune system, disease resistance, and health. As we move into the 21st century and the demands for animal food products increase to meet the nutritional needs of a growing world population, alternative strategies to prevent and treat animal diseases is a global issue and a critical component of efforts to alleviate poverty and world hunger.

Outcomes

With the proposed funding increase, novel biocontrol approaches that employ strategies specifically geared to reduce or eliminate drug resistance development will be developed for reducing bacterial pathogens (and where applicable viral and parasitic pathogens) in food animal production.

Means to Achieve Change

- Develop Countermeasures and Alternatives to Antibiotics to Prevent and Treat Pathogens Affecting Poultry and Emerging Diseases Affecting Farm Animals ($4,121,000). ARS will:
  - Enhance research on viruses affecting U.S. poultry production, i.e., tumor viruses, and the detection and elimination of emerging enteric viruses.
  - Enhance research on exotic diseases of poultry to better understand the immunogenetics of host-pathogen interactions.
  - Develop biorational technologies/techniques to control ants and floodwater mosquitoes.
  - Develop detection methods and countermeasures to foreign animal diseases.

c) An increase of $1,751,000 to Improve Agricultural Sustainability.

Note: See the "Crop Production" section.

d) An increase of $1,500,000 to Develop Alternatives to Antibiotics in Farm Animals to Prevent and Control Animal Diseases, Reduce Antibiotic Resistance, and Enhance Livestock Production.

Need for Change

There is increasing concern that the development of bacterial pathogen strains resistant to antibiotics used for human health may be traceable, in part, to the sub-therapeutic use of antibiotics in animal feed as growth promoters. Some countries such as those in the European Union (EU) have discontinued the use of antibiotic growth promoters (AGPs), and some Asian countries are planning to follow the EU in banning AGPs. These restrictions are not limited to developed countries with intensive animal production systems. They are also being considered in developing countries where people are dependent on the production of livestock and poultry for their livelihood. It is clear that the continued reliance on antibiotics in animal production will inevitably result in further restrictions, including the international trade of food animal products. There is also increasing scientific evidence that implicates certain antibiotics with disrupting the normal flora of the gut of animals and humans, yielding negative consequences to the immune system, disease resistance, and health. As we move into the 21st century and the demands for animal food products increase to meet the nutritional needs of a growing world population, alternatives to antibiotics to prevent and control animal diseases is a global issue and a critical component of efforts to alleviate poverty and world hunger.

Eliminating the use of antibiotics in food animal production may have adverse consequences on the production, health, and welfare of animals. Although the mechanisms by which antibiotics enhance animal production and health have not been fully investigated, scientific advances resulting from new research tools, such as metagenomics and other genome enabled technologies, are providing insights on the ecology of the gut microbiome, host-pathogen interactions, immune development, nutrition, and health. Development and enhancement of large metagenomics data sets is needed for microorganisms associated with feces and soil in livestock and poultry operations. These data sets will be part of the description of the animal agroecosystem, providing important inputs into how best to manage animals leading to discoveries of alternatives to antibiotics. By linking the data to large data sets on the conditions of individual animals determined by physiological and genomic measurement, further improvements will be made in management of animals for health.

Thorough analysis of the microflora through metagenomics will be associated with metagenomics of those inputs and with physiological and immunological measurements on the animals. Results should suggest many ways to manage animals for better health, and develop alternatives to antibiotics such as prebiotics, probiotics, bacteriophage, bioactive phytochemicals, essential oils, lytic enzymes, host antimicrobial peptides, bacteriocins, immune enhancers, and vaccines. Metagenomics and other genome enabled research tools provide a rapid and reliable path toward major improvements in feed efficiency, development of alternatives to antibiotics, and animal health.

Outcomes

The proposed increase will result in mapping the gut microbiome of food animals using an integrative approach to large data analysis that will provide a greater understanding of the function and ecology of gut microorganisms. The proposed increase will also result in the development of alternatives to antibiotics:

- With defined mechanisms of action to enhance feed conversion, weight gain, and other desirable production parameters.
- That do not disrupt the normal flora of the gut of food animals but rather enhance the immune system, disease resistance, and health.
- That can treat as broad a range of target pathogens as possible that are refractory to resistance development.
- That are synergistic with existing antibiotics as a means to enhance or prolong their useable lifetime.
- That also function as immune enhancers.

Means to Achieve Change

- Develop alternatives to antibiotics in farm animals to prevent and control animal diseases, reduce antibiotic resistance, and enhance livestock production ($1,500,000). ARS will:
  - Map the gut microbiomes of farm animals and provide large data sets aimed at understanding how microorganisms function and are interrelated.
  - Identify novel alternatives to antibiotics to prevent and control enteric diseases of poultry, enhance the host immune response to pathogenic organisms, and reduce the need for antibiotics.
  - Develop novel biological products to enhance host immune responses to foreign animal disease pathogens by analyses of microbial and host genomic and gene expression data to prevent the shed and spread of these pathogens during a disease outbreak.
  - Identify novel alternatives to antibiotics to prevent and control bacterial diseases of swine, enhance the host immune response to pathogenic organisms, and reduce the need for antibiotics.

e) An increase of $1,000,000 for the Development of a Veterinary Insect Genomics Information Center.

Need for Change

The Veterinary Insect Genomics Information Center will focus on collections-based research, with partners at the Walter Reed Army Institute of Research (WRAIR), the CDC, and the Smithsonian Institution. By taking advantage of new approaches to analysis of big data sets, the Center will be able to rapidly generate potential solutions to many kinds of problems. The strong connection between genomics and taxonomy will be examined systematically in order to understand phenotypic relationships between arthropods that transmit pathogens or damage food animals. Geographical distribution of these arthropods, environmental overlays, niche models, and genomics of associated microorganisms will also be integrated in studies at the Center. Relationships between data sets will be developed to answer practical problems related to climate change, energy efficiency of agriculture, invasive species, and risks to production. One of the major anticipated outcomes will be precise risk assessment during long time frames, developed in cooperation with other ARS elements dedicated to management of large data sets. The Center is needed to assemble large data sets that address the relationships and biology of many kinds of pests, leading to practical solutions of existing problems and the prevention of future ones.

The Veterinary Insect Genomics Information Center would take advantage of big data management in other programs, especially the EntBase program proposed under ARS'Crop Production and Protection program. The methods, connections to large scale computing, and data sets developed by EntBase could be used directly by the Center. Reciprocally, the emphasis on geographical distribution, climate modeling, and integrated pest management in the Center should help EntBase find practical applications for its genomic efforts.

Outcomes

Development of a Veterinary Insect Genomics Information Center will:
- Enhance ARS' ability to prevent the introduction of invasive species based on the ability to predict their movement in response to environmental factors.
- Result in more precise, less damaging, and cheaper methods for pest control on food animals and would result in safer food supplies by limiting movement of pathogens.
- Result in improved control of biting pests that limit childhood activity outdoors, therefore contributing toward a reduction of childhood obesity.
- Result in increased impact and productivity from collaboration with ARS' Crop Production and Protection program, and would result in improved human health by application of methods discovered through agricultural research.
- Improve agricultural adaptation to climate change based on accurate prediction and lower energy inputs to food animal production.
- Result in greater synergy between laboratories, more thorough utilization of data, and increased scientific innovation through new kinds of coordination of large data sets. It will be a strong force for the prevention of duplicated scientific effort.

Means to Achieve Change

- Development of a Veterinary Insect Genomics Information Center ($1,000,000). ARS will:
  - Develop bioinformatics tools and support for genome databases to better understand taxonomic relationships, disease transmission, and geographical distribution of insects.
  - Partner with other ARS labs (especially EntBase), the WRAIR, and the Smithsonian Institution to integrate data into a common resource.
  - Develop relationships between existing and new complex, comprehensive data sets to answer practical problems related to climate change, energy efficiency of agriculture, invasive species, and risks to production.

f) A decrease of $4,893,000 from ongoing research projects to support higher priority research initiatives.

The 2014 budget recommends selected high priority research initiatives which address the Administration's science and technology priorities and the Department's Strategic Goals. To finance these initiatives, within limited resources, some existing projects are proposed for reduction or termination given that they are: (1) mature where the research objectives have been mainly accomplished; (2) duplicative or can be accomplished more effectively elsewhere in ARS; (3) marginal or below threshold funding for program viability or sustainability; (4) conducted in substandard or inadequate infrastructure and future costs are prohibitive; (5) lacking a critical mass of scientists/support personnel for an effective program; or (6) are carried out by other research institutions. The savings achieved from these reductions/terminations will be redirected to finance the higher priority agricultural research initiatives identified in the 2014 budget, and will improve program and operational efficiencies.

Headquarters - Emerging Animal Diseases that Exist Offshore (-$215,000)
MI, East Lansing - Genetic and Biological Determinants of Avian Tumor Virus Susceptibility (-$2,188,000)
MS, Stoneville - Biting and Stinging Pests: Ecology and Biologically-Based Control (-$273,000)
TX, Kerrville – Mining the Genome of Rhipicephalus Microplus to Develop Novel Control Technology and Vaccines (-$1,751,000)

Note: There is an adjustment (-$466,000) to the Annualized Continuing Resolution.

g) A decrease of $221,000 in ongoing extramural research projects.

Need for Change

Under ARS' Livestock Protection program, selected extramural research projects are proposed for termination, given that the research conducted is carried out by other institutions including universities and land grant institutions. The savings achieved from these reductions/terminations will be redirected to finance the higher priority agricultural research initiatives identified in the 2014 budget.

MS, Stoneville – Red Imported Fire Ants (-$221,000)

Crop Protection

(6) A decrease of $15,525,000 for Crop Protection research ($194,996,000 available in 2013).

ARS' Crop Protection research program is directed toward epidemiological investigations to understand pest and disease transmission mechanisms, and to identify and apply new technologies that increase our understanding of virulence factors and host defense mechanisms. The agency's research priorities include: (1) identification of genes that convey virulence traits in pathogens and pests; (2) factors that modulate infectivity, gene functions, and mechanisms; (3) genetic profiles that provide specified levels of disease and insect resistance under field conditions; and (4) mechanisms that facilitate the spread of pests and infectious diseases. ARS is developing new knowledge and integrated pest management approaches to control pest and disease outbreaks as they occur. Its research will improve the knowledge and understanding of the ecology, physiology, epidemiology, and molecular biology of

emerging diseases and pests. This knowledge will be incorporated into pest risk assessments and management strategies to minimize chemical inputs and increase production. Strategies and approaches will be available to producers to control emerging crop diseases and pest outbreaks.

ARS' research program is carried out at numerous locations where agency scientists frequently collaborate with researchers from other Federal/State governments, academia, and private industry. Their research supports USDA's Strategic Goal 4: Ensure that All of America's Children Have Access to Safe, Nutritious, and Balanced Meals.

ARS' base research programs respond and provide solutions to the Nation's most important agricultural problems. Much of the research the agency carries out, in its nationwide network of laboratories, is national or international in scope. Base funding for the program will continue to finance the critical Crop Protection research program. Continuing the base funding and limiting reductions is essential to ensuring the continued success of the program.

The funding change is requested for the following items:

a) An increase of $1,060,000 for pay costs which includes $156,000 for annualization of the fiscal year 2013 pay raise and $904,000 for the anticipated fiscal year 2014 pay raise.

Funding for pay costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Absorption of these costs reduces the number of scientists and support personnel essential for conducting the agency's research programs. If pay costs are not fully funded, ARS will be unable to fill critical positions and will have to reduce spending for much needed laboratory equipment, supplies, and other materials.

b) An increase of $7,600,000 for Soil Microbial Ecology and Plant Disease Management.

Need for Change

Management of plant pathogenic microbes and nematodes that live in the soil is critical to the production of agronomic and horticultural crops. For more than 50 years, most diseases caused by these pathogens have been managed primarily through fumigation of soil with chemical biocides such as methyl bromide. The use of methyl bromide for soil fumigation has been banned (with limited exceptions) by international treaty, and additional fumigants and synthetic pesticides are under greater regulatory scrutiny. With the increased use of alternatives to methyl bromide, new soilborne disease problems have emerged.

The soil is an extremely complex environment with both biotic and abiotic components. Abiotic components include chemical and physical factors such as soil pH, nutrients, and texture. These often vary within a given field, and there is enormous variation in soils within the United States. The soil is also home to an abundance of microbes and nematodes. Most of these microbes live saprophytically, breaking down organic matter and thus contributing to nutrient cycling. Some microbes are beneficial to plants, including nitrogen fixing bacteria, mycorrhizae, and biocontrol microbes. Other microbes cause plant disease. In nature, disease is the exception, and most plants are not diseased. Disease management techniques such as crop rotation rely on maintenance of a stable microbial community that is conducive to plant production. Similarly, since the benefits of soil solarization last more than one season, the success of solarization has been attributed to soil microbes. While some soil dwelling nematodes are plant pathogens, others are saprophytic and some benefit plant growth by feeding on other nematodes.

Until recently, research in soil microbiology has been limited by techniques that could not evaluate roles of the large portion of the soil microflora that cannot be cultured on artificial media. New molecular tools and metagenomics greatly increase the ability to precisely quantify the size and ecological role of populations of nonculturable microbes, and their physiological functions, and allow precise tracking of specific microbes in soil. In addition, increased computational capacity and improved methodology facilitate dissection of the multitude of complex interactions among microbial populations, as well as their interactions with plants. The resulting holistic view of soil microbial ecology should enable us to foster stable microbial communities resistant to the establishment or persistence of soilborne plant pathogens.

Outcomes

The proposed research will enhance plant health by providing additional management tools for soilborne plant pathogenic microbes and nematodes. Increased knowledge of soil microbial ecology will be exploited to provide a soil environment optimized for plant growth and production. The means to create and maintain communities of soil microbes unfavorable to the establishment or persistence of soilborne plant pathogens and plant pathogenic nematodes will be established in a wide variety of soil types. Site specific knowledge of microbial communities in localized soil type, or even areas of a single field, can be combined with new technologies for site specific application technologies.

Means to Achieve Change

- Soil Microbial Ecology ($7,600,000). ARS will:
  - Determine mechanisms of microbial biocontrol to increase the effectiveness and consistency of biocontrol of soilborne pathogens in a variety of soils and cropping systems.
  - Identify and exploit mechanisms by which plant disease suppressing microbes become established in a variety of soils.
  - Identify physical, chemical, and biological factors that drive soil ecosystem changes and use this information to optimize microbial community stability that is unfavorable to disease development.
  - Identify and exploit soil microbes and their interactions to impair activities of soilborne plant pathogenic nematodes in a variety of soils and cropping systems.
  - Develop site specific soilborne disease management strategies.

c) An increase of $2,978,000 to Enhance Control of Invasive Pests in the United States.

Need for Change

Invasive weeds, arthropods, and plant pathogens that threaten our food, fiber, and natural ecosystems continue to increase by species and distribution as world trade and travel continue to expand. Economic losses of agricultural crops and natural ecosystems due to these pests are considerable with estimates in the tens of billions of dollars each year to agriculture, landscapes, and forests in the United States (e.g., cost estimates for crop pests, $14 billion; imported fire ants, $1 billion; Gypsy moths, $1 billion; lawn/garden pests, $1.5 billion; forest pests including the Asian Longhorned beetle and emerald ashborer, $2 billion; Asian tiger mosquito, $1 billion, etc.). Pest control continues to depend heavily on chemical controls. For instance, in 2007 over 850 million pounds of pesticides (i.e., herbicides, insecticides, fungicides, and nematicides) were applied to agricultural crops to protect them from pests and pathogens. In some major cropping systems, pest management strategies may rely on a single chemistry to control a given pest group, which has resulted in the development of pesticide resistance. There is a need to develop an integrated pest management (IPM) approach that uses multiple tactics as appropriate to the specific pest or pest complex. Such efficacious protocols would encourage adoption by producers and land managers.

For invasive weeds, the use of repeated chemical controls within a given management system may have unintended consequences on the sustainability of that system. For example, an overdependence on glyphosate in glyphosate resistant cropping systems has resulted in the development of glyphosate resistant weeds that can be highly invasive. Nontarget effects may be altering soil microbial communities that could have negative impacts on crop development and productivity. Such combined effects may significantly reduce the benefits and sustainability of modern cropping systems and make them more vulnerable to plant invasions. Consequently, a better understanding of the impacts of the long-term use of one or a limited number of herbicides to control weeds under a given cropping system is needed to identify and mitigate any unanticipated deleterious effects on their sustainability.

Invasive insect management has become particularly challenging because of the large number of recent invasions by insects, such as: the brown marmorated stink bug; glass-winged sharpshooter vector of Pierce's disease; Asian citrus psyllid vector of citrus greening; Asian tiger mosquito (which bites farmers and gardeners during daylight); Asian longhorned beetle and emerald ash borer beetle (pests of nursery stock and forests); spotted wing Drosophila fruit fly and European grape berry moth (pests of orchards); and bed bugs (which have become an emergent pest due to development of insecticide resistance). A more fundamental approach for managing all such pests is needed.

Fortunately, new tools are being developed that can be used to provide clues to control many of these pests, with approaches delivered through host resistance, new therapeutics such as RNAi, or biological control. A key new source of information for this effort will be the ARS led international "i5k project" which will sequence the genomes of 5,000 insects. This promises to provide basic genetic information that can be used by a broad spectrum of researchers who, with comparative genomics approaches, can identify genes and gene regulatory systems that can be studied to target insect vulnerabilities.

For invasive plant pathogens, rapid and accurate diagnostic tests and the means to cultivate "fastidious microbes" (i.e., those that require special conditions to grow in the laboratory) that cannot currently be cultured are needed to help curtail the spread of invasive plant pathogenic bacteria and fungi. Genome analysis of such pathogens can provide information to develop diagnostics used in international trade of agricultural products, as well as the regulated movement of quarantined agricultural commodities within the United States. Fundamental information is needed on emerging plant pathogens for accurate risk assessment and effective rapid response control methods.

Outcomes

The proposed research will lead to pest management approaches that will use knowledge-based intensive strategies on physiological and ecological insights to reduce or replace chemical-based strategies.

For weeds, the proposed research will ensure the sustainability and productivity of modern cropping systems and their resilience against weed invasions, and will provide insight into weed physiology and microbial ecology necessary for more effective weed management.

For insects, the major benefits of the research will be improved, environmentally safe control of key pests, protection of beneficial insects such as the honey bee, and more cost effective use of biological control agents. Comparative genomics approaches will lead to emergent advances such as improved targets for pesticide discovery, including interruption of pest immune pathways, and ease in finding RNAi targets. Novel advances will likely include control of vectored plant diseases which are the most difficult to control. Transformative advances will likely include better understanding of insect brain function and behavior, and molecular-based systems for beneficial insect enhancement.

For plant pathogens, the proposed research will provide improved prevention and early detection, and rapid response methods for potential or newly emerging invasive microorganisms.

Means to Achieve Change

- Strengthen Research to Develop Technologies to Protect Crops from Invasive Species ($1,867,000). ARS will:
  - Develop effective control methods for key invasive arthropod pests of row crops, fruits, and vegetables that utilize molecular and state-of-the-art technologies.
  - Disrupt insect vectored plant diseases caused by invasive insects through the development of new technologies that reduce arthropod survival and/or their ability to transmit disease.
  - Expand the capacity of the Overseas Biological Control Laboratories to discover, assess, and export agents of invasive species that can be integrated into agricultural systems.
  - Develop novel weed management solutions based on an expanded knowledge of the biochemical and physiological processes critical in the development and reproduction of invasive and weedy plants.
  - Develop biologically-based invasive plant control strategies that are cost effective, safe for the environment and people, and able to be maintained permanently as a useful component of IPM and as a standalone strategies.

- Strengthen the Nation's Capacity to Protect Against New and Potential Pest Invasions ($1,111,000). ARS will:
  - Develop technologies to prevent new species invasions that could reduce crop production and profitability or disrupt our natural resources.
  - Develop methodologies to improve early detection and rapid response to newly emerging species invasions.

d) An increase of $2,884,000 to Enhance Protection of Small Fruit and Nursery Crops, and Potatoes and Wheat from Disease in the United States.

Need for Change

Plant diseases cause billions of dollars in economic losses each year to agriculture, landscape, and forests in the United States. These diseases reduce yields, lower product quality or shelf life, decrease aesthetic or nutritional value, and sometimes contaminate food and feed with toxic compounds. Control of plant diseases is essential for providing an adequate and consistent supply of food, feed, fiber, and aesthetics. In addition, the presence of plant diseases can halt international trade. Strategies for managing plant diseases involve a coordinated approach that includes development and use of disease resistant varieties, modified cultural practices, pesticide development and application technologies, and integrated management strategies that include biological controls. New resistant crop varieties and new management strategies are constantly needed because pathogens continually develop new variants to overcome current resistance genes or management strategies. Further, new exotic pathogens are introduced through travel, trade, or major weather events, such as hurricanes.

Small fruit and nursery crops currently face significant losses from endemic pathogens including powdery mildew, grey mold, and several species of *Phytophthora*, as well as a relatively new disease, sudden oak death, caused by *Phytophthora ramorum*. The sudden oak death pathogen is of particular concern because it can attack an unusually large number of plants in unrelated families. Also, of concern is *Botrytis*, a fungal disease that assaults wine grapes.

Potatoes are an important food staple globally. Economic losses due to plant pathogens occur in the field, or can become evident after harvest and are caused by a wide variety of organisms including fungi, fungal like organisms such as the late blight pathogen, bacteria, viruses, and nematodes. Because potatoes are grown in many different geographical areas, varieties resistant to disease must be developed that are adapted to local growing conditions. National coordination of developing disease resistant potatoes is needed. For some emerging diseases where resistance is not yet available, alternative disease management methods are needed.

Wheat is the primary grain grown in the United States which is grown in 42 States, with half for domestic use and half exported. Recently a resurgence of stripe rust, also called yellow rust, has caused economic losses in wheat. The resurgence of this disease has been correlated with unusually mild winters and susceptible wheat varieties. Wheat varieties adapted to local growing conditions that are resistant to the stripe rust pathogen are needed.

Outcomes

The proposed research will lead to improved control of diseases attacking small fruit and nursery crops, and potatoes and wheat in the United States using multiple coordinated approaches.

Through the proposed research, ARS will develop new crop plants resistant to plant diseases or alternative disease management systems will be developed when resistant varieties are not available. Resistant varieties will provide continual protection from plant diseases (such as *Botrytis*) and greatly reduce the need for synthetic pesticides.

Means to Achieve Change

- Improve Potato Production though Resistant Varieties and New Disease Management Techniques ($1,454,000). ARS will:
  - Discover and deploy genes for resistance to economically important potato diseases including late blight and common scab.
  - Develop management strategies for emerging and re-emerging potato diseases.

- Improve Disease Management of Small Fruits and Nursery Crops ($1,213,000). ARS will:
  - Develop new pathogen detection methods to optimize timing of the application of management tools.
  - Improve management of the *Phytophthora* species in nursery environments.
  - Improve the forecasting of grape powdery mildew disease.

- Improve Management of Stripe Rust of Wheat with Resistant Varieties ($217,000). ARS will:
  - Discover genes for resistance to stripe rust in wheat and introgress these into wheat adapted for local conditions.

e) An increase of $1,750,000 to Enhance Fungal Disease Protection in Beans, Sunflowers, and Other Crops.

Need for Change

Sclerotinia is a serious fungal disease that affects most broad leaf plants, including canola, dry edible beans, soybeans, sunflowers, peas, lentils, and chickpeas. The collective annual losses from *Sclerotinia* for the crops listed have been as high as $252 million, including $100 million for sunflowers; $70 million for soybeans; $46 million for dry edible beans; $24 million for canola; and $12 million for pulse crops. The disease is very difficult to control or minimize. The fungus generates hard, black bodies called sclerotia that can remain in the soil for many years. Under the right weather conditions, the sclerotia produce spores that spread for miles and can infect a susceptible crop. A coordinated research strategy is needed to minimize the devastating effects of *Sclerotinia*, which causes serious economic losses by negatively impacting crop quality and yields.

Outcomes

The proposed research will be used to enhance fungal disease protection in beans, sunflowers, and other crops. Comprehensive genomics/bioinformatics centered germplasm improvement efforts will target *Sclerotinia* and other important fungal pathogens.

Genomics/bioinformatics research is a serious bottleneck to the development of marker assisted selection strategies for improving germplasm in sunflower, canola, and pulse and dry beans. Stakeholders have long identified the rapid development of plant germplasm with resistance to devastating fungal diseases as a critical need for their industry. This change will result in plant genomic/bioinformatic approaches that will enhance the production of these crops.

Means to Achieve Change

- Enhance Fungal Disease Protection in Beans, Sunflowers, and Other Crops ($1,750,000). ARS will:
  - Develop crop germplasm resources and improve genetics.
  - Improve pathogen biology and study mechanisms of disease resistance.
  - Develop crop genome analysis and genomic and bioinformatic tools.
  - Study disease management and pathogen epidemiology.

f) An increase of $1,000,000 to Reduce Insect Damage through Better Data Management.

Need for Change

Insect and related arthropod pests, and the diseases they carry threaten our food, fiber, and natural ecosystems as well as the health of the nation's pollinators for our nation's crops. Losses to agriculture are considerable with estimates of tens of billions of dollars each year. The i5k project (to sequence the genomes of 5,000 insect and related arthropod species over the next five years) is generating large amounts of insect sequence data. These data need to be managed and analyzed in order to develop new strategies to reduce insect caused losses to agriculture.

Outcomes

The proposed research will enable researchers to access and exploit new insect genome sequence information. This will help in the identification of vulnerable regions in the insect genome that can be targeted for novel and improved control strategies as well as the development of management products and techniques. Applications of this insect data analysis will include better models for dealing with insecticide resistance; better understanding of the transmission of disease; and the development of new and more environmentally friendly pesticides.

This initiative supports the development of "EntBase," a discovery environment and support system for describing insect and other arthropod genomes and linking genomic and gene-centric (RNA) data to metadata that can be used to control pests and aid in the survival of beneficial insects. EntBase also directly supports and benefits from development of a Veterinary Insect Genomics Information Center, as described here in the Animal Protection section. EntBase will support the Center by housing genomic information on insects that vector veterinary diseases, and will provide computational tools to analyze vector genomic data. EntBase, in turn, will benefit from systematics and allied, content rich information, e.g., insect associated microorganisms generated by and housed at the Center. The two systems will work together to solve practical problems in agriculture with an emphasis on rapid potential solutions generated with the help of large scale computing power.

Means to Achieve Change

- Develop EntBase to provide data management capacity to analyze and exploit insect and other arthropod genomic data for controlling pests and protecting beneficial insects such as bees ($500,000). ARS will:
  - Link and integrate EntBase into existing public computational resources, such as cloud-based systems.

- Develop cloud-based data management tools to support insect genome and genetic data analysis ($500,000). ARS will:
  - Develop new tools for computational solutions and data storage needs by converting and expanding the use of tools developed for iPlant and iAnimal, which are breeding-centric discovery environments, to an insect research model.

g) A decrease of $26,237,000 from ongoing research projects to support higher priority research initiatives.

Need for Change

The 2013 budget recommends selected high priority research initiatives which address the Administration's science and technology priorities and the Department's Strategic Goals. To finance these initiatives, within limited resources, some existing projects are proposed for reduction or termination given that they are: (1) mature where the research objectives have been mainly accomplished; (2) duplicative or can be accomplished more effectively elsewhere in ARS; (3) marginal or below threshold funding for program viability or sustainability; (4) conducted in substandard or inadequate infrastructure and future costs are prohibitive; (5) lacking a critical mass of scientists/support personnel for an effective program; or (6) are carried out by other research institutions. The savings achieved from these reductions/terminations will be redirected to finance the higher priority agricultural research initiatives identified in the 2014 budget, and will improve program and operational efficiencies.

CA, Davis – Integrated Strategies for Advance Management of Fruit, Nut, and Oak Tree Diseases (-$496,000)
CA, Parlier – California Cropping Systems/Soil Health (-$1,406,000)
CA, Salinas – Control of Pathogens in Strawberry and Vegetable Production Systems (-$602,000)
DC, Washington – Biologically-Based Management Strategies for Control of Soil-Borne Pathogens (-$250,000)
FL, Fort Pierce – Vegetable and Floriculture Production/Soil Health (-$1,724,000)
FL, Fort Pierce – Vegetable Grafting for Resistance to Soilborne Diseases (-$341,000)
Headquarters – Fusarium Head Blight of Wheat and Barley (-$880,000)
Headquarters – Minor Use Pesticides (-$364,000)
Headquarters – Potato Research (-$1,454,000)
Headquarters – Small Fruit and Nursery Research (-$1,213,000)
Headquarters – Wheat Stripe Rust Initiative (-$217,000)
Headquarters – Areawide Management of Agricultural Pests (-$5,684,000)
Headquarters – Floriculture and Nursery Research Initiative (-$3,206,000)
MD, Beltsville – Improved Knowledge of Virulence Factors to Develop Postharvest Decay Control Strategies (-$803,000)
MD, Beltsville – Integration of Biologically-Based Technologies for Suppression of Soilborne Plant Pathogens (-$545,000)

MD, Beltsville – Molecular Approaches to Understanding Host Resistance and Pathogen Variability for Improving Potato and Tomato (-$486,000)
MO, Columbia – Development of High Quality, Cost Effective, Mass Reared Biocontrol Agents for Small and Urban Farms, Organic (-$1,070,000)
MO, Columbia – Eicosanoid Mediated and Molecular Immune Signaling Inhibitors in Piercing/Sucking Insect Pests of Small and Urban Vegetable Farms (-$810,000)
ND, Fargo – Sclerotinia Diseases (-$1,750,000)
OR, Corvallis – Biology and Management of Soilborne Diseases of Horticultural Crop (-$609,000)
OR, Corvallis – Exotic, Emerging, Re-Emerging, and Invasive Plant Diseases of Horticultural Crops (-$428,000)
WA, Wenatchee – Biologically-Based Systems for Soilborne Disease Control in Tree Fruit Agro-Ecosystems (-$713,000)

Note: There is an adjustment (-$1,186,000) to the Annualized Continuing Resolution.

h) A decrease of $6,560,000 in ongoing extramural research projects.

Need for Change

Under ARS' Crop Protection program, selected extramural research projects are proposed for termination, given that the research conducted is carried out by other institutions including universities and land grant institutions. The savings achieved from these reductions/terminations will be redirected to finance the higher priority agricultural research initiatives identified in the 2014 budget.

FL, Ft. Lauderdale – Invasive Species (Aquatic Weeds) (-$225,000)
HI, Hilo – Fruit Fly Eradication (-$102,000)
HI, Hilo – Minor Crop Pest Control (-$202,000)
HI, Hilo – Papaya Ringspot (-$199,000)
HI, Hilo – U.S. Pacific Basin Agricultural Research (-$229,000)
Headquarters – Vomitoxin (Fusarium) (-$4,710,000)
IN, West Lafayette – Oat Virus (-$67,000)
MD, Beltsville – Weed Management Research (-$45,000)
MS, Stoneville – Cotton Genomics and Breeding (-$514,000)
NY, Ithaca – Golden Nematode (-$212,000)
NY, Ithaca – Pear Thrips (-$55,000)

Human Nutrition

(7) An increase of $9,503,000 for Human Nutrition research ($85,961,000 available in 2013).

Maintenance of health throughout the lifespan along with prevention of obesity and chronic diseases via food-based recommendations are the major emphases of ARS' human nutrition research program. These health-related goals are based on the knowledge that deficiency diseases are no longer important public health concerns. Excessive consumption has become the primary nutrition problem in the American population. This is reflected by increased emphasis on prevention of obesity from basic science through intervention studies to assessments of large populations. The agency's research program also actively studies bioactive components of foods that have no known requirement but have health promoting activities. Four specific areas of research are emphasized: (1) nutrition monitoring and the food supply, e.g., a national diet survey and the food composition databank; (2) dietary guidance for health promotion and disease prevention, i.e., specific foods, nutrients, and dietary patterns that maintain health and prevent disease; (3) prevention of obesity and related diseases, including research as to why so few of the population follow the Dietary Guidelines for Americans; and (4) life stage nutrition and metabolism, in order to better define the role of nutrition in pregnancy and growth of children, and for healthier aging.

ARS' Human Nutrition research program is carried out at numerous locations where agency scientists frequently collaborate with researchers from other Federal/State governments, academia, and private industry. Their research

supports USDA's Strategic Goal 4: Ensure that All of America's Children Have Access to Safe, Nutritious, and Balanced Meals.

ARS' base research programs respond and provide solutions to the Nation's most important agricultural problems. Much of the research the agency carries out, in its nationwide network of laboratories, is national or international in scope. Base funding for the program will continue to finance the critical Human Nutrition research program. Continuing the base funding and limiting reductions is essential to ensuring the continued success of the program.

The funding change is requested for the following items:

a) An increase of $254,000 for pay costs which includes $37,000 for annualization of the fiscal year 2013 pay raise and $217,000 for the anticipated fiscal year 2014 pay raise.

Funding for pay costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Absorption of these costs reduces the number of scientists and support personnel essential for conducting the agency's research programs. If pay costs are not fully funded, ARS will be unable to fill critical positions and will have to reduce spending for much needed laboratory equipment, supplies, and other materials.

b) An increase of $11,000,000 to Provide the Scientific Evidence Base for USDA's Food Assistance Programs.

Note: The total request for this initiative is $16 million -- $11 million for ARS and $5 million for the Food, Nutrition and Consumer Services.

Need for Change

ARS conducts the only nationally representative survey of food intake in the U.S. as part of the National Health and Nutrition Examination Survey (NHANES) in a long-standing partnership with the National Center for Health Statistics. Physical examinations, biological sampling, and dietary interviews are combined to provide snapshots of the health of the nation. ARS is responsible for the dietary survey interview methods, improving methods for assessing dietary intake, and processing the voluminous data collected from those interviews.

Population subgroups at high risk for obesity and other diet-related diseases, such as low income individuals or ethnic minorities are oversampled to provide better estimates for those groups. This is particularly important to Food and Nutrition Service (FNS), whose clients are primarily low income citizens participating in SNAP, WIC, and child nutrition programs. Data collected by USDA for NHANES are essential to understanding food choices, and nutritional and health status of nutrition assistance program participants. The data are also used as part of the evidence base to set Dietary Reference Intakes (DRI) values and update the *Dietary Guidelines for Americans,* the food policy for the United States. Some USDA food assistance programs, such as school meals, are obligated to provide a percentage of DRI in each meal. However, the DRI for young children and the elderly are often extrapolated from those obtained experimentally for young adults even though it is known that such values of often incorrect.

Funding for the national food intake survey has not increased in over 20 years, reducing resources to the point where the survey's continued functioning is jeopardized, with the potential for multiple critical failures possibly and insufficient funding for the second day of the dietary survey in NHANES, which is essential for reliability of the information since food intake varies day-to-day. Such information is critical for FNS estimates of both food intake and nutritional status of its participants. In addition, there have been annual 5 percent increases in costs for the field contract to obtain the diet interviews while the appropriated budget has been flat. Also, the ARS food composition database that feeds information on nutrients into the survey has been unable to update its computer infrastructure or keep pace with the proliferation of new and reformulated foods available in the U.S. as a result of flat funding for many years. Another example of activities jeopardized by the budget shortfall is provision of the Food Portion Equivalents Database, used by the USDA Center for Nutrition Policy and Promotion; this is used to develop *Dietary Guidelines for Americans* from USDA and DHHS and MyPlate but is not current and may no longer be available.

Finally, there is considerable interest in expanding the *Dietary Guidelines for Americans* to include children 0-2 years of age. Because the dietary guidelines are built upon the DRIs and because competitive grant programs do not fund such studies, there is a need to assess the DRIs for these target groups by intramural scientists; ARS has nutrition centers with Congressionally-mandated intramural missions of studying nutritional needs of children and the aging.

Outcomes

The proposed increase will enable ARS to provide the scientific evidence base for the USDA food assistance programs through the national food consumption survey, food composition data, and the research base for Dietary Reference Intakes.

Means to Achieve Change

With the proposed increase, ARS will:

- Enhance nationally representative food consumption survey capacity and analysis to support USDA's food assistance programs ($3,000,000).

- Augment food composition database to keep pace with food industry products that are purchased with USDA SNAP benefits and other food assistance programs ($3,000,000).

- Fill knowledge gaps in the DRI for children and for elderly so that USDA food assistance programs will not target improper nutrient goals in school and senior food programs ($5,000,000).

c) An increase of $2,887,000 to Enhance Human Nutrition in the United States.

Need for Change

Obesity is at a record level in the United States. Heart disease remains the number one cause of death, diabetes rates are increasing, and cancer incidence remains high. All of these conditions are linked in part to nutrition. Substantial research suggests that changes in diet may benefit public health by preventing the onset or severity of these conditions. An overarching message from nutrition professionals has been that diets should include more fruits, vegetables, and whole grains; are lower in sodium and solid fat; and include healthful beverages such as dairy. Moreover, an increasing body of evidence suggests that various "phytochemicals" in plant foods play a major role in chronic disease prevention, especially cancer and heart disease. However, observational studies often give conflicting results and many high dosage, single nutrient intervention studies have shown more harm than benefit.

The food system and the nutritive and non-nutritive components that it provides is complex. Food production is inexact and leads to variability in the nutritional composition of raw agricultural products and multiple formulations of retail food products increases compositional heterogeneity. Moreover, the sciences of genomics, epigenetics, and metabolomics show the human organism to be complex in its response to dietary inputs. Thus we need to adopt a systems approach characterized by linking food production and processing practices, and all its inherent variability, with human health outcomes (e.g., do phytochemicals in cruciferous vegetables decrease the risks of cancer?). This begins with characterizing the breadth and variability of food components in the food supply (e.g., there is a huge range of phytochemical compounds in crucifers, affected by factors as diverse as climate, date of harvest, and post-harvest processing).

The Federal government establishes dietary policy guidelines. ARS also conducts nutrition surveillance through the food consumption survey portion of the NHANES. To implement Federal food and nutrition policy, the food surveillance program needs to develop new tools and databases, such as the Food Patterns Equivalent Database (FPEDS) to link the NHANES and food composition data to Federal dietary guidance, namely the *Dietary Guidelines for Americans*. These tools do not presently exist.

Outcomes

The proposed initiative will strengthen the nutrition monitoring programs conducted by ARS. It will result in technology enhancements to the infrastructure of the USDA's "gold-standard" food nutrient database and national food consumption survey. The initiative will also facilitate the development of tools that link ARS nutrition surveillance data with Federal dietary guidance and associated policies.

Means to Achieve Change

- Enhance Nutrition Monitoring Capability by Adding Functionality to the Food Composition Database ($1,887,000). ARS will:
  - Enhance the food composition database to enable tracking over time and differentiation by brand name of foods and nutrients of concern to public health.

- Enhance Nutrition Surveillance Capability to Link USDA/ARS Food Consumption Survey Data with Federal Dietary Policy Guidance ($1,000,000). ARS will:
  - Develop new tools to link USDA's food composition and consumption data to Federal nutrition policy implementation tools such as "MyPlate." An example is development of the FPEDS database.

d) A decrease of $4,638,000 in ongoing extramural research projects.

Need for Change

Under ARS' Human Nutrition program, selected extramural research projects are proposed for termination, given that the research conducted is carried out by other institutions including universities and land grant institutions. The savings achieved from these reductions/terminations will be redirected to finance the higher priority agricultural research initiatives identified in the 2014 budget.

Headquarters - Delta Obesity Prevention Initiative/Human Nutrition Delta Initiative (-$3,929,000)
MA, Boston – Geriatric Nutrition Research (-$186,000)

Note: There is an adjustment (-$523,000) to the Annualized Continuing Resolution.

Environmental Stewardship

(8) An increase of $28,959,000 for Environmental Stewardship research ($190,191,000 available in 2013).

ARS' Environmental Stewardship research program supports scientists at more than 70 locations. Emphasis is given to developing technologies and systems that support profitable production and enhance the Nation's vast renewable natural resource base. The agency is currently developing the scientific knowledge and technologies needed to meet the challenges and opportunities facing U.S. agriculture in managing water resource quality and quantity under different climatic regimes, production systems, and environmental conditions. ARS' air resources research is developing measurement, prediction, and control technologies for emissions of greenhouse gases, particulate matter, ammonia, hydrogen sulfide, and volatile organic compounds affecting air quality and land surface climate interactions. The agency is a leader in developing measurement and modeling techniques for characterizing gaseous and particulate matter emissions from agriculture. In addition, ARS is evaluating strategies for enhancing the health and productivity of soils, including developing predictive tools to assess the sustainability of alternative land management practices. Finding mechanisms to aid agriculture in adapting to changes in atmospheric composition and climatic variations is also an important component of ARS research program. ARS range and grazing land research includes the conservation and restoration of the Nation's range lands and pasture ecosystems and agroecosystems through improved management of fire, invasive weeds, grazing, global change, and other agents of ecological change. The agency is currently developing improved grass and forage legume germplasm for livestock, conservation, bioenergy, and bioproduct systems as well as grazing-based livestock systems that reduce risk and increase profitability. In addition, ARS is developing whole system management strategies to reduce production costs and risks.

ARS' research program is carried out at numerous locations where agency scientists frequently collaborate with researchers from other Federal/State governments, academia, and private industry. Their research supports USDA's Strategic Goal 2: Ensure Our National Forests and Private Working Lands Are Conserved, Restored, and Made More Resilient to Climate Change, While Enhancing Our Water Resources.

ARS' base research programs respond and provide solutions to the Nation's most important agricultural problems. Much of the research the agency carries out, in its nationwide network of laboratories, is national or international in scope. Base funding for the program will continue to finance the critical Environmental Stewardship research program. Continuing the base funding and limiting reductions is essential to ensuring the continued success of the program.

The funding change is requested for the following items:

a) An increase of $1,268,000 for pay costs which includes $186,000 for annualization of the fiscal year 2013 pay raise and $1,082,000 for the anticipated fiscal year 2014 pay raise.

Funding for pay costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Absorption of these costs reduces the number of scientists and support personnel essential for conducting the agency's research programs. If pay costs are not fully funded, ARS will be unable to fill critical positions and will have to reduce spending for much needed laboratory equipment, supplies, and other materials.

b) An increase of $10,946,000 to Enhance Natural Resources and the Environment for Agriculture.

Need for Change

During the last 30 years, new technologies, changing demographics and social values, and the globalization of markets, cultures, and competition have produced dramatic changes in the world's food and agricultural systems. Agriculture is shifting from a solely commodity-driven system to one at least partly driven by global consumers who value the quality, safety, and nutrition of their food and the way it is produced. Today, consumer concerns about food prices, food safety, nutrition, product quality, energy use and cost, and the environmental footprint of agriculture are driving demands for high quality, sustainable agricultural products. At the same time, weather extremes and climate variability introduce uncertainties into production decision-making, projecting yields, and improving food security.

Most recently, the global economic downturn, rising energy costs, spikes in food prices, and growing food insecurity, particularly in the developing world, have highlighted the challenges that agriculture faces to meet the food, feed, fiber, and biofuel needs of a growing global population. These and other factors have shifted public policy towards the creation of more sustainable agricultural systems. This is evidenced by a renewed emphasis on the role of rural lands to provide essential ecosystem services and mitigate climate change, and a movement towards managing natural resources such as water at the landscape scale.

Reflecting a growing sense of urgency, these policy shifts signal a transformative change in agricultural production, accelerating progress towards achieving the four goals of sustainability as defined by the National Research Council: 1) satisfying human needs; 2) enhancing environmental quality and the resource base; 3) sustaining the economic viability of agriculture; and 4) enhancing the quality of life for farmers, ranchers, forest managers, workers, and society as a whole.

In agricultural ecosystems, physical and biological processes such as cycling of carbon, water, and nutrients are linked with social and economic processes. To achieve sustainability, it is essential that research enhances understanding of how these processes interact, and their impacts on the environment through space and time. Agricultural research must explicitly identify and address these linkages so that progress in one agricultural sector does not inadvertently create or exacerbate problems in another. Such an approach calls for increasing integrative

research by bringing together multi-disciplinary teams of scientists from the government, academic, and private sector research communities to increase synergies, accelerate progress, and improve cost effectiveness.

ARS' natural resources and sustainable agricultural systems program provides research to benefit the American public with water, soil, and air resources that are the essential foundation to agricultural production. Funding requested in FY 2014 targets three initiatives to develop new integrative research strategies, knowledge, management strategies, and technologies to sustain agricultural production on a landscape scale in a constantly changing environment, while enhancing water quality benefits, carbon and nutrient storage, and other ecosystem goods and services.

Outcomes

Long-term, landscape level, interdisciplinary research will improve our understanding of how key agricultural system components interact at the whole system level. Environmental field research will lead to better management of the physical, chemical, and biological aspects of agro-ecosystems. Critical insights from scientific teams involving experts in fields such as agronomy, biogeochemistry, ecology, hydrology, and soil science, in collaboration with social scientists such as economists, will lead to better resource management at scales from fields to river basins. Results will enable anticipating the environmental impacts of shifting agricultural practices, improving the effectiveness of conservation programs, adapting to climate variability and weather extremes, and identifying the broader societal benefits of modern agriculture, such as bioenergy production, carbon sequestration, improved water quality and water use efficiency, and wildlife habitat.

Means to Achieve Change

- Enhance the Quantity and Quality of Water Resources for Agriculture and Agriculture Dominated Landscapes ($5,288,000). ARS will:
  - Use a systems approach to integrate agricultural and municipal objectives for maximum benefits sustaining the long-term productivity of agriculture in urbanizing landscapes and along urban-to-rural gradients.
  - Develop new management tools based on geospatial information in crop condition, soil moisture, drought monitoring, and hydrologic models which lead producers, land managers, and communities to efficient and cost effective water use.

- Sustain Agricultural Production Capacity for Food and Energy Security and Ecosystem Services Over Long Periods at Landscape Scales ($3,568,000). ARS will:
  - Develop landscape scale conservation strategies to maximize multiple environmental benefits while minimizing costs.
  - Develop flexible, economically viable agricultural production systems for food, feed, and bioenergy crops that enhance ecosystem services and support existing markets.
  - Manage range and pasturelands to sustain agricultural production, control invasive species, and enhance ecosystem services in a changing climate.

- Adapt Agricultural Systems to Climate Variability and Weather Extremes ($2,090,000). ARS will:
  - Improve crop genetic and physiological models to interface with new models for climate variability, other environmental conditions such as water availability, and economies/markets to predict crop responses to changing conditions and enhance projections of food insecurity around the world (in support of U.S. involvement in the international Agricultural Model Intercomparison and Improvement Project, AgMIP).
  - Develop practices that enable agricultural systems to manage water supply; adapt to extremes in precipitation that affect soil moisture, runoff, and erosion; conserve soil and water resources; and maintain or enhance biodiversity and ecosystem services.

c) An increase of $9,500,000 to Enhance the Productivity of Crop Land.

Need for Change

As the 21st century unfolds, agriculture will face a series of challenges—in the United States and globally—in providing sufficient food, fiber, and fuel to support a growing global population while our natural resources, environmental health, and available arable land decline and climate changes. The unprecedented nature of these challenges creates a growing sense of urgency for transformative changes in agriculture to accelerate progress towards achieving sustainable agricultural systems that maximize production and economic return for producers, minimize environmental degradation, and adapt to changing climate. While genetic improvements to crop cultivars and germplasm are part of the answer to solving these problems, fully achieving such a transformation requires an improved understanding of the complexities of how agro-ecosystems function at multiple scales (i.e., fields to watersheds or landscapes). Long-term research and data collection are essential to achieving this understanding and to fully realizing our potential to double crop production at the landscape scale. At stake are the security and safety of our food production systems, our natural resources, and our environment.

Over the past 10 years, there have been frequent calls in the public agricultural research sector for the creation of an infrastructure to provide a sophisticated platform for research on the sustainability of U.S. agricultural systems. ARS currently maintains experimental watersheds and ranges that conduct research and collect long-term data on agricultural sustainability, climate change, ecosystem services, and the status and trends of natural resource conservation at the watershed or landscape scale (some that have been collecting data for nearly a hundred years). Through this initiative, ARS proposes to build on existing infrastructure and apply some of the sites to form the core of a Long-Term Agro-ecosystem Research (LTAR) network that will link ARS sites with partner sites operated by universities, other research institutions, and/or other Federal agencies. This enhanced network, collaborating with these other organizations and reaching out for partnerships in other land-based research networks, will enable multidisciplinary research and funding efforts addressing regional and national scale questions of maintaining or enhancing agricultural sustainability, environmental quality, and ecosystem goods and services in agricultural landscapes using shared research protocols. Such a long-term agro-ecosystem research network would provide the knowledge needed to substantially improve both agricultural sustainability and the delivery of ecosystem services to a society that demands that agriculture be safe, environmentally sound, and socially responsible, in addition to being productive and economically viable.

Outcomes

Enhancing USDA's ongoing research in watersheds/range lands, operating as a long-term agro-ecosystem research network will transform existing research infrastructure, both within and outside of USDA, into a sophisticated research platform to support investigations into the very nature of how to sustain and/or increase (i.e., double) the production of ecosystem goods and services, particularly food, feed, fiber, and fuel, in agricultural landscapes, addressing all of the various components of sustainability (i.e., productivity, economics, environmental quality, ecosystems services, and human and social well-being). The investment has the potential to transform the nature of USDA research and significantly raise the visibility of USDA in the scientific community. All facets of modern agriculture, from plant and animal production (including the evaluation of new crop types and genotypes), to food safety and security, to natural resource concerns, have the potential to be significantly enhanced by this effort. Such a network has the potential to put an end to "stovepipes" among agricultural science disciplines.

Beyond the obvious benefits to USDA, this network will leverage key existing and/or developing infrastructure supported by other Federal agencies, most notably the NSF –supported Long-Term Ecological Research (LTER) and National Ecological Observatory Networks (NEON). Partnerships are at the core of proposed network activities, which would be expected to expand as the network develops. National Oceanic and Atmospheric Administration (NOAA), with whom ARS has collaborated in the past on the Jobos Bay, and Puerto Rico Conservation Effects Assessment Project (CEAP) project, would be a primary target for initial outreach.

Means to Achieve Change

- Enhance ARS Research on Watersheds and Range Lands to Strengthen a Network for LTAR ($5,000,000). ARS will Organize and Enhance Existing Research Infrastructure into a Coordinated Network of Research Platforms in Representative Agricultural Landscapes in the U.S. to Develop an Understanding of how to:

- Sustain or enhance agricultural production at the watershed/landscape scale to meet increasing demands for agricultural goods and services (including the doubling of agricultural productivity) against a background of climate change.
- Simultaneously maintain or enhance environmental quality (i.e., water, soil, air) in these agricultural landscapes.
- Simultaneously maintain, enhance, or restore the provision of ecosystem goods and services in agricultural landscapes, including damages accruing from reductions in lost services and provide an understanding of the cost of replacing services with technology.
- Provide a research platform to field test agricultural germplasm engineered for maximum productivity with minimal inputs to evaluate their performance in and influences on agricultural ecosystems and landscapes.
- Manage competing demands for arable land and fresh water for the production of food, fiber, biofuels, and ecosystem services based on sustainability and biodiversity.
- Provide support for doctoral students or post-doctoral scientists to pursue research within the network. ARS will establish Ph.D. student assistantships or post-doctoral fellowships to train the next generation of agricultural scientists in using the network to answer questions related to the various facets of agricultural sustainability, developing research questions that are shared and coordinated across sites; providing the capacity to address issues across sites through shared research protocols; collecting compatible datasets across sites, and providing the capacity and infrastructure for cross-site analysis and synthesis; facilitating and fostering shared engagement in network thinking.

- Link the Research Network to NSF's NEON ($4,000,000). ARS will:
  - Establish key NEON infrastructure (e.g., towers and instrumentation for: soil and water observatories), designed specifically to focus on parameters of interest in agricultural landscapes, at each of the 10 coordinated watershed/range land locations.
  - Link this infrastructure to NEON cyber infrastructure to facilitate data publication, access, storage, and analysis, thereby integrating the LTAR network with state-of-the-art informatics capabilities supported by NEON.

- Use the Research Network to Support the Quadrennial Ecosystems Services Trends (QuEST) Assessment ($500,000). ARS will:
  - Use the network and associated NEON infrastructure to develop up-to-date syntheses of research findings on how ecosystem structure and condition are linked to ecosystem functions that contribute to societal important ecosystem services in agricultural ecosystems and landscapes.
  - Provide integrated information on the condition of U.S. agro-ecosystems, the measures of ecosystem services flowing from them, and their contributions to human health, economies, and other aspects of well-being.
  - Assess trends in these factors under a range of assumptions about driving forces, management strategies, and policies.
  - Apply the information to identify and characterize challenges to the sustainability of agro-ecosystems and agricultural landscapes, the benefits they provide, and ways to make policy responses to these changes more effective.

d) An increase of $5,000,000 to Improve Plants for Maximum Productivity with Minimal Inputs (i.e., Water, Nitrogen, Phosphorous) and Increased Tolerance to Environmental Stress.

Need for Change

U.S. agro-ecosystems face formidable challenges to achieve crop production goals that are sustainable and minimize off-site environmental impacts such as reduced water quality and quantity, nutrient runoff, and erosion. Moreover, some of the most difficult challenges involve successfully adapting these systems to the accelerating rates of change in factors affecting agricultural productivity, including climate change, weather variability and extremes, and higher costs of other inputs. The challenges identified can only be met by technologies that optimally harness the biodiversity of plant germplasm. Such technologies will enable those production systems to maximize profits as well as add to the security of supply, price stability, and market competitiveness. In addition, they will reduce crop losses

from genetic vulnerabilities to environmental conditions, such as climate and weather variation that can constrain agro-ecosystem productivity.

Researchers are increasingly aware of the importance of plant root systems for crop traits such as nutrient and water uptake and use. Deeper roots provide more drought tolerance and efficient water use in annual and perennial plants. However, very little has been known about the regulation of root systems because it is difficult to study whole root systems in the soil. Recently, USDA researchers have developed methods to grow root systems of cereal roots in transparent gellan gum tubes that allow them to digitally image the root system in great detail. Multiple images of the roots can be reconstructed into three dimensional models of the entire root system of individual plants. This new technology now enables root system architecture to be assessed by high throughput methods, and to identify the key traits that control water and nutrient uptake under limiting conditions. Combining this advance with new DNA sequencing and computational methods (i.e., genomic selection and association mapping) will provide powerful new tools for plant breeders to speed up crop improvement. Plant breeders will be able to carry out "root-based breeding" to generate higher yielding cereal varieties based on superior root traits.

Outcomes

Existing crop types and those modified via this crop improvement research will be evaluated in the field in ARS' network of long-term agro-ecosystem research sites. This will enable the assessment of water and nutrient use as well as changes in erosion or nutrient loss associated with modified crop plant architecture. Conversely, assessments of the plant environment interactions will enable identification of key traits needed for further modification to achieve sustainability and crop production goals.

Means to Achieve Change

Investment in three key platforms will enable sustained improvements in maize, rice, wheat germplasm for yield, drought tolerance, heat and cold tolerance, and improved nutrient use efficiency.

- Crop Genetic Resource Analysis ($2,000,000). ARS will:
  - Inventory crop germplasm biodiversity by sequencing U.S. maize, rice, and wheat germplasm (in the National Plant Germplasm System) and collaborate on genotyping key germplasm from international collaborators (CG Centers) to better enable translation of genotype to phenotype.
  - Research, model, and exploit rare alleles needed for environmental challenges from National germplasm collections.
  - Provide improved genotyping tools for access to rare but valuable alleles.

- High Throughput Phenotyping Platform ($2,000,000). ARS will:
  - Utilize USDA's new high throughput 3-D imaging and software platform for maize, rice, and wheat root phenotyping. Identify the genetic components for root system architecture, physiology, development, and the acquisition of limiting resources, e.g., water, nitrogen, and phosphorous.
  - Phenotype new nested association mapping populations to provide the genetic means for mapping and identifying alleles responsible for target traits.
  - Lead and collaborate on field trials for diverse maize, rice, and wheat on yield, abiotic stress tolerance, flowering, and quality at multiple locations and under multiple environments.

- Germplasm Improvement Using NexGen Theory and Methods for Translating Genotype to Phenotype ($1,000,000). ARS will:
  - Create bioinformatic tools that unite Genomic Selection (GS) and Genome Wide Association Analysis (GWAS) approaches with molecular biology (MaizeGDB, Gramene, and GrainGenes that integrate and maintain diverse datasets) to identify useful and bad alleles, and to accelerate germplasm improvement.
  - Create bioinformatic tools to curate maize, rice, and wheat diversity data for use by plant breeders.
  - Initiate the development of perennial maize, rice, and wheat.

e) An increase of $5,000,000 to Improve Water and Soil Quality Outcomes of USDA Conservation Programs.

Need for Change

Conservation effectiveness is commonly reported as "acres treated." Watershed scale models are then used to translate this metric to mass amounts of nitrogen and phosphorus retained. Watershed models and simulations estimate the potential benefits, but not necessarily the true outcomes of conservation efforts. When long-term trends in water quality data are analyzed they often show little or no improvement in water quality at larger watershed or landscape scales. Four potential causes of this dissociation between practice focused and watershed scale assessments have been identified (*Tomer and Locke*, 2011). ARS will use this knowledge to improve conservation strategies, helping environmental managers to set realistic timelines for water quality improvement goals, and maintaining soil quality by reducing erosion and enhancing carbon sequestration.

Monitoring is necessary to validate the projected impacts of targeted conservation, but large scale monitoring efforts are expensive and clearly not sustainable under current fiscal circumstances. Twenty-first century technology must be brought to bear to more effectively quantify the water and soil quality outcomes of USDA conservation efforts (i.e., more cost effective; less labor intensive). Prior ARS research has used remote sensing to quantify at the watershed scale nitrogen and phosphorus retained by cover crops and water saved by the adoption of conservation tillage. Combining remote sensing with new developments in sensor technology and state-of-the-art modeling has the potential to facilitate cost effective, large scale assessments of water and soil quality outcomes directly linked to USDA conservation efforts.

Outcomes

More effectively quantifying the actual benefits of USDA conservation efforts, combined with developing new or improved practices, and new methods of practice placement will lead to improved water and soil quality at the watershed scale, helping to reduce the impacts of agriculture on important U.S. water resources (e.g., the Mississippi River, the Gulf of Mexico, and the Chesapeake Bay), while enhancing soil fertility in agricultural landscapes. More careful targeting has the potential to achieve greater environmental benefits at the same level of expenditures while providing a mechanism to prioritize expenditures based on cost efficiency. Through these efforts, USDA conservation efforts will become more effective at preventing nutrient and sediment losses from agricultural landscapes, increasing conservation benefits. Improved nutrient and sediment retention will increase soil fertility, reducing fertilizer costs for farmers while improving the economic bottom line for farmers in rural communities. Developing and deploying 21st century technology to quantify the benefits of USDA's targeted conservation efforts will provide more accurate validation of the conservation outcomes of USDA conservation programs at key watershed and landscape scales, while reducing the costs of obtaining this information. This combined approach will maximize conservation benefits while minimizing conservation investments.

Means to Achieve Change

- Assess the Actual Water and Soil Quality Impacts of Targeted Conservation ($2,800,000). ARS will use its CEAP in benchmark watersheds to:
  - Measure (rather than model) water and soil quality impacts of targeted conservation, including how conservation practices affect ecologically important soil organisms (e.g., fungi and bacteria) that influence soil fertility, promote nutrient cycling, or consume wastes.
  - Develop new or improved practices to improve conservation benefits.
  - Develop new or improved methods of practice placement to improve conservation outcomes at the watershed scale.

- Develop More Cost Effective and Less Invasive Methods to Quantify Water and Soil Quality Outcomes of Targeted Conservation ($2,200,000). ARS will:
  - Use twenty-first century technology (i.e., remote sensing, geospatial modeling, and state-of-the-art sensor technologies) to develop new or improved methods to quantify the water and soil quality outcomes of USDA conservation efforts.

f) An increase of $4,650,000 to Expand Research Capacity in the Earth Sciences.

Note: This initiative is divided between two program areas, i.e., here and Crop Production ($350,000).

Need for Change

Additional information on the condition of the natural resources base (i.e., soil, water, and air) can provide a more accurate accounting of the status and trends of agricultural production. New remote sensing and surface-based technologies focused on the hydrologic cycle are becoming available that can provide this information. Algorithms for processing the data from these systems are needed for assessments of domestic and foreign food, feed, fiber, and biofuel production.

Understanding and managing agriculture relating to the effects of a changing climate requires an understanding of exposure and sensitivity. The spatial aspects of these effects are especially important and thus a merger of remote sensing and modeling technologies is needed.

Outcomes

Progress in determining effects of climate change on the natural resources base and agricultural production will be available to decision-makers, producers, and land managers, thus enabling better risk management. By coupling data with models, future projections of the effects of climate on agriculture and the effectiveness of adaptation strategies will be possible.

USDA's LTAR infrastructure represents the perfect platform to integrate agro-ecosystem crop and animal production research with research on natural resources and agricultural sustainability. All of the key facets of modern agriculture, from plant and animal production to food safety and security to natural resource concerns have the potential to be significantly enhanced by this effort. Improved tools, earth observation systems, remote sensing, and modeling techniques enable extrapolation and expansion of knowledge gained throughout the globe. Beyond the obvious benefits to USDA, continued investment in and use of the LTAR network leverages key investments being made by other Federal agencies, including NSF's - supported LTER and NEON, and the science that these networks support. The American people benefit because existing resources are used much more efficiently. Successes arising from these efforts will also have significant potential to enhance national and international food security.

This initiative is separate from but complementary to the LTAR activities described below under "Enhance Cyberinfrastructure for Agricultural Sustainability," which addresses the archiving management, storage, and subsequent accessibility of data collected by the LTAR network as a whole. This initiative focuses on the collection of new data.

Means to Achieve Change

- ARS will:
  - Use the LTAR network infrastructure as a platform for testing the improved production efficiency and sustainability of newly developed crops that have reduced requirements for water, nutrients, and/or pesticides ($800,000).
  - Develop tools using products from current and expected future earth observation systems that provide information on domestic and foreign agricultural production status and trends to enhance the security and vitality of U.S. agriculture ($1,000,000).
  - Develop remote sensing and modeling technologies that enable detection and monitoring of agroecosystem changes caused by variable weather and climate trends. Develop quantitative metrics for the indications of change, and the effectiveness of agricultural systems to adapt to the effects of a changing climate ($1,000,000).
  - Develop and/or improve remote sensing techniques and associated modeling tools to enhance drought detection and monitoring over large geographic areas, develop predictive drought models, improve large scale estimation of key components of the hydrologic cycle, and facilitate downscaling of climate change information to spatial and temporal scales relevant to investigators of soil, water, and agricultural production issues ($1,850,000).

Note: Some of the activities listed above will be carried out under the Crop Production area.

g) An increase of $4,590,000 to Reduce the Vulnerability of Agriculture to Climate Change.

Note: This initiative is divided among several program areas, i.e., here and under Crop Production ($4,503,000) and Livestock Production ($907,000).

Need for Change

As earth's climate changes, the availability of fresh water is becoming less predictable. Droughts are increasing in frequency and severity, and humid regions are experiencing periodic droughts. Irrigation is required to maintain or enhance agricultural production, and the competition for fresh water continues to increase as former agricultural lands become more urbanized or suburbanized. And yet in the U.S. alone, irrigated agriculture produces approximately 49 percent of total crop market value on only 18 percent of cropped lands. Agriculture must do everything it can to increase the efficiency of agricultural water use, including using alternative water sources that save valuable fresh water supplies for other users.

Increasingly, there is a need to develop new crop varieties and management systems that are more resilient to larger temperature fluctuations. Plants are required that can continue to thrive and yield under a wider range of temperatures.

The impacts of climate change on animal systems is also increasing. Production systems are needed which enable animals to better adapt to extreme climates, particularly where a majority of the world's societies that are most in jeopardy for food security exist. Increasing ambient temperature are expected to exacerbate already critical disease and parasite challenges, further restrict feed and forage availability, and create additional production and welfare challenges for food animal systems.

The threat of invasive species will increase due to more extensive transport of agricultural commodities in order to achieve adequate distribution of food, feed, and fiber. Rapid shifts in climate and extreme weather events are creating habitats that are more susceptible to invasion by rapidly colonizing species from anywhere in the world. Programs that are directed at protection of agriculture from pathogens, arthropods, and weeds need to be re-examined to determine the specific risks and to design potential responses. This research could potentially prevent establishment of new harmful species and provide the means to mitigate the effects of others.

Outcomes

Using the latest technologies to improve the efficiency of irrigation practices while accelerating the development of acceptable techniques for the use of alternate water sources (e.g., treated wastewaters; degraded waters) to support some of agriculture's water needs will help to sustain agricultural production while reducing agriculture's overall demand for fresh water. As a result, agricultural production will be sustained or enhanced despite changes in climate, unpredictable patterns of precipitation, and periodic droughts, and more fresh water will be available for municipal and/or industrial users.

More durable resilience of crops to temperature extremes and changing weather will reduce the risk of catastrophic losses, better protect rural economies, and improve food security.

Means to Achieve Change

- ARS will reduce agriculture's vulnerability to climate change ($4,590,000):
  - Increase the capacity to adapt agriculture to climate change.
  - Develop new or improved sensors and/or other water management technologies to increase agricultural water use efficiency as an adaptation to the effects of drought on agricultural water availability.
  - Explore and refine the use of alternative water sources for agricultural irrigation.

- Develop more climate resilient crops by accelerating crop genetic selection and germplasm development for drought tolerance, reduced water requirements, and temperature extremes.
- Develop risk assessments and precision animal management strategies to ameliorate heat stress effects; develop ventilation design standards for contemporary production systems.
- Assess risk and design responses to potential invasive species of arthropods and arthropod-borne diseases that threaten animal production and rural human health.

Note: Some of the activities listed above will be carried out under the Crop and Livestock Production areas.

h) An increase of $4,000,000 to Enhance Cyberinfrastructure for Agricultural Sustainability.

Need for Change

The agricultural sector faces unprecedented challenges to provide food, feed, fiber, and fuel for the nine billion people anticipated by mid-century. To meet these challenges, researchers must develop ways to achieve sustainable intensification of agricultural systems - - those that continuously and progressively maximize production and economic return for producers, minimize environmental degradation, adapt to changing climate, and avoid conversion of vast new land areas and associated natural resources to agricultural production. Although genetic improvements to crops are a key part of the answer to these problems, fully achieving such a transformation also requires improved management of natural resources and other complex components of agro-ecosystems at field, watershed, and landscape scales over long periods of time. To ensure this management capacity at such very large and decadal scales, and fully realize goals for food production to meet population demands, long-term research and data collection are essential.

The 10 ARS research watershed and rangeland locations that comprise the LTAR network are organized around national scale collaborations to address the information needs required for these challenges. Each of these sites possesses historical data sets of critical importance that extend back as long as 100 years. Data collected in research programs at the various LTAR sites are needed for continent-wide integration for analyses of agro-ecosystem condition, trends, and sustainability. This includes physical, chemical, and biological measurements of soil, water, and air resources; management parameters, such as crops and livestock produced, conservation practices implemented, and production inputs, such as fertilizers, pesticides, irrigation, and energy consumption; modeled projections of production, input losses, and economic returns; quantification of a wide array of attributes related to ecosystem goods and services, such as agricultural yields, wildlife habitat, water and nutrient cycling, and carbon storage; and data relating such measurements to time and geographic location on the landscape. Existing LTAR data may not include all such variables at all sites, however, the network is moving toward increasing coordination and commonality of data collected and methods used.

Outcomes

This initiative will enable ARS to realize the benefits of the LTAR network's large scale, coordinated research program by allowing the assembly, archiving, storage, combined access, analyses, and syntheses of network-wide datasets, as opposed to data collected independently and managed for local application. These benefits will include vastly improved assessments of the condition, trends, and sustainability of agricultural production systems under current and alternative management scenarios, including investment and deployment of conservation practices in the landscapes in which agro-ecosystems are embedded at varying scales of space and time.

This LTAR network-wide approach will leverage key existing and/or developing research supported by USDA and other Federal agencies, most notably the NSF's Long-Term Ecosystems Research (LTER) and NEON programs, and other network programs such as ARS' Greenhouse gas Reduction through Agricultural Carbon Enhancement network (GRACEnet), Conservation Effects Assessment Project (CEAP), and the Renewable Energy Assessment Project (REAP). Additionally, partners already engaged in research with ARS at the 10 LTAR locations include nearly 60 colleges and universities (including 1890 and 1994 Land-Grant colleges), nearly 30 Federal and State government agencies, and more than 40 non-government and private sector organizations. This initiative will provide further synergies with data, modeling, and information development involving these partners.

This initiative is separate but complementary to the LTAR activities described under the "Expand Research Capacity in the Earth Sciences" initiative. This initiative focuses on cyberinfrastructure and associated personnel to enable more effective use of LTAR data. The "Expand Research Capacity in the Earth Sciences" initiative describes new research that integrates plant and animal production with natural resources research.

Means to Achieve Change

- Enhance data collection, management, analyses, and syntheses for ARS research on watersheds and range lands ($4,000,000). ARS will:
  - Increase the data management capacity of the LTAR network to allow access, comparison, and synthesis of historical and future LTAR datasets across sites and in comparison with datasets collected by other ARS research networks (e.g., CEAP, GRACEnet, and REAP) by creating an LTAR Data Management Framework.
  - Provide the infrastructure, personnel, and software/model development capacity to enhance the storage, analysis, and synthesis of "big data" from research on agro-ecosystem condition, management, and sustainable intensification; acquire hardware for data storage, and hire personnel to coordinate the entry of historical and future datasets and provide associated software engineering to support data analysis, synthesis, and visualization capacity; and establish this capacity through the 10 LTAR sites and the data demands by focusing on different USDA Economic Research Service Farm Resource Regions (based on physiographic, soil, climatic, and predominant farm production characteristics). LTAR's 10 locations are for:
    - The tile drained landscapes of the heartland region that produce a significant amount of the Nation's corn, soybeans, alfalfa, and winter wheat, as well as widespread hog and beef cattle production.
    - Agriculture in clay-pan or restricted drainage landscapes of the mid-Mississippi River Basin portion of the heartland region that produce a significant amount of the Nation's corn, soybeans, alfalfa, winter wheat, as well as widespread hog and beef cattle production.
    - Agriculture in the prairie gateway region, which produces a considerable amount of the Nation's wheat and grain sorghum, and provides forage and range lands that support cattle and other livestock production.
    - Agriculture in the basin and range region, near the important transition to the Northern Great Plains and the prairie gateway, in a key area that represents a significant component of the Nation's forage and livestock production.
    - Agriculture in the very arid, extreme southeastern part of the basin and range region, a region that contains a significant proportion of the Nation's grazing or range lands; the location occurs at a critical transition zone towards the prairie gateway region to the east, and the farms of the southwest fruitful rim in Texas.
    - Agriculture in the northern great plains region, which accounts for a considerable portion of the Nation's wheat, small grains, oilseed, potato, sugar beet, dry bean and pea production, and significant beef cattle and sheep production.
    - Agriculture in northern portions of the basin and range region, nearing the farms of the northwest fruitful rim region, containing a considerable amount of land area used for grazing and irrigated crops.
    - Agriculture in the southern seaboard region, characterized by a mix of small and large farms producing corn, soybeans, sweet potatoes, wheat, tobacco, cotton, pecans, peaches, and peanuts, as well as poultry and livestock (i.e., hogs and cattle) production.
    - The arid portion of the southwest fruitful rim region, which include cotton and grain sorghum as major crops, and land that is grazed by beef cattle; it occurs at a critical transition zone towards the basin and range region to the east.
    - Agriculture in the northern crescent region, including a region whose farms produce a wide array of crops such soft winter wheat, potatoes, grapes, forage crops, sugar beets, and sweet corn.

i) An increase of $4,000,000 to Advance the Capacity for Assessing the Impacts of Climate and Environment on Food, Feed, and Fiber Production and Adapt to those Impacts and Changes.

Need for Change

Demand for agricultural products is increasing worldwide, yet the amount of land used for agriculture is decreasing and is subject to increasing pressures from changing climate. The trend of intensified agriculture that is subjected to greater environmental stress generates a critical need for yield and sustainability assessments domestically and worldwide. Assessments of the trends of yields, the conditions of agro-ecosystems, and ecosystem services based on observations and numerical simulation models are needed to prioritize and guide adaptation of crops and production systems to climate change by developed and developing countries. Crop growth and yield simulation models are in need of updating to the sophistication level of General Circulation Models (GCM) linked with economic models and the weather and climate GCMs. The crop simulation models need to account for the interactions of climate change with new agronomic technologies and practices; the spatial and temporal resolution and estimates of uncertainty need to be commensurate with GCMs. Data and expertise of the Group on Earth Observations (GEO) provide new opportunities to enhance the power of crop simulation models.

Outcomes

Characterization of the risks of hunger and world food security due to climate change will be significantly enhanced. Agro-ecosystem vulnerabilities and opportunities for adaptation to climate change will be identified in crop systems in both developing and developed countries. This supports the U.S. Global Change Research Program (USGCRP) strategy to build adaptation science. An integrated, interdisciplinary framework will be available for continuing assessments of climate impacts on the agricultural sector in fulfillment of the USGCRP National Climate Assessment (NCA) mandated by Congress. Findings of the NCA will subsequently strengthen the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). National and international data networks linked by the GEO will be accessed and exploited, thus increasing return on these investments. The ability to project regional changes in agricultural land use and production will reveal new trading opportunities, imbalances, and shortages in world markets resulting from climate change and other driving forces of agricultural supply and demand. International collaboration and model analyses conducted during regional workshops will lead to commonly established protocols, identification of key regional questions, and building capacity nationally and internationally.

Means to Achieve Change

- Partner with other Federal Agencies, Universities, and International Scientists to Improve Projections of Global Crop Yields and Sustainability Under Different Climate Scenarios and Environments ($4,000,000). ARS will:
  - Enhance an ongoing global agricultural modeling intercomparison and improvement project in collaboration with the climate modeling community to develop improved estimates of global crop yields, uncertainties of these estimates, and related economic values.
  - Incorporate existing and new data from research, monitoring, and observational systems such as ARS long-term agro-ecosystem watershed/range land research sites, NSF's NEON, and new earth observing satellites into the crop models.
  - Modernize and expand ARS specialized research facilities to improve, validate, and quantify uncertainty for crop growth models, and generate data needed to improve crop growth models.
  - Incorporate new information from improved crop models into estimates of national crop yields for the National Climate Assessment for agriculture.

j) An increase of $2,540,000 for Earth Observation and Environmental Data Activities.

Note: This initiative is divided between several program areas, i.e., here, Library and Information Services ($1,200,000), and Crop Production ($260,000). The total funding of $4 million will be distributed among USDA agencies including NRCS to implement an agencywide framework for managing and curating Earth system data.

Need for Change

The combination of population growth, climate change, resource demands, and the loss of productive farmland and scarce natural resources through continued urban development are placing unprecedented stress on our planet. Understanding and addressing these global system level problems depends upon the availability of high quality, easily accessible, earth observation data. A coordinated approach is needed to drive innovation, sustain capacity, and build on the current set of earth observations. However, interoperable systems for earth observation data is challenged by the heterogeneous nature of the data and information; the diversity of lifecycle management approaches; the wide range of disciplines producing and consuming the data; time scales measured in centuries; information system design decisions; and the many Federal agencies and consumers involved. The large size of the datasets poses additional challenges for their collection, normalization, preservation, access, and interoperability. Leveraging existing systems and building integrative capabilities is needed to fully realize the benefits of data gathered over centuries by many researchers, in natural resource inventories and agricultural programs across the Federal government. Additions and updates to existing data management systems may be required for most government agencies to develop data exchange capabilities and information display facilities.

Outcomes

Accurate modeling to predict the spread of deadly human diseases, devastating crop infestations, or drought conditions will offer scientists and policymakers information needed to prevent, diminish, or avert emerging crises in our food and agriculture and human health systems. Implementing robust modeling systems is dependent upon access to reliable data, which in turn is best supported through the establishment of a Departmentwide framework to guarantee coordination of data collection, description, preservation, and access. Coordination of datasets will result in searchable data stores and produce reusable assets. Developing a resource hub and reference repository will efficiently, cost effectively provide the means to rapidly mature interoperability capabilities; will enable transparency and equitable access; measure utilization; and increase use of preservation best practices for high value datasets. This platform model will provide a nexus for the formation of communities of practice, which will support sustainable community led curation and valuation of the datasets. The framework will take advantage of the advances in semantic technologies to maximize data discovery, integration, and analysis of diverse data types, and formats, thereby expanding the usability and reuse of datasets for researchers, the general public, entrepreneurs, and Federal, State, local, and tribal government decisionmakers. The semantic enabled approach will support machine readable interoperable formats for the easy exchange of data between systems, a cornerstone of the Digital Government Strategy and the Strategic Assessment of the U.S. Group on Earth Observations. Achieving interoperability will maximize return on longstanding research investments and facilitate new knowledge discovery. Moreover, a common framework will enhance improved data distribution channels such as mobility and geospatial mapping, accelerating realization of Digital Strategy objectives and fostering public service transformation as stakeholders develop and mutually leverage naturally integrated operating plans and solutions. As the Interagency Working Group on Earth Observations stated, “earth observation systems are strengthened when data collection and analysis are achieved in an integrated manner.”

Means to Achieve Change

- This initiative is part of an interagency Big Earth data initiative to improve coordination and management of Federal earth system observations, data, and information for civilian purposes. Establish a USDA enterprise information resource hub following EcoINFORMA practices and standards. ARS will coordinate with Office of the Chief Information Officer (OCIO) and Office of Communications (OC) while conducting the following activities:
  - Apply metadata standards, conventions, and templates ensuring datasets are adequately described thereby enabling interoperability, search, groups, ranking, and comprehensive data retrieval to maximize effective dataset reuse.
  - Facilitate the quality review and assurance, and registration of datasets with automated tools, peer review, and other validation processes.
  - Develop a Web-based linked open data database (LOD) to facilitate the linkage of datasets between systems and providers, based upon an agroecological core ontology, and cross reference with other disciplinary schema and methods. Operation of the LOD is intended to automate the selection of the best

available dataset, and facilitate the integration of diverse datasets. The work will extend existing open source resources, such as the NRCS' National Cooperative Soil Survey (NCSS) and the FSA's National Common Land Unit (NCLU).
- Develop applications and Applied Programming Interfaces (APIs) to facilitate the transformation and exchange of data among databases, ingestion of data into map visualization and spatial analysis tools, and integrated data mashups for data reuse across the broad landscape of environmental sciences. Develop an integrated development environment for geospatial solutions.
- Serve as the data repository for high value datasets in a central or federated architecture as needed to facilitate collaboration and support formal, adhoc, and emerging agency information requirements.

- Provide access and preservation for datasets relating to earth observation and environmental data. ARS will coordinate with OCIO while conducting the following activities:
  - Evaluate, adapt, and develop data standards to enable interoperability and facilitate data integration.
  - Identify and/or develop software tools and APIs to collect, organize, manage, retrieve and preserve datasets and models. Software tools will be focused on web browser interfaces with cloud-based data collection, loading and retrieval; data exploration; and specialized user interfaces to access and analyze earth observation and environmental data. Provide agile IaaS, PaaS, and SaaS platform technologies delivery for open data and model access, demand scaling, and capacity management.
  - Develop analytic tools to analyze, visualize and synthesize data for modeling, forecasting, and decision-making.

- Develop a virtual centralized repository of literature which is semantically linked to datasets through ontologies, to add context to the data through indepth historical knowledge which can bring an understanding of long-term datasets. This will leverage and extend NAL's Digital Collections.
  - Apply ontologies used in describing the earth observation and environmental datasets will be applied to indexing of the literature which will maximize comprehensive and accurate linkage between inquiries, search patterns, structured and unstructured data, and literature.
  - Make functional linkages between datasets, and between datasets and the literature.
  - Develop spatial metadata to perform location-based search and content management by place.

- Build a linkage and distributed collection capacity with field data collected using ARS' LTAR network to facilitate scaling up of data and analysis results to broader landscape and regional levels ($550,000). ARS will coordinate with OCIO while conducting the following activities:
  - Provide a geospatial context for LTAR data via incorporation of remotely sensed data and products, including hydrologic cycle variables that will be available for the first time via upcoming satellite missions, such as the Soil Moisture Active and Passive (SMAP) system.
  - Facilitate the inclusion of historical data from the LTAR sites to enable assessments of long term trends of production, environmental quality, and the effects of climate change.
  - Enable USDA and external stakeholder practitioner community to create and share reusable data layers in the form of web map services and features services leveraging a common GIS platform and portal.

- Use the USDA enterprise information resource hub and other structures as a platform to enhance climate change mitigation research and decision support ($500,000). ARS will coordinate with OCIO the following activities:
  - Incentivize, reuse, and/or construct API which will enable science applications for areas, such as cropland and grazing land greenhouse gas and carbon sequestration data in ARS' GRACEnet data management system, NRCS' NCSS, and crop residue data in ARS' REAP data management system.
  - Incorporate APIs for greenhouse gas emission and crop residue management decision support developed by REAP to enable landscape level production, environment, and economic sustainability assessments of residue harvest for biofuels and livestock feedstock.

- Use the USDA enterprise information resource hub structure as a platform to engage NIFA, NRCS, FS, OCE, DOI, NOAA and NASA on collaborative research to be conducted as part of contributions to the USDA Climate Change Regional Centers ($1,490,000). ARS will coordinate with OCIO while conducting the following activities:

- Organize data and models needed for agricultural topics of the ongoing National Climate Assessment activities in preparation for formal reports required every four years.
- Provide portals and specialized online availability of models to assess the effects of climate change on agriculture.
- Provide linkages and organization where needed to the Agricultural Modeling Intercomparison and Improvement Project (AgMIP).

Note: Some of the activities listed above will be carried out under the Library and Information Services, and Crop Production areas.

k) An increase of $1,613,000 to Improve Agricultural Sustainability.

Note: See the "Crop Production" section.

l) An increase of $1,500,000 to Equip Producers in the Major Grain Production States with the Most Current Climate Change Adaptation Science and Information Needed to Enhance the Productivity of Crop Lands under Changing Climate.

Need for Change

The impacts of climate variability and change on agriculture are becoming more acute, threatening yields, economic viability, and environmental quality needed for sustained production of crops and ecosystem services. A highly interdisciplinary approach is required to work with farmers, ranchers, industry, and government and nonprofit organizations to identify their information and technology needs, enhance their decision making capabilities, and acquire new information on how climate variability and change may impact agro-ecosystems and production systems. Continuous assessment of climate impacts on agricultural production and ecosystem services addresses complex climate sensitive issues of concern to decision makers and policy planners at a regional level. Tools to help agriculture make day-to-day and long-term planning decisions are needed that take full advantage of the latest advances of climate science and agricultural sciences.

NOAA's Regional Integrated Science and Assessments (RISA) program is a demonstrably successful approach to establishing research teams that conduct innovative, interdisciplinary, user inspired, and regionally relevant research that informs resource management and public policy. RISA teams help build the nation's capacity to prepare for and adapt to climate variability and change by providing cutting edge scientific information to public and private user communities, working closely with decision makers to meet regional information needs.

RISA teams currently investigate climate impacts on fisheries, water, wildfire, agriculture, public health, transportation, and coastal zones. Because climate variability cuts across sectors, RISA teams are expected to analyze connections between sectors and provide assessments of integrated issues to create and enhance adaptation support tools. Current RISA regions generally cover two or three States, large watershed boundaries, or issue focused areas (e.g., the urbanized, heavily populated corridor between Boston, New York, and Philadelphia).

Outcomes

Links between climate science and society will be strengthened to ensure sustained yields, economic viability, environmental enhancements, and improved quality of life for rural populations and society at large for the critically important grain production region of the central United States. Information from climate adaptation science will be provided to stakeholders, customers, and collaborators to enable better decision making for day-to-day management of agricultural production systems, and strategic decisions affecting policy formulation and implementation.

Means to Achieve Change

- ARS/NOAA Collaboration to Expand Agricultural Adaptation Research by Funding one RISA Team, Comprised of Scientists from ARS, Universities, and Other Partner-Stakeholder Organizations in the Major Agricultural States of the Central United States ($1,500,000). ARS will:

- Partner with NOAA's RISA Program, along with other Federal organizations and universities, to develop and deliver information to ensure continued crop yields and other ecosystem goods and services in the face of climate variability and change, using teams of scientists and non-scientist stakeholders.

m) A decrease of $23,328,000 from ongoing research projects to support higher priority research initiatives.

The 2014 budget recommends selected high priority research initiatives which address the Administration's science and technology priorities and the Department's Strategic Goals. To finance these initiatives, within limited resources, some existing projects are proposed for reduction or termination given that they are: (1) mature where the research objectives have been mainly accomplished; (2) duplicative or can be accomplished more effectively elsewhere in ARS; (3) marginal or below threshold funding for program viability or sustainability; (4) conducted in substandard or inadequate infrastructure and future costs are prohibitive; (5) lacking a critical mass of scientists/support personnel for an effective program; or (6) are carried out by other research institutions. The savings achieved from these reductions/terminations will be redirected to finance the higher priority agricultural research initiatives identified in the 2014 budget, and will improve program and operational efficiencies.

AR, Booneville – Management of Temperate Pastures and Silvopastures for Small Farm Livestock Production (-$1,960,000)
AZ, Maricopa – Enhancing Water Conservation and Crop Productivity in Irrigated Agriculture (-$875,000)
AZ, Tucson – Ecohydrological Processes, Scale, Climate Variability, and Watershed Management (-$600,000)
CA, Parlier – Developing Sustainable Cropping Systems to Improve Water Productivity and Protect Water and Soil Quality in Irrigated Agriculture (-$613,000)
CA, Riverside – Integrated Field Scale Management Systems for Use of Degraded Waters (-$252,000)
CO, Ft. Collins – Management Practices to Mitigate Global Climate Change, Enhance Bioenergy Production, Increase Soil Carbon Stocks and Sustain Soil Productivity (-$650,000)
CO, Ft. Collins – Spatial Modeling of Agricultural Watersheds: Water And Nutrient Management and Targeted Conservation Effects at Field to Watershed Scales (-$955,000)
GA, Dawson – Develop and Transfer Irrigated and Non-Irrigated Peanut Management Technologies (-$730,000)
GA, Tifton – Enhancing Environmental Quality and Ecosystem Services in Southeastern U.S. Coastal Plain Agricultural Watersheds (-$100,000)
Headquarters - Air Quality Associated with Agricultural Operations (-$680,000)
Headquarters - Combined Water Quality Initiative (-$104,000)
Headquarters - Global Change Research (-$136,000)
IA, Ames – Management of Agricultural and Natural Resource Systems to Reduce Atmospheric Emissions and Increase Resilience to Climate Change (-$485,000)
IA, Ames – Managing Agricultural Water Quality in Fields and Watersheds: New Practices and Technologies (-$100,000)
IA, Ames – Soil Management for Enhanced Agricultural Productivity and Sustainable Biofuel Feedstock Production (-$250,000)
ID, Boise – Understanding Snow and Hydrologic Processes in Mountainous Terrain with a Changing Climate (-$500,000)
MD, Beltsville – Biological Treatment of Manure and Organic Residuals to Capture Nutrients and Transform Contaminants (-$395,000)
MD, Beltsville – Effects of Elevated Atmospheric Carbon Dioxide, Environmental Stress, and Edaphic Conditions on Bioactive Compounds in Brassica Crops (-$718,000)
MD, Beltsville – Leveraging Remote Sensing, Land Surface Modeling and Ground-Based Observations...Variables within Heterogeneous Agricultural Landscapes (-$2,000,000)
ME, Orono – Enhancing Sustainability of Food Production Systems in the Northeast (-$1,117,000)
MN, Morris – Advancing Sustainable and Resilient Cropping Systems for the Short Growing Seasons and Cold, Wet Soils of the Upper Midwest (-$1,454,000)
MN, Morris – Multi-Scale Evaluation of Land Use Management Systems in the Upper Midwest (-$777,000)
MN, St. Paul – Practices to Protect Water Quality and Conserve Soil and Water Resources in Agronomic and Horticultural Systems in the North Central U.S. (-$500,000)

MO, Columbia – Landscape-Based Crop Management for Food, Feed, and Bioenergy (-$200,000)
MO, Columbia – Improving Irrigation Management for Humid and Sub-Humid Climates (-$350,000)
MO, Columbia – Improving Water Quality in Agricultural Watersheds Underlain by Claypan and Restrictive Layer Soils (-$100,000)
MS, Oxford (Jonesboro, AR worksite) – Preserving Water Quality and Availability for Agriculture in the Lower Mississippi River Basin (-$500,000)
MS, Stoneville – Development of Water Management Technologies for the Mid-South (-$500,000)
ND, Mandan – New Technologies to Enhance Sustainability of Northern Great Plains Grasslands (-$350,000)
NE, Lincoln – Management Strategies for Meeting Agronomic, Environmental, and Societal Crop Production Demands (-$100,000)
NM, Las Cruces – Management Technologies for Conservation of Western Range Lands (-$100,000)
OK, El Reno – Adapting Soil and Water Conservation to Meet the Challenges of a Changing Climate (-$500,000)
OK, El Reno – Agricultural Land Management to Optimize Productivity and Natural Resource Conservation at Farm and Watershed Scales (-$100,000)
PA, University Park – Managing Farms for Environmental Stewardship and Profit (-$100,000)
PA, University Park – Management and Conservation Practices to Improve Water Quality in Agroecosystems of the Northeastern U.S. (-$100,000)
SC, Florence – Managing Water Availability and Quality to Maintain or Increase Agricultural Production, Conserve Natural Resources, and Enhance Environment (-$500,000)
TX, Bushland – Improving Water Productivity and New Water Management Technologies to Sustain Rural Economies (-$500,000)
TX, Bushland – Sustaining Rural Economies through New Water Management Technologies (-$1,658,000)
TX, Temple – Grassland Productivity and Carbon Dynamics: Consequences of Change in Atmospheric Carbon Dioxide, Precipitation, and Plant Species Composition (-$400,000)
WI, Madison – Alternative Crop and Forage Production Systems for Improved Nutrient Management (-$162,000)

Note: There is an adjustment (-$1,157,000) to the Annualized Continuing Resolution.

n) A decrease of $2,320,000 in ongoing extramural research projects.

Need for Change

Under ARS' Environmental Stewardship program, selected extramural research projects are proposed for termination, given that the research conducted is carried out by other institutions including universities and land grant institutions. The savings achieved from these reductions/terminations will be redirected to finance the higher priority agricultural research initiatives identified in the 2014 budget.

KY, Bowling Green – Waste Management (-$536,000)
MS, Oxford – Acoustics (-$806,000)
MS, Oxford – National Center for Computational Hydroscience and Engineering (-$882,000)
UT, Logan – Locoweed (-$96,000)

Library and Information Services

(9) An increase of $4,596,000 for Library and Information Services ($20,919,000 available in 2013).

NAL provides services directly to the staff of USDA and to the public, primarily via its web site, http://www.nal.usda.gov. NAL was created with the USDA in 1862 and was named in 1962 a national library by Congress, as the primary agricultural information resource of the United States. NAL is the premier library for collecting, managing, and disseminating agricultural knowledge. The Library is the repository of our National's agricultural heritage, the provider of world class information, and the wellspring for generating new fundamental knowledge and advancing scientific discovery. It is a priceless national resource that, through it services, programs, information products, and web-based tools and technologies, serves anyone who needs agricultural information.

Base funding for the National Agricultural Library (NAL) will continue to finance the agency's Library and Information Services. Continuing the base funding and limiting reductions is essential to ensuring the continued success of NAL's operations.

The funding change is requested for the following items:

a) An increase of $96,000 for pay costs which includes $14,000 for annualization of the fiscal year 2013 pay raise and $82,000 for the anticipated fiscal year 2014 pay raise.

Funding for pay costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Absorption of these costs reduces the number of scientists and support personnel essential for conducting the agency's research programs. If pay costs are not fully funded, ARS will be unable to fill critical positions and will have to reduce spending for much needed laboratory equipment, supplies, and other materials.

b) An increase of $6,000,000 to Establish Broad Infrastructure Capacity Within the National Agricultural Library to Source, Store, Manage, and Disseminate Large and Complex Environmental, Life Cycle Assessment, Genomic, Biologic, and Other Databases for Public Use.

Need for Change

Information is the fundamental currency of modern scientific research, and yet researchers' data and findings too often remain stored in isolation. The increasingly interdisciplinary nature of agricultural problems requires pulling that information together into a common, coordinated informatics structure. Such a structure will link the researchers with their scholarly publications and research findings, with the data that underlie those findings, and with other scientists investigating different aspects of the problem at hand. This coordinated informatics structure will enable researchers to access, compare, and use datasets, research findings, scientific collections and scholarly publications across research sites and disciplines. Such a solid infrastructure will also ensure the preservation and availability of datasets collected by ARS networks during the course of projects such as the Long-Term Agro-ecosystems Research (LTAR) network, Conservation Effects Assessment Project (CEAP), the Greenhouse gas Reduction through Agricultural Carbon Enhancement network (GRACEnet), and the Renewable Energy Assessment Project (REAP). Data from these projects and others must be made accessible to advance the development, validation, and application of the simulation models and risk management tools that support day-to-day production management decisions, national and international assessments, and research. A broad and scalable common infrastructure that includes communication networks, cyber security mechanisms, computing platforms, digital storage, database management systems, programming, modeling capabilities, and skilled informatics personnel is necessary to fully realize the benefits of coordinating the decades long, landscape scale investments already made in ARS research programs, projects, and land-based infrastructure.

Outcomes

This initiative will establish a sophisticated data and information management strategy that will deliver the expected benefits from nationwide research. It will allow ARS to establish the infrastructure and environment to facilitate research collaboration among government agencies, industry, and academia. Such an enhanced data and information management capacity for ARS research will enable decision-making based on multi-institutional, interdisciplinary science obtained from a scale of effort surpassing that achieved by any single location or region. Management and decisions based on such a large-scale research information and data strategy greatly increase the overall capability to further agricultural sustainability, environmental quality, and provision of ecosystem goods and services in agricultural landscapes throughout the nation.

With a solid data analysis infrastructure behind it and the open access to scientific collections, scholarly publications, and networked researchers, investigations into how to sustain or increase the production of food, feed, fiber, fuel, and other agro-ecosystem goods and services will succeed beyond current levels. Researchers can better determine how to minimize the environmental footprint, and can comprehensively address all components of agricultural sustainability and sustainable intensification on a national scale.

ARS data and information management capacity, practices, and guidelines will increase staff productivity by reducing time spent re-creating data, identifying scientific collections, or locating scholarly publications. This increased productivity will allow a renewed focus on questions that are currently not possible or feasible to address. In addition, capturing scientific outcomes at all stages reduces the knowledge loss due to attrition or closure of locations and projects.

Means to Achieve Change

- Establish the natural resources and sustainable agricultural systems component for Agricultural Informatics at NAL ($1,000,000). ARS will:
  - Establish a scalable common infrastructure that includes communication networks, cyber security mechanisms, computing platforms, digital storage, database management systems, and skilled informatics staff.
  - Create a locus of coordination for historical and future datasets collected by the 10 LTAR sites. Provide critical infrastructure to coordinate and manage data storage and synthesis across various ARS natural resources research networks, and key personnel to effect this coordination, including overseeing the activities of the LTAR site data coordination personnel identified above, and software engineering expertise to enable synthetic data analysis including state-of-the-art visualization techniques.
  - Develop quality assurance mechanisms to ensure high quality data. Mechanisms include: best practices, matured processes, and automated software tools for creating metadata; reviewing contents; validating formats and codes; organizing contents; and data conversion.

- Establish a stewardship site for data relating to agricultural management, greenhouse gas emission, and soil carbon sequestration at NAL ($1,000,000). ARS will:
  - Establish a scalable common infrastructure that includes communication networks, cyber security mechanisms, computing platforms, digital storage, database management systems, and skilled informatics staff.
  - Create a primary long-term storage and stewardship site for GRACEnet data and models. Develop software tools to collect, organize, manage, retrieve, and preserve datasets and models. Software tools will be focused on web-based data entry, data retrieval, data exploration, and specialized user interfaces to access and run greenhouse gas, carbon sequestration, and other models needed for life cycle analysis. Provide open data and model access.
  - Develop software tools to interface, exchange, and integrate GRACEnet data with LTAR datasets.

- Develop a North American Life Cycle Assessment (LCA) Digital Commons at NAL by enhancing and expanding the USDA LCA Digital Commons ($500,000). ARS will:
  - Create an integrated system linking life cycle-related data from across the U.S. Federal government, Canada, and Mexico. Provide database and infrastructure support to the federal partners (including the Environmental Protection Agency, Department of Energy, National Oceanic and Atmospheric Administration, U.S. Geological Survey, and Nuclear Regulatory Commission) via hosted databases, shared database applications, or links with established systems. Nurture close coordination to increase access to and use of life cycle assessment and associated data.
  - Update and expand data coverage in the existing USDA LCA Digital Commons. Give a new purpose or use for high value data from USDA's Economic Research Service (ERS) and obtain and transform data from the Forest Service (FS), National Agricultural Statistics Service (NASS), ARS, Office of the Chief Economist, and the Natural Resource Conservation Service (NRCS) for the business and life cycle communities. Incorporate international data important for agricultural trade and analysis of the global supply chain.
  - Develop tools to move data seamlessly between modeling applications and the Digital Commons, facilitating the capacity to conduct consequential, "what if" analyses.

- Develop Open Ag Central to facilitate access, dissemination, and long-term stewardship for unclassified scientific research and technical literature to make reliable agricultural and related information openly available to the public, research community, and policy-makers ($1,200,000). ARS will:

  - Develop a comprehensive web-based system to provide access to significant current, recent, and historical scientific research outcomes, in partnership with the Federal community, universities, and non-governmental global partners and in support of the America Compete Reauthorization Act of 2010.
  - Establish systems for submitting, storing, querying, and retrieving digital scientific research outcomes. Create descriptive information about each item to facilitate retrieval. Develop search tools, interfaces, and delivery mechanisms that work across desktop and mobile devices and that support the machine-to-machine exchange of information for automated systems. Create a mechanism for linked-open interoperability and content sharing with other data providers and stakeholders.
  - Provide open access to peer reviewed literature to accelerate understanding of complex agricultural systems, drive rapid progress in meeting social challenges, and advance fundamental scientific knowledge. Access to research outcomes will facilitate crop yield improvements, crop resilience, and nutritional enhancements, and will accelerate adoption of new technologies to help the U.S. adapt to changes in climate and economic viability.

- Establish the Discovery Center for Scientific Collections at NAL to collect, digitize, steward, and maintain collections of scientific importance to USDA, the Federal community, and non-governmental partners ($1,300,000). ARS will:
  - Build a comprehensive web-based inventory of high value scientific collections maintained by USDA, integrating records from dispersed collections into a common framework and linking to significant collections outside of USDA. This single, web-based gateway will increase visibility and use of the collections.
  - Develop a system for storing, querying, and retrieving digitized USDA scientific collections of images and non-image objects. Support transforming physical collections and realia to digital objects to increase their visibility and ease access while preserving the physical items themselves. Create descriptive information about each image and object to facilitate retrieval.
  - Develop search tools, interfaces, and delivery mechanisms that work across desktop and mobile devices and that support the machine-to-machine exchange of information for automated systems. Create an interoperable mechanism for content sharing with other data providers and stakeholders. Facilitate access to key scientific collections to support research, policy-making, and practical use, including the rapid identification of organisms with the potential to threaten the food chain and the environment; the detection of elements useful in forensics and law enforcement; and the development or expansion of various commercial sector applications such as oil exploration.

- Expand the reach and capacity of USDA VIVO (i.e., a web application designed to enable better national networking between scientists from different disciplines and locations) to increase collaboration, in support of the White House evidence-based budgeting and data transparency initiatives and efforts to improve America's competitiveness through research and development ($500,000). ARS will:
  - Develop and manage a robust web-based semantic discovery and collaboration tool to facilitate the calibration of USDA, agency, and individual research portfolios and integrate and exchange data across the USDA science agencies (i.e., ARS, ERS, FS, NASS, and the National Institute for Food and Agriculture). Establish a system to re-use data, visualize specific research topics, map research networks, and locate expertise across these agencies, expanding to include additional USDA agencies and researchers once established.
  - Design and facilitate automated data exchange from participating agencies' systems of record to the USDA VIVO system. Link to other science agencies in the Federal sector and to other VIVO instances across the hemisphere to expose research and collaboration opportunities.
  - Share VIVO data with associated systems such as STAR METRICs (Science and Technology for America's Reinvestment: Measuring the Effect of Research on Innovation, Competitiveness, and Science) to document the outcomes of science investments to the public. Use gained capabilities to make evidence-based budget decisions on where to invest resources across the USDA science enterprise.
  - Link digital full-text content to researchers to add depth and usefulness to the records. Maintain the system to include scientists, publications, research projects, and patents working across USDA science agencies and the larger Federal sector and beyond, and disambiguate researchers with similar names.

- Establish a Bioinformatic (Genomic) Research Platform at NAL as a collaborative resource for agricultural genomic information and analytical tools ($500,000). ARS will:
  - Develop a unique bioinformatic research platform, bringing together gene sequence information for agriculturally important species in a scalable system. Ensure this multiple-species system can receive, review, store, discover, and retrieve gene sequences; adapt existing tools for sequence comparisons; and link phenotypes with genotypes and other types of genomic data increasingly used in agricultural research. Support ARS labs and partners without the cyber-infrastructure to host their own system, ensuring their data is fully inter-operable with related data sets. Expand the potential for gene discovery by focusing beyond individual species, thereby supporting scientific advances in the biological control of insect pests, breeding for resistance to the viruses and other infective agents involved in colony collapse disorder, and developing other novel biologic agents helpful in human health.
  - Provide collaboration-based tools for analyzing genomic data, such as genome visualization and editing (browsing), genome annotation, curation and community annotation, sequence alignment, and comparative genome visualization. Develop a tool set based on available open source software such as GMOD components, integrated with new tools developed by ARS and partner projects, to enable ARS and other scientists to integrate, process, and analyze large datasets from multiple sources in one platform. Globally there are 500 families of insects, with only one of ten million species identified. This large collaborative framework, established to facilitate comparative genetic analysis, will greatly aid the identification and characterization of unknown species. Such species could be the source for new biological materials as diverse and useful as strong fibers to be woven into bullet resistant clothing or venoms with human health applications, such as anti-clot medications. It is increasingly urgent to build the capacity to characterize these unique organisms and their biological products before they are lost due to the growing environmental challenges resulting from climate change, global population pressures, and the loss of unique habitats.
  - Implement a distributed database architecture to link local data with other large sequence datasets from iPlant Collaborative, i5K, DOE Knowledgebase, XCEDE, iAnimal, iLife, Joint Genome Institute, European Bioinformatics Institute, and other projects, leveraging "big data" expertise and infrastructure with other Federal agencies. Facilitate sequence data comparisons across organisms to help identify gene motifs and potential gene function in newly discovered species. Establish an inter-operable network of databases, each managed and maintained by domain experts, to ensure scalable, secure, reliable, and cost-effective solutions for the emerging world of genomic "big data."

c) An increase of $1,200,000 for Earth Observation and Environmental Data Activities.

Note: See the write-up under the "Environmental Stewardship" section.

d) A decrease of $2,700,000 in ongoing operations or activities to provide savings to finance higher priority research initiatives.

Need for Change

In its FY 2014 Budget, ARS is proposing the termination or decreasing of selected ongoing programs or activities within the Library and Information Services. This will include the termination of new monograph acquisition; the end of library association memberships; the decline of digital journal subscription (DigiTop); the reduction of reference and document delivery services; and the cutback on cataloging. The savings achieved from these terminations or decreases will be redirected to finance increases needed in digital information services.

MD, Beltsville – NAL, downsize programs/operations (-$2,700,000)

Repair and Maintenance

ARS' Repair and Maintenance (R&M) program, about $18 million annually, is intended to improve existing agency facilities, i.e., to a condition substantially equivalent to its original state and efficiency. A portion of R&M funds are generally used to address recurring mandates, such as real property, energy, and sustainability assessments and reporting requirements, as well as seismic studies, accessibility surveys and corrective actions. Another portion of

the R&M funds are typically used for phased upgrades and modernization of existing structures, generally in the $1 to $3.5 million range.

Proposed Laboratory Closures and Consolidations

Proposed Closure/Consolidation	Laboratory/Location To Which Redirected	Research
Dale Bumpers Small Farm Research, Booneville, Arkansas (Integrated crop, forage, and livestock systems research)	U.S. Meat Animal Research Center, Clay Center, Nebraska; Grazinglands Research Laboratory, El Reno, Oklahoma; Grassland, Soil, and Water Research Laboratory, Temple, Texas	Improve production efficiencies and product quality in farm animals/ water quantity and quality research
Plant, Soil, and Water Research, Orono, Maine (Crop management systems research)	National Coldwater Marine Aquaculture Center; Orono, Maine/Franklin, Maine	Aquaculture research
Food Quality Laboratory Beltsville, Maryland (research on biology/technology of fruits/vegetables to reduce postharvest losses)	Human Nutrition Research Center; Hydrology and Remote Sensing Laboratory; and Crop Systems and Global Change Laboratory, Beltsville, Maryland	Enhance nutrition monitoring and surveillance capability/water quantity and quality research/adapt agriculture systems to climate variability
Avian Disease and Oncology Research, East Lansing, Michigan (Avian disease research)	Southeast Poultry Research Laboratory, Athens, Georgia	Countermeasures to prevent and control viral diseases of poultry
Biological Control of Insects Research, Columbia, Missouri (Biological insect control research)	Crop Systems and Water Quality Laboratory, Columbia, Missouri; National Animal Disease Center, Ames, Iowa	Water quantity and quality research/alternatives to antibiotic resistance
Biobased and Other Animal Co-Products, Wyndmoor, Pennsylvania (Biobased and animal co-products research)	Food Safety and Intervention Technologies Laboratory at Wyndmoor, Pennsylvania	Identify and evaluate specific intervention strategies through the food production chain

Geographic Breakdown of Obligations and Staff Years (SY)
(Dollars in thousands)

	2011 Actual		2012 Actual		2013 Estimate		2014 Estimate	
Location	Amount	SY	Amount	SY	Amount	SY	Amount	SY
ALABAMA, Auburn	$6,622	53	$5,957	46	$5,907	46	$5,907	46
ALASKA, Fairbanks	4,584	18	628	6	--	--	--	--
ARIZONA								
Maricopa	9,936	80	9,810	74	9,572	74	9,797	74
Tucson	5,138	46	5,144	47	5,775	52	7,072	52
Total	15,074	126	14,954	121	15,347	126	16,869	126
ARKANSAS								
Booneville	2,244	22	1,570	19	1,765	16	--	--
Fayetteville	1,737	13	1,689	12	1,627	12	1,627	12
Little Rock	9,794	11	7,681	5	6,349	5	6,349	5
Stuttgart	7,287	64	7,553	57	8,254	57	8,974	57
Total	21,062	110	18,493	93	17,995	90	16,950	74
CALIFORNIA								
Albany	37,657	268	35,540	240	36,455	261	37,512	261
Davis	11,706	97	11,588	93	10,954	93	10,965	93
Parlier	12,387	105	12,229	108	11,777	108	11,777	108
Riverside	5,513	42	5,277	36	5,574	36	5,584	36
Salinas	4,881	48	4,953	47	4,907	47	4,907	47
Shafter	1,458	16	267	8	--	--	--	--
Total	73,602	576	69,854	532	69,667	545	70,745	545
COLORADO								
Akron	2,094	21	1,973	20	2,049	20	2,519	20
Fort Collins	16,035	145	12,515	134	13,801	148	15,795	148
Total	18,129	166	14,488	154	15,850	168	18,314	168
DELAWARE								
Newark	2,081	15	2,088	16	2,070	16	2,070	16
DISTRICT OF COLUMBIA								
National Arboretum	12,084	80	11,853	78	11,413	78	11,413	78
Headquarters Federal Administration	83,365	500	91,135	490	85,664	490	85,664	490
Total	95,449	580	102,988	568	97,077	568	97,077	568
FLORIDA								
Brooksville	1,688	10	357	4	--	--	--	--
Canal Point	2,926	34	2,922	35	2,888	35	2,888	35
Fort Lauderdale	2,512	27	2,551	25	2,552	25	2,349	25
Fort Pierce	19,048	147	15,331	143	14,270	143	14,270	143
Gainesville	13,473	123	12,712	118	12,075	118	12,300	118
Miami	4,793	49	4,677	41	4,570	41	4,570	41
Total	44,440	390	38,550	366	36,355	362	36,377	362

Geographic Breakdown of Obligations and Staff Years (SY)
(Dollars in thousands)

	2011 Actual		2012 Actual		2013 Estimate		2014 Estimate	
Location	Amount	SY	Amount	SY	Amount	SY	Amount	SY
GEORGIA								
Athens	27,155	217	22,850	195	23,804	211	27,636	224
Byron	3,432	36	3,796	31	3,651	31	3,651	31
Dawson	4,239	39	3,654	32	3,879	32	3,879	32
Griffin	2,445	20	2,436	20	2,319	20	2,476	20
Tifton	10,258	96	10,184	89	9,954	89	12,035	89
Total	47,529	408	42,920	367	43,607	383	49,677	396
HAWAII, Hilo	9,727	65	9,177	63	9,544	63	8,404	63
IDAHO								
Aberdeen	6,275	56	5,827	49	6,012	49	6,448	49
Boise	2,365	21	2,191	19	2,143	19	2,613	19
Dubois	2,431	19	2,401	20	2,149	20	2,149	20
Kimberly	3,631	36	3,610	35	3,585	35	3,945	35
Total	14,702	132	14,029	123	13,889	123	15,155	123
ILLINOIS								
Peoria	34,475	246	32,085	217	33,587	236	34,037	236
Urbana	5,831	41	5,949	39	5,731	39	6,406	39
Total	40,306	287	38,034	256	39,318	275	40,443	275
INDIANA, W. Lafayette	7,675	66	7,799	61	7,753	61	7,999	61
IOWA, Ames	51,016	428	50,769	418	51,086	418	56,937	430
KANSAS, Manhattan	14,917	99	13,803	110	13,798	110	14,248	110
KENTUCKY								
Bowling Green	2,608	17	2,660	16	2,584	16	1,841	16
Lexington	2,580	15	2,617	14	2,635	14	1,806	14
Total	5,188	32	5,277	30	5,219	30	3,647	30
LOUISIANA								
Baton Rouge	2,736	24	2,779	23	3,138	26	3,138	26
Houma	4,008	49	3,995	48	4,069	48	4,069	48
New Orleans	25,482	192	22,617	169	22,093	169	21,648	169
Total	32,226	265	29,391	240	29,300	243	28,855	243
MAINE, Orono	2,992	22	2,452	14	2,470	14	2,470	14
MARYLAND								
Beltsville	139,344	940	134,073	871	136,271	885	153,946	890
Frederick	5,672	44	5,694	41	5,630	41	6,630	41
Total	145,016	984	139,767	912	141,901	926	160,576	931
MASSACHUSETTS, Boston	15,009	9	15,166	10	15,258	10	15,991	10
MICHIGAN, East Lansing	4,919	41	4,331	35	4,597	35	1,327	10

Geographic Breakdown of Obligations and Staff Years (SY)
(Dollars in thousands)

	2011 Actual		2012 Actual		2013 Estimate		2014 Estimate	
Location	Amount	SY	Amount	SY	Amount	SY	Amount	SY
MINNESOTA								
Morris	2,909	26	2,763	25	2,643	25	2,643	25
St. Paul	7,430	67	6,922	66	6,793	66	6,793	66
Total	10,339	93	9,685	91	9,436	91	9,436	91
MISSISSIPPI								
Mississippi State	8,675	75	8,776	71	9,216	71	8,842	71
Oxford	14,060	96	14,113	91	14,040	91	10,848	91
Poplarville	5,218	35	5,300	35	5,169	35	4,423	35
Stoneville	36,537	289	35,646	281	37,203	295	31,725	295
Total	64,490	495	63,835	478	65,628	492	55,838	492
MISSOURI, Columbia	9,039	81	8,771	75	9,104	75	10,982	75
MONTANA								
Miles City	3,510	26	4,691	26	3,337	26	3,697	26
Sidney	5,075	51	5,082	45	5,136	45	5,361	45
Total	8,585	77	9,773	71	8,473	71	9,058	71
NEBRASKA								
Clay Center	19,395	120	19,504	116	19,580	116	22,009	119
Lincoln	5,954	66	5,862	69	5,983	69	5,983	69
Total	25,349	186	25,366	185	25,563	185	27,992	188
NEVADA								
Reno	2,126	7	2,232	20	2,366	20	2,366	20
NEW MEXICO								
Las Cruces	6,033	51	6,143	48	6,032	48	7,217	48
NEW YORK								
Geneva	3,961	32	3,977	32	3,926	32	3,937	32
Greenport	4,177	30	4,078	31	3,840	31	4,371	31
Ithaca	10,697	55	10,850	59	10,595	59	13,144	59
Total	18,835	117	18,905	122	18,361	122	21,452	122
NORTH CAROLINA								
Raleigh	9,615	83	9,570	78	9,402	78	10,077	78
NORTH DAKOTA								
Fargo	15,683	132	14,798	116	15,780	116	15,780	116
Grand Forks	10,018	48	9,007	47	9,560	47	9,560	47
Mandan	3,630	37	3,505	34	3,441	34	4,656	34
Total	29,331	217	27,310	197	28,781	197	29,996	197
OHIO								
Columbus	1,613	15	1,396	15	1,478	15	1,838	15
Coshocton	1,328	13	329	5	--	--	--	--
Wooster	6,015	49	5,906	47	5,108	47	4,923	47
Total	8,956	77	7,631	67	6,586	62	6,761	62

Geographic Breakdown of Obligations and Staff Years (SY)
(Dollars in thousands)

	2011 Actual		2012 Actual		2013 Estimate		2014 Estimate	
Location	Amount	SY	Amount	SY	Amount	SY	Amount	SY
OKLAHOMA								
El Reno	5,444	42	5,408	40	5,361	40	7,416	44
Lane	2,075	20	530	9	--	--	--	--
Stillwater	3,654	33	3,631	29	3,661	29	3,661	29
Woodward	1,691	17	1,663	15	1,645	15	1,645	15
Total	12,864	112	11,232	93	10,667	84	12,722	88
OREGON								
Burns	3,255	28	3,394	30	2,727	30	2,727	30
Corvallis	13,742	123	13,631	116	11,910	116	12,838	116
Pendleton	1,946	18	1,974	17	1,961	17	1,961	17
Total	18,943	169	18,999	163	16,598	163	17,526	163
PENNSYLVANIA								
University Park	4,670	37	4,297	37	4,216	37	5,791	37
Wyndmoor	33,783	216	32,534	198	33,291	208	32,226	208
Total	38,453	253	36,831	235	37,507	245	38,017	245
SOUTH CAROLINA								
Charleston	4,518	42	4,651	42	4,485	42	4,485	42
Clemson	2,296	25	665	11	--	--	--	--
Florence	4,037	33	4,213	32	4,148	32	4,148	32
Total	10,851	100	9,529	85	8,633	74	8,633	74
SOUTH DAKOTA								
Brookings	3,468	37	3,042	32	2,967	32	2,967	32
TEXAS								
Beaumont	1,331	13	--	--	--	--	--	--
Bushland	6,862	48	6,507	44	6,960	44	5,468	44
College Station	16,139	138	14,487	125	14,493	138	14,763	138
Houston	13,533	8	13,967	7	13,678	7	17,278	7
Kerrville	5,589	46	5,937	53	5,664	53	5,664	53
Lubbock	8,917	99	8,908	96	9,038	96	9,038	96
Temple	3,545	31	3,386	29	3,586	29	4,860	33
Weslaco	9,963	106	3,975	59	--	--	--	--
Total	65,879	489	57,167	413	53,419	367	57,071	371
UTAH, Logan	9,153	82	9,302	81	9,007	81	9,371	81
WASHINGTON								
Prosser	3,761	30	3,657	30	3,369	30	3,369	30
Pullman	16,789	129	16,257	124	16,514	124	18,284	124
Wapato	4,557	50	4,553	49	4,631	49	4,631	49
Wenatchee	2,130	25	2,030	24	2,108	24	2,108	24
Total	27,237	234	26,497	227	26,622	227	28,392	227
WEST VIRGINIA								
Beaver	6,957	50	1,310	24	--	--	--	--
Kearneysville	7,296	65	7,114	61	7,186	61	7,186	61
Leetown	7,039	34	6,828	33	7,157	33	5,105	33
Total	21,292	149	15,252	118	14,343	94	12,291	94
WISCONSIN, Madison	17,627	122	15,808	118	16,088	118	16,272	118
WYOMING, Cheyenne	2,302	21	2,089	21	2,313	21	2,313	21

Geographic Breakdown of Obligations and Staff Years (SY)
(Dollars in thousands)

Location	2011 Actual		2012 Actual		2013 Estimate		2014 Estimate	
	Amount	SY	Amount	SY	Amount	SY	Amount	SY
PUERTO RICO								
Mayaguez	2,798	34	2,953	35	2,837	35	2,837	35
OTHER COUNTRIES								
Argentina, Buenos Aires	818	--	1,177	--	--	--	--	--
France, Montpellier	3,047	1	3,055	2	3,078	2	3,078	2
Total	3,865	1	4,232	2	3,078	2	3,078	2
Extramural and Funds Administered from Headquarters-Held Funds	16,189	--	29,406	--	61,028	--	33,831	--
Repair & Maintenance of Facilities	17,116	--	17,319	--	17,468	--	17,468	--
Obligations	1,133,001	8,159	1,089,795	7,596	1,110,316	7,596	1,124,003	7,596
Lapsing Balances	1,856	--	5,218	--	--	--	--	--
Bal. Available, EOY	6,845	--	8,970	--	--	--	--	--
Total Available	1,141,702	8,159	1,103,983	7,596	1,110,316	7,596	1,124,003	7,596

Salaries and Expenses

Classification by Objects
(Dollars in thousands)

		2011 Actual	2012 Actual	2013 Estimate	2014 Estimate
Personnel Compensation:					
Washington D.C.		$41,528	$46,162	$46,488	$46,908
Field		523,798	480,155	483,550	487,915
11	Total personnel compensation	565,326	526,317	530,038	534,823
12	Personal benefits	171,675	165,418	176,291	177,883
13.0	Benefits for former personnel	984	9,633	-	-
	Total, personnel comp. and benefits	737,985	701,368	706,329	712,706
Other Objects:					
21.0	Travel and transportation of persons	13,185	11,765	13,165	13,090
22.0	Transportation of things	595	793	807	789
23.1	Rental payments to GSA	52	19	19	19
23.2	Rental payments to others	897	751	764	748
23.3	Communications, utilities, and misc. charges	46,192	41,303	42,027	41,093
24.0	Printing and reproduction	1,311	668	759	650
25.1	Advisory and assistance services	956	925	941	920
25.2	Other services from non-Federal sources	8,707	6,132	11,269	8,273
25.3	Other purchases of goods and services from Federal sources	291	-	-	320
25.4	Operation and maintenance of facilities	37,515	33,200	33,778	33,032
25.5	Research and development contracts	148,107	147,481	151,557	153,211
25.6	Medical care	552	325	331	324
25.7	Operation and maintenance of equipment	14,900	14,813	13,140	15,687
25.8	Subsistence and support of persons	12	39	40	39
26.0	Supplies and materials	74,676	81,883	86,208	85,820
31.0	Equipment	29,088	35,713	36,345	44,729
32.0	Land and structures	5,223	3,042	3,095	3,026
41.0	Grants	12,757	9,575	9,742	9,527
	Total, Other Objects	395,016	388,427	403,987	411,297
99.9	Total, new obligations	1,133,001	1,089,795	1,110,316	1,124,003
Position Data:					
Average Salary (dollars), ES Position		$137,942	$138,302	$139,280	$140,538
Average Salary (dollars), GS Position		$68,089	$68,088	$68,570	$69,189
Average Grade, GS Position		10.5	10.6	10.6	10.6

Status of Programs

The Agricultural Research Service's (ARS) major research programs -- New Products/Product Quality/Value Added; Livestock/Crop Production; Food Safety; Livestock/Crop Protection; Human Nutrition; and Environmental Stewardship -- address the Department's goals and priorities. A brief summary of the agency's selected accomplishments for 2012 and current research activities, including the National Agricultural Library, are detailed below.

New Products/Product Quality/Value Added

Current Activities:

ARS has active research programs directed toward: (1) improving the efficiency and reducing the cost for the conversion of agricultural products into biobased products and biofuels, (2) developing new and improved products to help establish them in domestic and foreign markets, and (3) providing higher quality healthy foods that satisfy consumer needs in the United States and abroad.

Selected Examples of Recent Progress:

New rapid digital imaging wheat sorting system developed. Single grain wheat sorting is traditionally accomplished by a human, hand-held visual detection method of identifying mold, weather, disease, and storage damaged grains. Although several attempts have been made over the decades to develop instrument-based alternatives, inspection still remains a challenge. ARS scientists from Beltsville, Maryland have developed a digital imaging system that captures images of individual seeds in freefall. The imaging system, coupled with rapid image processing, scans more than 82 percent of each seed during high speed sorting. This new system will affect the inspection/grading of U.S. wheat and its trading and milling industries. It also is being tested by a pharmaceutical company for assessing the quality of pill coatings. Licensing and patent applications are being filed.

Milk processing plant simulator lowers greenhouse gas emissions. Life cycle assessments of on-farm and off-farm fluid milk production found on-farm activities generated 70 percent of greenhouse gas emissions due to methane from cows and manure. Other off-farm activities such as milk processing, packaging, and refrigeration contributed the remaining 30 percent. Significant reductions in greenhouse gas emissions for off-farm processors are practical only if processors know the energy hot spots in their plants and if the costly upgrades reduce greenhouse gas emissions. ARS scientists in Wyndmoor, Pennsylvania partnered with dairy processors to create a computer-based model of the fluid milk process to lower greenhouse gas emissions. The model can offer multiple ways of making changes in individual processing plants and instantly calculate both greenhouse gas reductions and costs of implementing the changes. The model has been distributed to more than 100 processors in the United States and will help the dairy industry realize its goal of reducing greenhouse gas emissions by 25 percent per gallon of milk by 2020.

Packaging inserts that fight decay of fresh produce. Decay of fresh produce, especially small fruits such as strawberries and blueberries that cannot be washed, contributes to a short postharvest shelf life. ARS scientists in Fort Pierce, Florida, in collaboration with a Cooperative Research and Development Agreement (CRADA) partner, developed small single use packets that when inserted into packaged fruit release an antimicrobial vapor (Curoxin) that surrounds the fresh fruit. The vapor extended the postharvest shelf life of blueberries and strawberries by maintaining fruit firmness, reducing water loss and decay, and maintaining color and overall quality. It was also used to treat citrus fruit infected with citrus canker. Canker is a problem for the fresh citrus market because fruit coming from groves where canker is found cannot be marketed internationally. Packets containing the vaporizing compound placed inside containers of citrus significantly reduced bacterial canker counts. The antimicrobial vapor packets are being tested in pilot studies with commercial packing houses. The packets could save the international fresh produce industry more than $1 billion annually.

Improved winter hardy switchgrass strains have high biomass yields. Lowland switchgrass cultivars have greater biomass yield than upland switchgrass, but are largely of southern origin and are often affected by winter cold temperature injury or loss from winter kill. ARS researchers in Lincoln, Nebraska have developed an experimental

lowland switchgrass with improved winter hardiness and high biomass yield potential. The lowland strain was obtained by crossing upland and lowland plants followed by three generations of selection and breeding for winter survival in Nebraska, Wisconsin, and Illinois. In eastern Nebraska, average yields were 2.4 tons per acre greater than the best available released upland cultivar. This research demonstrates the feasibility of improving the winter hardiness of switchgrass through conventional, non-genetically modified plant breeding methods by understanding the underlying genetic diversity of native germplasm populations and utilizing appropriate traits not found in existing cultivars. The lowland experimental strain is now in the seed increase phase for potential release as a cultivar. The availability of this new strain is crucial to the success of the first commercial biorefineries being constructed in the region which need high yield biomass cultivars to reduce biofuel production costs.

Genetically engineered yeast overcomes major limitation to ethanol production. A major technical barrier in the commercial conversion of biomass to ethanol is the fact that the lowest cost biomass pretreatment technology – dilute-acid hydrolysis – produces byproducts such as furfural and hydroxymethylfurfural, which inhibit yeast metabolism and ethanol production. ARS scientists in Peoria, Illinois engineered a new inhibitor tolerant, pentose, utilizing yeast strain for lignocellulose-to-ethanol conversion. A patent application has been filed. They also found that the final ethanol concentration obtained from xylose fermenting inhibitor tolerant yeasts can be increased almost 10-fold by choosing casein as the fermentor's nitrogen source. This research overcomes a major technical barrier to commercial conversion of biomass to ethanol.

First estimates of cellulosic biofuel potential for double cropped Midwest winter rye. Concerns have been raised over potential conflicts between land used for food and biomass production. One approach to reduce potential land use conflicts is to raise cellulosic biomass crops during the period from fall through spring, between major summer crops when land lays fallow during the winter. ARS researchers in Ames, Iowa estimated potential biomass production from winter rye planted in the fall that could be harvested for cellulosic biofuel prior to spring planting of corn or soybean for the upper Midwest regions. Using computer simulation, the average biomass yield projected for 30 locations within the study region was 1.9 tons of dry matter per acre. Total potential annual biomass production for the entire region was projected to range from 120 to 170 million tons which would yield the energy equivalent of as much as 20 billion gallons of gasoline. These results provide biofuel producers and policymakers with estimates of double crop biofuel production that could be considered as a potential resource helping meet our domestic renewable energy needs.

Keeping ethanol producers a step ahead of antibiotic resistant microbes. Antibiotics are routinely used to control bacterial contamination in fuel ethanol plants but their use may be increasingly constrained by new strains of antibiotic resistant bacteria, or by new regulations to limit the presence of antibiotics in livestock feed (for which ethanol co-products are used). ARS scientists in Peoria, Illinois discovered laparaxin, a polypeptide produced by *Lactobacillus paracasei*, that inhibits growth of bacteria that contaminate ethanol plants, as well as some human and animal pathogens such as *Staphylococcus aureus*. A patent application has been filed. This research provides commercial ethanol distilleries with regulatory friendly tools for controlling bacterial contaminations.

New healthy functional foods from oats. Studies revealed that the soft-solid characteristics of various oat carbohydrates (beta-glucan) provided creamier, less runny properties that are valuable for developing new functional foods such as yogurt, instant puddings, custard, batter, smoothies, and ice cream. ARS scientists in Peoria, Illinois developed the oat concentrates, which appear to have great potential for health concerned consumers. An industrial partner has licensed this ARS patented digestible, functional food from oats for the production of Calorie-Trim and Nutrim, Z-Trim, for expanded markets including USDA's school lunch program.

Program Evaluations: In 2012, ARS conducted retrospective reviews of selected national programs. Overall, the programs were found to have had high impact (i.e., significant benefit or influence.) The programs were evaluated by a panel of experts who represented government, private industry, and customer/stakeholder groups and the non-profit arena. Performance was evaluated based on the quality of the research leading to actual impact, or progress toward anticipated benefits to end-users, scientific communities, and the broader society. The panel of experts provided recommendations that ARS managers can use in making future management decisions.

Livestock Production

Current Activities:

ARS' livestock production program is directed toward: (1) safeguarding and utilizing animal genetic resources, associated genetic and genomic databases, and bioinformatic tools; (2) developing a basic understanding of the physiology of livestock and poultry; and (3) developing information, tools, and technologies that can be used to improve animal production systems. The research is heavily focused on the development and application of genomics technology to increase the efficiency and product quality of beef, dairy, swine, poultry, aquaculture, and sheep systems. Current areas of emphasis include increasing efficiency of nutrient utilization, increasing animal well being and reducing stress in production systems, increasing reproductive rates and breeding animal longevity, developing and evaluating non-traditional production systems (e.g., organic, natural), and evaluating and conserving animal genetic resources.

Selected Examples of Recent Progress:

Alternatives to conventional antimicrobials for livestock. Finding novel antimicrobials that kill multi-drug resistant pathogens is a worldwide problem for livestock industries and human medicine alike. In collaboration with Spanish scientists, ARS scientists in Beltsville, Maryland identified a bacterial cell wall degrading protein from a virus of *Staphylococcus* bacteria that when applied externally binds and kills *Staphylococcus aureus* bacteria. The protein was then fused to lysostaphin, another protein that is lethal to *S. aureus* bacteria, and then to a third bacterial cell wall degrading protein. The combination of these three proteins effectively kills both bovine and human strains of *S. aureus*, including multi-drug resistant strains. This three protein fusion strategy, to create cell wall degrading enzymes with multiple simultaneous lethal activities, is potentially applicable to any bacteria with externally exposed cell wall components and should enable production of antimicrobials that are highly refractory to resistance development while not targeting beneficial strains of bacteria. This novel fusion protein has the potential to effectively treat persistent mastitis on dairy farms and multi-drug resistant *S. aureus* (MRSA) in hospitals and clinics.

Genome copy number variation affects reproduction, tropical adaptation, and metabolism in cattle. Previously, no links between genome copy number variation (CNV) and phenotype differences in cattle were known. ARS scientists in Beltsville, Maryland and Clay Center, Nebraska using next generation, whole genome sequencing completed the first comprehensive discovery of CNV in cattle in relation to phenotypic differences. CNV regions from indicine and taurine cattle were linked to genes associated with health and production traits such as fertility, parasite resistance, and feed efficiency. In related research, ARS scientists evaluated more than 700,000 genome markers in beef cattle for fertility. Evidence of CNV regions were found on all chromosomes associated with reproductive efficiency, and a DNA region was identified specific to cattle that fail to conceive. These results were validated in more than 300 *Bos indicus* × *Bos taurus* pregnant females, confirming the negative effect of the CNV related gene deletions. These findings are a major step forward in identifying components affecting genetic variation beyond typical mutations which are not accounted for in current genetic evaluation systems and will lead to greater genetic insight and greater genetic progress in cattle breeding programs. These results will also enable development of DNA marker tests to improve reproduction and production efficiencies for the beef industry.

Temperature humidity index as a useful predictor of live performance in heavy broiler chickens. As the temperature humidity index increases, drastic declines in growth and efficiency occur in heavy broiler chickens. ARS scientists in Starkville, Mississippi found that once building temperatures exceed a surprisingly relatively cool temperature of 20°C (68°F) for 49 day old birds, the amount of feed consumed per pound of live weight gain increases dramatically from about three pounds of feed per pound of gain (which is typical for the last two weeks of production) to in excess of six pounds of feed per pound of live weight gain at 27°C (80°F), an increase of more than 100 percent in some production systems. This finding was significant to the poultry industry. As feed costs escalate, this research underscores the critical need to optimize cooling techniques and ventilation rates to best manage feed conversion efficiencies in heavy broiler production systems, particularly in warmer climates and warmer periods during the year.

Controlling ammonia emissions and increasing nutritional efficiency in dairy cows through diet. Cows excrete urea nitrogen in urine which is rapidly converted to ammonia gas and volatized into the atmosphere. Milk urea nitrogen (MUN) testing was developed to help dairy producers and nutritionists evaluate protein levels and nitrogen use efficiency of dairy cattle diets. A large component of protein is nitrogen. ARS scientists in Madison, Wisconsin determined that MUN is also a reliable indicator of concentrations of urea nitrogen in urine and ammonia emissions from dairy farms. Six feeding trials were analyzed to determine the relationships between feed nitrogen intake, MUN, and ammonia emissions from dairy barns. Ammonia emissions dropped between 10 percent and 34 percent when MUN levels decreased, whereas milk production and animal well-being were maintained. Feeding less dietary nitrogen would save dairy producers approximately $740 million annually in reduced feed protein (nitrogen) costs while reducing the environmental footprint of the dairy industry through reduced ammonia (greenhouse gas) emissions.

Management options for range livestock producers during drought. Dealing with drought is a major challenge for livestock producers. To provide producers with options to help address severe localized drought conditions for range beef cattle producers, ARS researchers in Miles City, Montana evaluated the effect of early weaning calves at 80 days of age on all segments of range livestock production. Early weaning was shown to improve body weight and condition of cows through the subsequent critical winter period, particularly in young cows which are generally more adversely affected by drought and body condition. It had no effect on heifer calves that were retained for breeding replacements, and it improved growth and quality performance of feedlot steers under some management protocols. Early weaning of calves provides range cattle producers with a method to conserve drought limited forages, preserve sensitive range lands, maintain cow condition and reproductive performance, and minimize the need for significant herd reductions during periods of extreme seasonal drought.

Yeast supplementation improves adaptation to heat stress and enhances the health of feedlot cattle. ARS research in Lubbock, Texas identified yeast products as nonantibiotic alternatives that improve productivity in feedlot cattle by enhancing immune function, which in turn, lessens the need for conventional antibiotics. Further collaborative research indicated that supplementing yeast products during a period of heat stress improved feed intake and weight gain while maintaining the overall health of the cattle. Analyses also indicated that yeast supplementation appears to mitigate the negative immune response effects of dietary endotoxins in feedlot rations which are increased in grain during drought years. Mitigating endotoxins improves or maintains immune function and enhances the overall health of feedlot cattle. Collectively, these studies indicate that using yeast products as a feed supplement for feedlot cattle improves health and well-being, mitigates dietary endotoxins, and reduces the negative effects of heat stress on growth and feed intake. These benefits will improve the economic competitiveness of the feedlot industry through improved efficiencies, lower costs, and enhanced adaptation to heat stress.

A method to recover high value co-products from grain-based ethanol production. There is increasing production of fuel ethanol from grains in the United States. The primary co-product is corn distiller's dried grains with solubles. The quantity of this relatively low value product is increasing and is used primarily in cattle but its use for feeds is limited due to an imbalance of nutrients. ARS scientists in Aberdeen, Idaho developed a new processing method that will produce more consistent, higher protein distiller's dried grains with solubles and two new products, a protein and a mineral source with improved nutrient profiles. Feeding trials with rainbow trout demonstrated that both products are highly digestible which is vitally important to the trout industry. This new process can be easily added to the existing process which reclaims valuable phosphorus and protein from the soluble and separates the nutrients into distinct products, thus increasing the overall flexibility, economic value, and sustainability of ethanol production.

Development and validation of split pond production systems to increase catfish production. Most U.S. aquaculture production comes from large, earthen ponds. Disadvantages of traditional pond production are the need for continuous management of pond oxygen concentrations, sporadic algae related fish off-flavors, losses to avian predators, difficulties in disease control, inefficient fish harvesting, and lack of tight control of water quality. ARS scientists at Mississippi State University in Stoneville, Mississippi have addressed these constraints by modifying ponds to physically separate the fish holding function from the life support and waste treatments functions. A commercial scale system, called the split pond, has been developed and validated in Stoneville. The split pond is constructed by dividing an existing earthen pond into two unequal sections with an earthen levee and then linking the two sections with water flow. Validation studies indicate that the split pond is easy to manage and that fish

production can be tripled compared with that of traditional ponds. Split ponds have now been widely adopted by the catfish farming industry. More than 1,000 acres of commercial ponds have been built with at least an additional 1,000 acres under construction or planned.

Third generation of selectively bred yellow perch reach market size four months sooner. High performers of yellow perch strains were identified, tagged, genotyped, and selectively bred by ARS researchers in Milwaukee, Wisconsin and their University of Wisconsin at Milwaukee partners. As a result of two generations of selection, the time needed to reach market size has been reduced from 11 to seven months. Faster growth to market size will enable producers to have multiple production cycles in a single year which increases profitability of commercial yellow perch aquaculture operations. Additionally, genetic differences in resistance to viral hemorrhagic septicemia virus have been demonstrated and will enable further genetic improvement in disease resistance.

Development of a live attenuated vaccine and in pond vaccination platform to protect catfish against enteric septicemia. A new vaccine and vaccine delivery platform have been developed resulting in exceptional protection against Enteric Septicemia of Catfish (ESC). Based on experimental pond studies conducted under conditions similar to the commercial production setting, vaccination increased survival, fish size, and feed consumption while improving the feed conversion ratio by 40.4 percent. The improved feed conversion represented up to a 30 percent reduction in feed costs, while improved production efficiencies in vaccinated fish increased gross sales more than 100 percent. Similar results were obtained over two years of field testing. Field and laboratory research is being conducted as part of the USDA licensing process for live attenuated vaccines.

Summer diets for hybrid striped bass. High daily summertime feeding rates can result in concentrations of ammonia in pond water that are toxic to hybrid striped bass. In response, farmers may curtail feeding or switch to a lower protein feed, both of which reduce production. With input from a Mississippi-based hybrid striped bass producer, Nature's Catch, ARS scientists in Stuttgart, Arkansas demonstrated that a diet with higher digestible protein and fat that was supplemented with deficient amino acids maximized growth and nutrient retention and reduced ammonia waste production. Fish feed manufacturers are using new digestibility coefficients recently developed by ARS in their diet formulations for hybrid striped bass, feeding the new summer diet formulation and improving summer production.

Program Evaluations: In 2012, no retrospective program reviews were conducted.

Crop Production

Current Activities:

ARS' crop production program focuses on developing and improving ways to reduce crop losses while protecting and ensuring a safe and affordable food supply. The research program concentrates on effective production strategies that are environmentally friendly, safe to consumers, and compatible with sustainable and profitable crop production systems. Research activities are directed at safeguarding and utilizing plant genetic resources and their associated genetic, genomic, and bioinformatic databases that facilitate selection of varieties and/or germplasm with significantly improved traits.

Current research activities attempt to minimize the impacts of crop pests while maintaining healthy crops and safe commodities that can be sold in markets throughout the world. ARS is conducting research to discover and exploit naturally occurring and engineered genetic mechanisms for plant pest control, develop agronomic germplasm with durable defensive traits, and transfer genetic resources for commercial use. ARS provides taxonomic information on invasive species that strengthens prevention techniques, aids in detection/identification of invasive pests, and increases control through management tactics that restore habitats and biological diversity.

Selected Examples of Recent Progress:

New USDA Plant Hardiness Zone Map released. The USDA Plant Hardiness Zone Map (PHZM) is an essential tool for the country's estimated 60 million gardeners, nurseries, horticultural producers, plant breeders, and government agencies that use it as a primary reference to define geographic patterns of extreme winter cold and

identify plants that are most likely to thrive in a particular area. ARS researchers from Ames, Iowa and colleagues from the PRISM Climate Group at Oregon State University in Corvallis, Oregon have completed a new 2012 edition of the PHZM which brought the map into the "Digital Age." It combines leading edge geographical information systems analytical technology, Internet information delivery, and traditional horticultural and climatological scientific expertise and clientele input to transform what had been a static, paper map into a dynamic, Web accessible, multi-functional interactive information resource. The new PHZM has set a new standard of accuracy and repeatability for such maps. The PHZM Web site attracted more than 500,000 visitors during the first two weeks after release and more than two million visitors to date. The PHZM earned a Special Achievement in Geographical Information Systems Award from Esri, Inc., one of 150 chosen for awards from 100,000+ Esri clients worldwide.

Tomato genomes sequenced. The full genome sequence for a crop constitutes a powerful tool for a wide spectrum of research goals, most importantly enabling breeders to accelerate the development of superior varieties. Tomato is one of the most important vegetables globally, as it provides key vitamins and minerals to populations worldwide, and generates billions of dollars of economic value in the United States. The International Tomato Genomics Consortium led by ARS scientists in Ithaca and Cold Spring Harbor, New York sequenced the genomes of the domesticated tomato and its wild ancestor. These genome sequences constitute an invaluable knowledge base for uncovering the genetic bases for tomato fruit taste, quality, size, yield, nutritional content, and host-plant resistance to diseases, pests, and environmental extremes. Access to this new knowledge should enable tomato breeders and geneticists to enhance the efficiency and effectiveness of tomato crop improvement for key, high value horticultural traits.

More than 150 corn traits mapped to specific regions of the corn genome. ARS corn researchers in Columbia, Missouri; Ithaca, New York; and Raleigh, North Carolina completed extensive evaluations of biochemical and agronomic traits for 5,000 corn lines that collectively included much of the total variation found in the corn breeding gene pool. These evaluations located the regions of the corn genome associated with more than 150 traits of major agronomic importance. Also, researchers characterized more than 55 million variable regions in the corn genome as a first step for identifying genetic markers for breeding those traits or the actual genes controlling the traits. All of this important new information and corn genetic stocks are accessible through the Maize Genome Database. This new information will enable variation in corn gene sequences to be associated with gene function and with variation in plant traits. The analytical (informatics) tools developed for managing those data and relating them to other genome databases for other plants will enable geneticists and breeders to more rapidly identify genes for improved crop performance, quality, and yield.

Ribonucleic Acid Interference (RNAi) technology -- a new strategy for controlling infectious diseases and parasites of bees. Israeli acute paralysis virus is a suspected cause of Colony Collapse Disorder (CCD). ARS scientists in Fort Pierce, Florida, in collaboration with university, industry (Beeologics/Monsanto), and military partners, have successfully developed a new control strategy that uses RNA interference (RNAi) technology to protect bees against the virus. The RNAi product protects bees when fed sugar solutions, routinely used by beekeepers as a honey substitute. This RNAi strategy not only controls the virus, and thus has potential for reducing CCD, but could also be adapted to target and control other diseases and pests of bees and other insects. This was the first large scale, field proof-of-concept use of RNAi for pest control. The bee treatment product is now commercialized as Remebee©.

Novel method for identifying different nitrogen fixing bacteria and determining their benefits to soybean growth and production. Soybean benefits from symbiotic bacteria rhizobia that occupy the roots and help the plant to produce its own nitrogen, thus eliminating the need for nitrogen fertilizer applications. The many different genetic types of rhizobia differ substantially in their ability to produce the nitrogen required for soybean growth and production. Several genetic types of rhizobia might occupy the same plant simultaneously, each with a specific preference for a different site on the soybean roots, and each with significant variation in efficiency for producing nitrogen. Consequently, identifying the unique types of rhizobia in culture collections is a priority, as is determining how effectively the different types produce nitrogen in symbiosis with the soybean plant. ARS researchers at Beltsville, Maryland developed novel methods for describing soybean rhizobia genotypes belonging to the genus *Bradyrhizobium*, and analyzing how these bacteria occupy soybean roots. This new technology includes a method to extract rhizobial DNA directly from sites on soybean roots to identify genetic types of rhizobia in each root

location, determine nitrogen production efficiency, and identify the soybean varieties that form symbioses with the most efficient rhizobia.

Genetic control of essential dietary minerals in beans. Dry beans (*Phaseolus* species), a staple food world- wide, are a valuable source of dietary zinc and iron for populations with largely plant-based diets. ARS researchers in East Lansing, Michigan analyzed dry bean cultivars with different concentrations of zinc and identified genes in two navy bean cultivars with divergent gene expression patterns that yielded a 30 percent difference in seed zinc concentration. They determined that 10 differentially expressed genes are involved in zinc or iron transport in dry beans. The identification of these differentially expressed transport genes will enable more effective breeding for increased seed zinc and iron levels in dry beans to benefit human nutrition.

Improved technology for producing long cane blackberry plants. U.S. blackberry growers would like to extend the growing period of their plants to enable them to sell fruit after the traditional growing season as out of season blackberries command a higher price. ARS researchers in Kearneysville, West Virginia used a unique trellis and cane training system to propagate long cane plants which can be manipulated to produce off season fruit. The new propagation system increased plant output five to seven fold over the current commercial propagation technique. The new innovations include long cane plants that are rooted at both ends of the cane. These long cane plants produced more fruit clusters, clusters with more fruit, larger fruit, and 250 percent increase in fruit production compared to long cane plants produced by traditional methods. The new propagation method is efficient for producing a large number of long cane blackberry plants which will be useful to both growers and nurseries.

Maximizing benefits for energycane and sugarcane production systems. In some areas of Louisiana, sugar production is not economical because of delayed planting or flooded conditions. ARS scientists in Houma, Louisiana completed a five year study comparing the flood tolerance of energycane and sugarcane. Production practices vary whether sugarcane is grown primarily for sucrose (sugarcane) or as a biofuels feedstock (energycane). Energycane increases management flexibility for the existing sugarcane production system. Energycane tolerated the flooded conditions better than sugarcane when biomass and sucrose yields were compared between treatments. Utilization of energycane for production of cellulosic biomass may be a sustainable rotational crop for sugarcane.

Fertilizer value of recovered phosphorus from animal manures. Many fields around large animal feeding operations in the southeastern United States have excessive soil phosphorus from land applied animal manures. Previously, a method to recover phosphorus from animal waste in a concentrated form was developed by ARS scientists in Florence, South Carolina. These ARS scientists field tested the recovered phosphorus for its value as a fertilizer product, and found that the material can be processed into commercial sized fertilizer pellets with relative ease. They discovered that applied as small particles (between 0.5 and 1.0 millimeters in diameter), recovered phosphorus is effective as a fertilizer source. Since the recovered phosphorus can be transported in concentrated form and recycled as plant fertilizer, adoption of this technology by animal producers will reduce the environmental impact of excessive phosphorus in soils around these animal farms. In addition, recycling manure phosphorus will lengthen the duration of the world's supply of minable phosphorus.

Program Evaluations: In 2012, ARS conducted retrospective reviews of selected national programs. Overall, the programs were found to have had high impact (i.e., significant benefit or influence.) The programs were evaluated by a panel of experts who represented government, private industry, and customer/stakeholder groups and the non-profit arena. Performance was evaluated based on the quality of the research leading to actual impact, or progress toward anticipated benefits to end-users, scientific communities, and the broader society. The panel of experts provided recommendations that ARS managers can use in making future management decisions.

Food Safety

Current Activities:

Assuring that the United States has the highest levels of affordable safe food requires that the food system be protected at each stage from production through processing and consumption from pathogens, toxins, and chemical contaminants that cause diseases in humans. The U.S. food supply is very diverse, extensive, easily accessible, and

thus vulnerable to the introduction of biological and chemical contaminants through natural processes, intentional means, or by global commerce.

ARS' current food safety research is designed to yield science-based knowledge on the safe production, storage, processing, and handling of plant and animal products, and on the detection and control of toxin producing and/or pathogenic bacteria and fungi, parasites, chemical contaminants, and plant toxins. All of ARS' research activities involve a high degree of cooperation and collaboration with USDA's Research, Education, and Economics agencies, as well as with the Food Safety and Inspection Service (FSIS), Animal and Plant Health Inspection Service (APHIS), Food and Drug Administration (FDA), Centers for Disease Control and Prevention (CDC), Department of Homeland Security (DHS), and the Environmental Protection Agency (EPA). ARS also collaborates in international research programs to address and resolve global food safety issues.

Specific research efforts are directed toward developing new technologies that assist ARS stakeholders and customers, that is, regulatory agencies, industry, and commodity and consumer organizations, in detecting, identifying, and controlling foodborne diseases that affect human health.

Selected Examples of Recent Progress:

Listeria monocytogenes in the ready-to-eat foods. Significant efforts have been made to control *Listeria monocytogenes* in foods over the past decade. Outbreaks of foodborne illness are especially associated with ready-to-eat foods such as deli meats, soft cheeses, raw and smoked fish, and raw or partially processed vegetables. At the request of the FDA and the FSIS, ARS researchers in Wyndmoor, Pennsylvania undertook a study to determine the current prevalence and levels of *Listeria monocytogenes* in deli packaged versus pre-packaged ready-to-eat foods purchased at retail establishments in four FoodNet sites. The study indicated an observed *Listeria monocytogenes* prevalence from 0 to 1 percent for seven product categories. This is the most comprehensive survey of *Listeria monocytogenes* in retail ready-to-eat foods in the past decade, providing data critical for control for this pathogen. The study received the FDA Commissioners Award.

Novel probiotics target human food safety pathogens and improve poultry health. *Campylobacter* and *salmonella* are the most commonly reported bacterial pathogens causing foodborne infections in the United States. Epidemiological evidence has implicated poultry products as a significant source of these pathogens. A novel probiotic method was developed by ARS in Fayetteville, Arkansas capable of inhibiting growth of specific enteric pathogens. These probiotic cultures (composed of non-pathogenic healthy bacteria) target *salmonella* and *campylobacter* in the gastrointestinal system of poultry. This discovery was licensed to an Arkansas-based start-up company in cooperation with the University Arkansas. The commercial product (FloraMax-B11) is marketed in 16 countries with approximately 300 million birds dosed per/year.

Pathogens in produce growing areas in Salinas Valley, California. Several bacteria have been linked to produce associated foodborne illness outbreaks. ARS researchers in Albany, California, in collaboration with the FDA and National Aeronautics and Space Administration, conducted a survey of the Salinas watershed for the presence of *E. coli* O157, non-O157:H7 Shigatoxin positive *E. coli* (STEC), *salmonella*, *listeria*, and *campylobacter*. Data collected indicated substantial differences in the prevalence of the various pathogens with a definite correlation to sampling region and date. The data enabled the development of a predictive geospatial risk assessment model (PGRAM). The study provided industry and public health regulatory agencies with valuable epidemiological data for development of a risk assessment model for this important agricultural region.

Rapid, portable test for botulinum neurotoxins. Produced by the common soil bacterium *Clostridium botulinum*, botulinum neurotoxins (BoNTs) are potent toxins that can cause severe foodborne disease, botulism, and could be used as a biological threat agent. ARS scientists in Albany, California developed a rapid, sensitive diagnostic test for BoNTs that could be used by minimally trained personnel in the event of a foodborne outbreak or a bioterrorist threat. The simple lateral flow device, similar in design, use, and time as a pregnancy test, can detect and distinguish between BoNT/A and B, two of the four serotypes that are known to poison humans and together account for more than 80 percent of naturally occurring botulism. This rapid diagnostic method, which has been validated and now transferred to regulatory and other biosecurity/military agencies, is a valuable tool in the areas of

food safety and homeland security.

Vaccine development for *E. coli* O157:H7. *E. coli* O157:H7 can cause life threatening foodborne illnesses. Beef cattle are a major asymptomatic carrier of the pathogen, and development of a vaccine for cattle to eliminate the pathogen is a major goal for government and industry. *E. coli* O157:H7 colonize the terminal portion of the large intestine in cattle by sticking to a specific type of tissue. Specific bacterial proteins are required for adherence; studies have implicated the protein (intimin) responsible for adherence. However, ARS researchers in Ames, Iowa have now determined that *E. coli* O157:H7 lacking the intimin protein use additional proteins for adherence. This finding is significant in the context of developing efficacious vaccines for blocking adherence of the bacteria. Better vaccines would be those that would include not only the intimin protein but other proteins to reduce adherence. ARS will redirect its vaccine development studies to address this critically important observation.

Cronobacter sakazakii in powdered infant formula. *Cronobacter sakazakii* is a deadly foodborne pathogen found in dehydrated powdered infant formula. ARS researchers in Wyndmoor, Pennsylvania investigated the growth kinetics of *C. sakazakii* in reconstituted powdered infant formula and developed predictive models. Thermal growth studies indicated that *C. sakazakii* grows well at temperatures between10 to 48 degrees C. The results will assist industry in their production of infant formula, regulatory agencies in conducting risk assessments of reconstituted powdered infant formula exposed to various temperature-abuse conditions, and parents and other caretakers in properly storing and preparing reconstituted powdered infant formula.

Natural antimicrobials to replace antibiotics in swine diets. The use of antibiotics in animal production is a controversial issue due to the concern of transmission of antibiotic resistance genes. Young swine are often fed dietary antibiotics to improve health, reduce pathogen load, and enhance performance. Few natural alternatives have been identified to replace these compounds. ARS scientists in Clay Center, Nebraska determined that a commercial product containing lysozyme (naturally found in eggs) could replace dietary antibiotics. The impact of this research, particularly for industry, is that the use of lysozyme in diets of young piglets could help maintain a safe food supply and reduce the use of prophylactic antibiotics that are typically used for swine production.

Program Evaluations: In 2012, no retrospective program reviews were conducted.

Livestock Protection

Current Activities:

ARS' animal health program is directed at protecting and ensuring the safety of the Nation's agriculture and food supply through improved disease detection, prevention, control, and treatment. Basic and applied research approaches are used to solve animal health problems of high national priority. Emphasis is given to methods and procedures to control animal diseases.

The research program has ten strategic objectives: (1) establish ARS' laboratories into a fluid, highly effective research network to maximize use of core competencies and resources; (2) access specialized high containment facilities to study zoonotic and emerging diseases; (3) develop an integrated animal and microbial genomics research program; (4) establish centers of excellence in animal immunology; (5) launch a biotherapeutic discovery program providing alternatives to animal drugs; (6) build a technology driven vaccine and diagnostic discovery research program; (7) develop core competencies in field epidemiology and predictive biology; (8) develop internationally recognized expert collaborative research laboratories; (9) establish a best-in-class training center for our Nation's veterinarians and scientists; and (10) develop a model technology transfer program to achieve the full impact of ARS' research discoveries.

ARS' current animal research program includes eight core components: (1) biodefense research, (2) animal genomics and immunology, (3) zoonotic diseases, (4) respiratory disease, (5) reproductive and neonatal diseases, (6) enteric diseases, (7) parasitic diseases, and (8) transmissible spongiform encephalopathies.

Selected Examples of Recent Progress:

Genetic evolution of novel reassortant swine influenza viruses with the capability of infecting humans. Swine influenza A virus causes a respiratory disease in pigs and variant strains that attain the ability to infect humans pose a significant public health threat. In collaboration with the National Institutes of Health, ARS scientists in Ames, Iowa investigated the genetic evolution of novel reassortant swine influenza A viruses detected in the United States and Canada between 2009-2011 with a focus on H3N2 viruses. Analyses included H3N2 viruses designated A(H3N2) variant (v) because of their capability to also infect humans as discovered in the United States in July 2011. Analyses of samples from 12 human cases revealed that the variant swine lineage H3N2 viruses contained the pandemic matrix (pM) gene from pandemic H1N1 viruses. The A(H3N2)v viruses are distinct from contemporary H3N2 circulating in humans and the flu viruses incorporated in the human seasonal flu vaccine, and hence represent a potential pandemic threat. Monitoring and reporting evolutionary dynamics of gene segments in swine at a detailed level is critical to understanding how these novel H3N2 viruses emerged in swine and to assessing and predicting the potential epidemic and/or pandemic threat of variant influenza viruses pose to humans.

Seeking alternative strategies to antibiotics. Although widespread use of antibiotic-based growth promoters has improved the efficiency of worldwide poultry production, there is an increasing interest in developing alternative strategies to antibiotics to control infectious diseases in livestock and poultry because of the emergence of drug resistant pathogens. ARS scientists in Beltsville, Maryland investigated dietary phytogenics (cinnamon, garlic, and aloe vera) to enhance poultry immunity using avian coccidiosis as a disease model. Phytogenics are a group of natural growth promoters derived from herbs, spices, or other plants, and many medicinal foods and herbal products highly effective in enhancing host defense against microbial infections. ARS scientists previously showed that phytogenics augment host immunity against infectious agents and decrease inflammatory diseases. For example, cinnamon has been shown to possess antioxidant properties and antimicrobial activities, as well as being able to modulate the immune response. In chickens fed a diet supplemented with cinnamon, the levels of certain immune cytokines were 2- to 47-fold higher compared with chickens given a non-supplemented diet. Importantly, dietary cinnamon was shown to attenuate bodyweight loss caused by *Eimeria*, an important intestinal parasite of poultry.

Diagnostics to detect a newly emerging virus. HoBi-like virus is a newly emerging type of virus distantly related to bovine viral diarrhea virus (BVDV) that has been isolated from cattle in South America, Southeast Asia, and Europe. The clinical presentation following infection with this type of virus is very similar to that seen following infection with BVDV. Like BVDV, HoBi-like viruses cause immune suppression and can establish lifelong persistent infection in cattle. HoBi-like viruses have not yet been detected in the United States. ARS scientists in Ames, Iowa have developed tests to provide diagnosticians and regulatory agencies with tools to screen imported animals and animal products to prevent introduction of HoBi-like viruses into the United States. These tests have been transferred to APHIS and provide the means to detect and control an introduction if it were to occur in the United States.

A genetic marker associated with reducing susceptibility to porcine reproductive and respiratory syndrome. Porcine reproductive and respiratory syndrome (PRRS) virus is the most important infectious endemic disease of pigs. A genetic marker for reduced susceptibility to PRRS, the most economically significant disease in pigs, has been discovered by a research team that includes ARS scientists in Beltsville, Maryland, and Kansas State University and Iowa State University scientists. This project was funded by the National Institute of Food and Agriculture (NIFA). PRRS affects pigs at all stages of growth and is easily spread. PRRS costs the United States an estimated $642 million per year. The PRRS Host Genetics Consortium (PHGC) was established with funds from the National Pork Board to discover the genetic basis of host resistance or susceptibility to PRRS virus infection. Groups of 200 commercial crossbred pigs were infected with PRRS virus and followed for 42 days; blood samples and body weights were collected for detailed viral load and weight gain phenotypes. The entire genome of all pigs from the first three PHGC trials were searched to identify chromosomal segments that were common to pigs that had lower virus levels and faster growth after infection. This resulted in the discovery of the genetic marker, called a quantitative trait locus (QTL), on swine chromosome 4 (SSC4) associated with improved growth of pigs that are infected with the PRRS virus. These results could have a major impact on the swine industry by enabling geneticists to develop plans for marker assisted selection of pigs with improved response to PRRS.

Gold and nanotechnology bring viruses to light. Gold nanoparticles have the ability to scatter and absorb light, making them ideal in detecting virus infected cells. Using a technology called surface enhanced Raman scattering (SERS), signals emitted from these nanoparticles can be measured using a spectrometer. ARS scientists in Manhattan, Kansas and collaborators at the University of Wyoming used gold nanoparticles to design tests to rapidly identify West Nile virus, a virus spread by infected mosquitoes that can cause headaches, fever, flu like symptoms, and sometimes fatal neuroinvasive disease—aseptic meningitis, encephalitis, or acute flaccid paralysis. The goal of the project is to bring laboratory level analytical sensitivity to the field for portable care devices. If successful, veterinarians and medical doctors will be able to take a blood sample, put it in a small vile and read it with a hand held device. ARS scientists are also working on adapting this technology to identify multiple disease agents.

Development of a monoclonal antibody specific for a Johne's disease protein. Johne's disease (Paratuberculosis) is a chronic, progressive enteric disease of ruminants caused by infection with *Mycobacterium avium paratuberculosis* (MAP). Cattle become infected as calves, yet usually do not develop signs of diarrhea and weight loss until two to five years of age. During the subclinical phase of disease, animals may intermittently shed the organism in their feces, thereby contaminating the environment and infecting other animals within the herd. Current diagnostic tests are not able to accurately identify these subclinically infected animals. In order to prevent the further spread of this disease improved diagnostic tools for the detection of infection, and development of new vaccines to enhance control strategies is needed. ARS researchers at the National Animal Disease Center, Ames, Iowa identified a new monoclonal antibody that selectively detects MAP and not other closely related bacterial strains. This antibody is currently the only one in the world that has this capability. Further research identified the protein, termed MAP1025 that this specific antibody. This antibody is the subject of a recently issued U.S. patent. The identification of this unique protein and antibody for MAP will be helpful in developing new diagnostic tools to detect infected animals.

Accurate mosquito trapping results for precise integrated pest management. Integrated pest management requires accurate information on the number of pests and where they are. This is particularly important for mosquito control because resources are always limited compared to the geographic area requiring treatment. ARS scientists in Gainesville, Florida compared the number of female mosquitoes captured by suction traps, portable light traps (with carbon dioxide), and landing on a human subject. A statistical algorithm that corrects mechanical trap-based estimates of adult mosquito density to the landing rate of mosquitoes on a human host was constructed, and will provide a better estimate of mosquito density in a local area. This information can be used to help mosquito control professionals determine the best method of control. The algorithm will also enable State and Federal authorities to more accurately compare trapping results from different locations. More accurate estimates of mosquito numbers will help authorities target resources, make accurate risk assessments of disease, and assess with more confidence whether or not invasive species are present.

Treatment of stable fly larval sites using an organic compliant chemical. Stable flies develop in damp soil with an abundance of incorporated vegetable matter, conditions often associated with feedlots and other cattle operations. The flies feed on the blood of many kinds of animals, including humans, and are considered the principle pest of cattle in the United States, causing $2 billion per year in loss of yield. Larval control has been difficult because of the widespread distribution of maggots and the difficulty of applying chemicals to them below ground. ARS scientists in Lincoln, Nebraska developed an encapsuled formulation of catnip oil to control immature stable flies developing in animal wastes. The formulation deters female flies from depositing their eggs and inhibits larval development under field conditions. A single application is effective for five to seven days. This is the first botanical-based product for the control of immature stable flies. The formulation, once registered, will provide an effective stable fly control option for cattle producers.

Novel and effective vaccine for cattle against the cattle fever tick. The southern half of the United States used to be infested with two species of the one host tick that transmitted bovine babesiosis to cattle. The disease is often fatal in adult cattle and is one of the infections that prevent export of live animals. The ticks are abundant in Mexico and elsewhere in the world, so APHIS actively fights re-introduction by requiring special treatment of cattle from areas where the ticks still live, and by maintaining a quarantine zone in southern Texas between Mexico and the United States. Anti-tick vaccines are an attractive idea for control, both to reduce the amount of pesticide required in eradication programs and to manage tick populations overseas where the ticks continue to be a problem. A vaccine based on a tick gut protein, Bm86, has been available in some countries for over 10 years. Recent evaluations

performed by ARS in Mission, Texas in cooperation with APHIS, showed that the Bm86 vaccine is highly effective against one of the species of cattle fever ticks and ineffective against the other. Genomic studies and bioinformatics of the cattle fever tick by ARS scientists produced a series of vaccine candidates based on finding protein sequences likely to cause a strong immune response in cattle. The scientists, in collaboration with EMBRAPA scientists in Campo Grande, Brazil, completed trials of the most promising candidate vaccine antigens, one of which was 75 percent effective against the cattle fever tick that was unaffected by Bm86. The mechanism of action of the vaccine was demonstrated by knocking out the target tick gene with RNAi, showing this particular gene was essential for tick survival. This novel antigen was highly expressed in tick nerve tissues. The results indicate that vaccination against cattle ticks has great potential for integration into APHIS' Cattle Fever Tick Eradication Program and for tick management.

Transgenic screwworm produces only males. The screwworm fly is a damaging pest of livestock that infests wounds and eats living flesh often killing cattle and other animals. The screwworm fly used to live throughout the southern United States, but was eradicated by the systematic release of sterile male flies that mated with wild female flies, a procedure developed by ARS. Currently, the fly is prevented from reinfesting these areas by continuously releasing sterile males in eastern Panama as a barrier between South America, where the fly still exists, and Central America, where it has been eradicated. Screwworms are produced in a large factory in Panama, supported by the ARS research program. For the past five years, APHIS funded ARS to develop a transgenic strain of screwworm fly that would only produce males, saving rearing, distribution, and sterilization costs. This project required discovery and insertion of a DNA cassette that was female sex linked and lethal when tetracycline was not added to the larval medium. In 2012, ARS scientists in Kerrville, Texas and Pacora, Panama worked with a collaborator at North Carolina State University to successfully produce a strain in which 99 percent of females died if tetracycline was not present in the medium. This strain will enable ARS to prove the concept of the value of a transgenic, male only strain, eventually saving APHIS as much as $5 million per year.

Program Evaluations: In 2012, ARS conducted retrospective reviews of selected national programs. Overall, the programs were found to have had high impact (i.e., significant benefit or influence.) The programs were evaluated by a panel of experts who represented government, private industry, and customer/stakeholder groups and the non-profit arena. Performance was evaluated based on the quality of the research leading to actual impact, or progress toward anticipated benefits to end-users, scientific communities, and the broader society. The panel of experts provided recommendations that ARS managers can use in making future management decisions.

Crop Protection

Current Activities:

ARS research on crop protection is directed toward epidemiological investigations to understand pest and disease transmission mechanisms, and to identify and apply new technologies that increase our understanding of virulence factors and host defense mechanisms. Currently, ARS research priorities include: (1) identification of genes that convey virulence traits in pathogens and pests; (2) factors that modulate infectivity, gene functions, and mechanisms; (3) genetic profiles that provide specified levels of disease and insect resistance under field conditions; and (4) mechanisms that facilitate the spread of pests and infectious diseases.

ARS is developing new knowledge and integrated pest management approaches to control pest and disease outbreaks as they occur. Its research will improve the knowledge and understanding of the ecology, physiology, epidemiology, and molecular biology of emerging diseases and pests. This knowledge will be incorporated into pest risk assessments and management strategies to minimize chemical inputs and increase production. Strategies and approaches will be available to producers to control emerging crop diseases and pest outbreaks.

Selected Examples of Recent Progress:

Sudden oak death fungus soil remediation. *Phytophthora ramorum* causes sudden oak death and also seriously impacts the commercial nursery industry due to losses resulting from quarantine issues. The nursery industry badly needs new methods to control *P. ramorum* so that infested nurseries can be removed from quarantine status and

resume normal production. ARS researchers in Fort Detrick, Maryland demonstrated for the first time in a nursery setting that the beneficial biocontrol fungus *Trichoderma asperellum* grown on wheat bran and raked into nursery test plot soil can reduce *P. ramorum* soil populations to non-detectable levels after six weeks. California regulatory agents confirmed these results at a commercial nursery, and the nursery was lifted from quarantine status. The new method will have wide applicability in reducing losses to the nursery industry due to *P. ramorum*. Technology transfer is underway to facilitate development of a commercial formulation of the biocontrol fungus.

Postharvest irradiation treatment controls light brown apple moth. Since the invasive, light brown apple moth was found in California in 2007, several countries have imposed trade restrictions on some of its host fruits and vegetables. ARS researchers in Hilo, Hawaii found a radiation dose that resulted in zero tolerance (100 percent control) at the most tolerant light brown apple moth stage. Some countries require zero tolerance to access their markets. This information will facilitate the trade of commodities that are hosts of light brown apple moth.

New lures for critical pests. The spotted wing drosophila is an invasive pest of soft fruits, and the brown marmorated stink bug is a pest of many fruits, vegetables, and field crops. Both originated in Asia and are spreading throughout North America. ARS researchers in Wapato, Washington, working with ARS colleagues in Poplarville, Mississippi and Oregon State Department of Agriculture scientists, isolated and identified a set of chemicals from the odors of wine and vinegar that can be used as a lure for the spotted wing drosophila. ARS researchers in Beltsville, Maryland and Kearneysville, West Virginia discovered a male produced pheromone that causes brown marmorated stink bug nymphs and adults to aggregate. Both lures are being combined with traps and will be used to monitor pest populations for treatment and, perhaps, to control the insects via trapping or insecticidal baits. A provisional patent has been filed for the stink bug lure.

Diagnostic test for the new boxwood blight pathogen. The recent rapid emergence and spread of boxwood blight disease in the United States places the nursery and landscape industry at substantial risk. Boxwood is a high value ornamental nursery crop valued at $103 million annually. Early and rapid detection of *Calonectria pseudonaviculata* in plants and soil is needed to prevent the spread of this emergent disease which threatens the health and production of U.S. boxwood. ARS scientists in Beltsville, Maryland developed a DNA-based boxwood blight diagnostic assay capable of detecting the presence of the causal agent of boxwood blight disease. This diagnostic test will be used by plant scientists to halt the spread of boxwood blight and to develop control measures for the disease.

Extensive cereal disease evaluation protects U.S. wheat and barley from stripe rust losses. Cereal rust expertise provided by ARS researchers in Pullman, Washington was applied in 2012 to protect the wheat and barley crop from new, emerging strains of the stripe rust fungus. During the 2012 growing season, ARS scientists evaluated more than 18,000 wheat and 5,000 barley lines for resistance to stripe rust in the field, and hundreds were also tested in the greenhouse with cultured stripe rust strains. This enabled U.S. wheat and barley breeders to select lines for advancing new varieties with resistance to new stripe rust strains. The results of the extensive evaluation combined with molecular marker analysis in 2012 resulted in the advancement and release of more than 10 new wheat and barley varieties with increased stripe rust protection.

High yielding soybean with resistance to multiple cyst nematode populations. In the United States, nearly $1 billion are lost in annual soybean production due to a tiny root parasite, soybean cyst nematode. Cultivars with genetically controlled resistance would reduce these losses. ARS researchers in Jackson, Tennessee, in cooperation with the Tennessee Agricultural Experiment Station, released soybean germplasm line JTN-5203 with resistance to multiple pathogens endemic to the mid-southern United States, and with high yield potential. Traditional breeding methods were combined with modern marker assisted biotechnology techniques for rapid advancements. Soybean JTN-5203 will be highly useful as parent material in breeding programs for providing more durable resistance, especially to soybean cyst nematode, while maintaining very high yield potential in development of new cultivars. The soybean line can also be grown directly as an excellent conventional soybean cultivar in the mid-southern United States.

Cold treatment stops coffee berry borer. Green coffee, which is shipped around the world for custom blending and roasting carries the risk of spreading coffee berry borer. ARS scientists in Hilo, Hawaii tested the freezing tolerance of over 15,000 coffee berry borer insects at three different temperatures and determined the temperature and time at which they could control 100 percent of all life stages. Hawaii State regulators are using this information to

implement a freezing treatment protocol that enables coffee growers in an infested area to ship green coffee to other islands without the need for methyl bromide fumigation.

Improvement of the sterile insect technique in fruit flies. Fruit flies of all kinds are a major pest of fruit orchards and a major trade issue. ARS scientists in Tifton, Georgia have improved the efficacy of the sterile insect technique used to control tephritid fruit flies. They incorporated the juvenile hormone analog methoprene (which coordinates sexual signaling and reproductive development) and a protein supplement into the diets of adult sterile male flies. Flies fed the protein supplement became sexually mature four to seven days earlier and thus mated earlier. The males also attracted more wild mates, thus increasing the mating frequency. The International Atomic Energy Agency and the Food and Agricultural Organization of the United Nations are including the technology in a coordinated research program to improve the efficacy of the sterile insect technique. The technology is now used in Mexico to improve the effectiveness of sterile Mexican fruit flies that have been released to control invasive populations.

New methods of using fungus to kill insect pests. Root weevils, soil grubs, rootworms, wireworms, fruit flies, and root maggots are insect pests that affect a wide variety of agricultural crops, landscape plants, and turf. ARS researchers in Peoria, Illinois developed new methods to grow and commercially produce a bioinsecticidal fungus to kill these pests. The fungus, *Metarhizium,* also kills lesser meal worm larvae and adults, which are pests in commercial poultry operations. Koppert BV has licensed the technology from ARS through a patent. ARS researchers also developed dried granular formulations of *Metarhizium* which will give homeowners, farmers, and land managers an effective, nonchemical way to control numerous soil dwelling insect pests.

Stabilization of beneficial traits enhances effectiveness of biological control. Biological control (the use of predators, parasitoids, or pathogens in pest suppression) provides a safe alternative to the use of chemical insecticides. However, during mass production biological control agents can lose some beneficial traits, such as virulence and reproductive capacity which can make the agents less effective in pest suppression. ARS researchers in Byron, Georgia and colleagues at Brigham Young and Rutgers universities discovered that beneficial trait loss can be prevented by selecting inbred lines. Inbred line technology has been adopted by three commercial companies that produce insect killing nematodes.

Program Evaluations: In 2012, ARS conducted retrospective reviews of selected national programs. Overall, the programs were found to have had high impact (i.e., significant benefit or influence.) The programs were evaluated by a panel of experts who represented government, private industry, and customer/stakeholder groups and the non-profit arena. Performance was evaluated based on the quality of the research leading to actual impact, or progress toward anticipated benefits to end-users, scientific communities, and the broader society. The panel of experts provided recommendations that ARS managers can use in making future management decisions.

Human Nutrition

Current Activities:

Maintenance of health throughout the lifespan along with prevention of obesity and chronic diseases via food-based recommendations are the major emphases of ARS' human nutrition research program. These health-related goals are based on the knowledge that deficiency diseases are no longer important public health concerns. Excessive consumption has become the primary nutrition problem in the American population. This is reflected by increased emphasis on prevention of obesity from basic science through intervention studies to assessments of large populations. ARS' research program also actively studies bioactive components of foods that have no known requirement but have health promoting activities.

Four specific areas of research are currently emphasized: (1) nutrition monitoring and the food supply, e.g., a national diet survey and the food composition databank; (2) dietary guidance for health promotion and disease prevention, i.e., specific foods, nutrients, and dietary patterns that maintain health and prevent disease; (3) prevention of obesity and related diseases, including research as to why so few of the population follow the *Dietary Guidelines for Americans*; and (4) life stage nutrition and metabolism, in order to better define the role of nutrition in pregnancy and growth of children, and for healthier aging.

Selected Examples of Recent Progress:

New modeling study suggests lower vitamin E requirement. Ninety-three percent of the American population does not meet the current dietary recommendation for vitamin E. However, there is little if any evidence that deficiency of this vitamin exists in the U.S., suggesting the current requirement may be set too high. An ARS scientist in Beltsville, Maryland, in collaboration with scientists at the University of California, Davis, modeled and quantified the kinetics, bioavailability, and metabolism of alpha tocopherol in healthy adults by measuring tiny doses of the radioactively labeled vitamin excreted in urine or feces over 21 days and amounts in blood over 70 days. The new data suggest the true vitamin E requirement is one third of that set in 2000 by the Institute of Medicine and could form the basis for a revision of that recommendation. Lowering the vitamin E requirement would help the Food and Nutrition Service, which administers the School Lunch Program and is required to provide one third of the Vitamin E daily requirement, address the issue of what is actually needed.

First animal model to study age-related macular degeneration. Age-related macular degeneration (AMD) is the leading cause of blindness among older adults in the U.S. and there are no known means to delay the onset of the disease. ARS funded researchers in Boston, Massachusetts developed the first animal model of AMD in a strain of mice that shows lesions similar to those in humans. Use of the model will enable study on the basic cellular and molecular mechanisms involved and will enable testing of dietary changes that could reduce the prevalence of AMD in a few months rather than the standard five years it takes in humans. The model has already corroborated the observation that diets leading to high blood glucose levels in humans are associated with greater risk for AMD.

Calories available from almonds are lower than those listed on the food label. Because nuts are high fat foods, their calorie content is high and, when eaten in large quantities, might be expected to lead to weight gain. However, observational studies of people eating the most nuts repeatedly find their body weight is lower than average. ARS scientists in Beltsville, Maryland fed volunteers three doses of whole almonds in a highly controlled diet for 18 days and energy intake and excretion were carefully measured. Almonds provided one third fewer calories than the value on the food label. All nuts are recommended for consumption in the *Dietary Guidelines for American*s because they provide a number of shortfall nutrients. These data will assist the FDA in updating the calorie content on the food label.

Sodium and potassium consumption in the United States does not meet guidelines. Most Americans exceed the *Dietary Guidelines for Americans* and other Federal recommendations for sodium and potassium intake, according to new data from ARS scientists in Beltsville, Maryland who collaborated with colleagues from the Centers for Disease Control. Using the National Health and Nutrition Examination Survey (NHANES) data on more than 12,000 adults participating in NHANES from 2003 to 2008, scientists found 91 percent of Americans exceeded the threshold set by the Institute of Medicine for sodium; 99 percent of those at high risk for hypertension consumed more than the sodium level recommended by the *Dietary Guidelines for Americans*. Less than two percent of the sample met the potassium recommendation. The differences between actual and recommended intakes point out that major changes in the types of foods eaten and reformulations of existing products will have to be made if these goals are to be met. Given the large gap between recommendations and consumption, this is further impetus to determine whether increased potassium and calcium offset adverse effects of sodium on blood pressure, as has been suggested in some controlled studies.

Raising plasma HDL cholesterol may not always reduce the risk of heart attacks. HDL cholesterol has long been termed "good" cholesterol. Interventions that increased HDL cholesterol levels are expected to reduce the risk of heart attacks. ARS researchers in Boston, Massachusetts, in collaboration with an international consortium, have used genetic technology to thoroughly analyze the strength of the association between high plasma HDL cholesterol and heart attacks by analyzing gene variants in large numbers of cases and controls from 20 studies. The findings clearly demonstrate that some genetic mechanisms that raise plasma HDL cholesterol do not lower the risk of heart attack. These data challenge the long held concept that interventions that raise plasma HDL cholesterol will uniformly translate into reduction of risk. This finding will lead to more individualized dietary recommendations for health.

Dietary vitamin D2 competes with vitamin D3. Vitamin D deficiency leads to loss of bone mineral density and osteoporosis in adults and is common in the U.S. because few foods contain either vitamin D2 (found in some plants

and mushrooms) or vitamin D3 (of animal origin). Vitamin D3 is also produced in human skin by sun exposure, but this source is limited by skin pigmentation (thus African Americans are at high risk for deficiency) and lack of sun exposure. Consequently, many Americans seek to improve their vitamin D intake through foods and supplements enriched with the nutrient. ARS scientists in Davis, California tested the availability of vitamin D2 in healthy humans from mushrooms that had been treated with ultraviolet light to increase their vitamin D2 content. The goal of the study was to determine whether such mushrooms might be a useful source of vitamin D in the American diet. Results of the study showed that vitamin D2 was readily absorbed from mushrooms but that vitamin D3 levels decreased proportionally to the increase in D2, therefore resulting in no net improvement of vitamin D status. These findings emphasize the complexity of human supplementation and show the importance of testing dietary recommendations for health endpoints.

Breast feeding is best for infant development but formula is close. Breast feeding is recommended as the best source of nutrition for infants. There is also controversy about the relative merits of formula made with cow's milk or soy protein. ARS supported scientists in Little Rock, Arkansas evaluated almost 400 infants four times during their first year of life for development of mental, motor, and language abilities. Breast fed infants scored slightly but significantly higher on some of these measures and at some of the four time points. Both types of formula led to similar scores, which were within the normal range. Although the advantage was very small, these data support the recommendation to breast feed during the first year of life, but they also give reassurance to mothers who are not able to do so because formula feeding results in babies reaching normal developmental milestones.

Low intake of flavonoids increases risk of death from cardiovascular disease. Flavonoids are plant pigments found primarily in fruits, vegetables, nuts, cocoa, and beverages, such as tea and wine that have health benefits in short-term studies. ARS supported scientists in Boston, Massachusetts collaborated with scientists at the American Cancer Society on a study following 100,000 participants that included dietary assessment and tracking health status. After seven years, about 3,000 study participants had died from cardiovascular disease. Those with higher flavonoid intake were 18 percent less likely to die from cardiovascular disease, and men were 37 percent less likely to die from stroke. Sophisticated statistical analyses of the intake and mortality data revealed a threshold effect rather than a linear dose response, and showed that low intake was responsible for excess risk and higher intake was not beneficial in reducing cardiovascular disease mortality. This addresses one of the fundamental issues in interpreting observational studies on diet and health: namely, is more intake better? This is often the standard interpretation and this study suggests it may be incorrect. Application of this approach should lead to more critical interpretation of data from epidemiological studies and more realistic dietary recommendations for health.

Program Evaluations: In 2012, ARS conducted retrospective reviews of selected national programs. Overall, the programs were found to have had high impact (i.e., significant benefit or influence.) The programs were evaluated by a panel of experts who represented government, private industry, and customer/stakeholder groups and the non-profit arena. Performance was evaluated based on the quality of the research leading to actual impact, or progress toward anticipated benefits to end-users, scientific communities, and the broader society. The panel of experts provided recommendations that ARS managers can use in making future management decisions.

Environmental Stewardship -- Water Quality; Air/Soil Quality; Global Climate Change; Range/Grazing Lands; Agricultural Systems Integration

Current Activities:

ARS' research programs in environmental stewardship support scientists at approximately 70 locations. Emphasis is given to developing technologies and systems that support profitable production and enhance the Nation's vast renewable natural resource base.

ARS is currently developing the scientific knowledge and technologies needed to meet the challenges and opportunities facing U.S. agriculture in managing water resource quality and quantity under different climatic regimes, production systems, and environmental conditions. ARS' air resources research is developing measurement, prediction, and control technologies for emissions of greenhouse gases, particulate matter, ammonia, hydrogen sulfide, and volatile organic compounds affecting air quality and land surface climate interactions. The

agency is a leader in developing measurement and modeling techniques for characterizing gaseous and particulate matter emissions from agriculture. In addition, ARS is evaluating strategies for enhancing the health and productivity of soils including developing predictive tools to assess the sustainability of alternative land management practices. Finding mechanisms to aid agriculture in adapting to changes in atmospheric composition and climatic variations is also an important component of ARS' research program.

ARS' range and grazing lands research includes the conservation and restoration of the Nation's range lands and pasture ecosystems and agroecosystems through improved management of fire, invasive weeds, grazing, global change, and other agents of ecological change. The agency is currently developing improved grass and forage legume germplasm for livestock, conservation, bioenergy, and bioproduct systems as well as grazing-based livestock systems that reduce risk and increase profitability. In addition, ARS is developing whole system management strategies to reduce production costs and risks.

Selected Examples of Recent Progress:

Fall planted cover crops can improve water quality in the Upper Mississippi River basin. Fall planted cover crops are a management practice with benefits that include reducing nitrate losses from artificially drained fields. While the practice is widely used in the southern and eastern United States, little is known about the efficacy of the practice in the upper Midwest, which is characterized by long, cold winters and extensive artificial subsurface drainage systems. ARS scientists in Ames, Iowa used the Root Zone Water Quality Model to predict the impact of a cereal rye cover crop on reducing nitrate losses from drained fields across five Midwestern States. The model estimated that across the region, winter cover crops, planted at main crop maturity in a corn–soybean rotation, reduced nitrogen loss in tile flow by an average of more than 40 percent. The model also indicated that if winter cover crops were planted on the area of the five States draining to the Mississippi River, the potential reduction in nitrate nitrogen losses from drained fields would be about 20 percent of the total nitrate nitrogen load in the Mississippi River. Additionally, the model estimated that the cost of nitrate nitrogen removed by cover crops would be from $2.08 to $4.13 per kilogram. The estimated cost is competitive with other management practices that reduce nitrate losses to surface waters. These results are of interest to stakeholders seeking viable ways to reduce hypoxia in the Gulf of Mexico.

WinSRFR 4.1 released to the public and the Natural Resources Conservation Service (NRCS). The water use efficiency of gravity (surface) irrigation, the prevalent method of on-farm water application, is typically low but can be substantially improved if systems are designed and/or operated based on hydraulic engineering principles. ARS researchers in Maricopa, Arizona released Version 4.1 of WinSRFR, a surface irrigation software program that can be used to analyze field evaluation data, estimate field infiltration properties, analyze design alternatives, optimize operations, and conduct simulation studies. The new software features an updated simulation engine that was reprogrammed using a design layout that includes a modern graphical diagnostic and debugging tool. New functionalities include improved simulation capabilities and irrigation modeling. Intended users include university extension agents, farm advisors, irrigation consultants, and NRCS irrigation specialists.

Deeper application of fertilizer in soil reduces greenhouse gas emissions when used with no- or reduced-tillage. A major greenhouse gas (GHG) source from cropping systems is nitrous oxide (N_2O) -- a by-product of fertilizer use that has 300 times the GHG warming effect as the same amount of carbon dioxide (CO_2). No tillage and reduced tillage are used increasingly to enhance soil carbon storage, decrease soil CO_2 emissions, conserve moisture, and reduce erosion, but the effects of both tillage methods on N_2O emissions have been inconsistent. A global meta-analysis of 239 direct comparisons of GHG emissions from conventional till, no tillage, and reduced tillage was performed by ARS scientists in St. Paul, Minnesota, the University of California-Davis, and Northern Arizona University. In studies where nitrogen fertilizer was initially placed two inches or deeper in the soil, N_2O emissions tended to be 25 percent lower with no tillage or reduced tillage than with conventional till, especially in humid climates. In contrast, when nitrogen fertilizers were placed closer to the soil surface, N_2O emissions tended to be greater or no different with no tillage or reduced tillage than with conventional till. These results provide a simple means of optimizing tillage and fertilizer management practices to reduce N_2O and CO_2 GHG emissions, while maintaining the other benefits of no or reduced tillage.

Sensitivity of herbicide volatilization to soil moisture. Efficient herbicide application has been hampered by a lack of understanding of fate and transport mechanisms. Field investigations over the past 14 years by ARS scientists in Beltsville, Maryland; Ames, Iowa; and Riverside, California have determined that volatilization (vapor loss to the atmosphere) appears to be the most critical pathway for herbicide loss from production fields into neighboring ecosystems. Herbicide volatilization experiments conducted in Beltsville, Maryland—the longest record of herbicide vapor loss observations worldwide—demonstrated that herbicide volatilization is greatest under warm, wet soil moisture conditions during the day when air near the soil has a tendency to rise as the soil warms. Consequently, all herbicide volatilization models must be revised to account for atmospheric stability and soil moisture conditions. The addition of these terms significantly improves herbicide volatilization models used to help guide herbicide applications on crop fields worldwide. These model improvements have uses in herbicide application practices and demonstrate ways to reduce environmental and economic losses incurred with volatilization.

Volatilization moves pesticides through the air into South Florida ecosystems. The health of south Florida ecosystems has been declining due to nutrient and pesticide losses from agricultural activities and urban encroachment. The high humidity and temperatures, frequent rainfall and irrigation, soil type, and soil structure enhance the loss of applied pesticides to the atmosphere. ARS researchers in Beltsville, Maryland and Tifton, Georgia, in collaboration with researchers from the University of Florida, examined the fate of endosulfan, an insecticide previously identified as a potential hazard to aquatic organisms of this region. The scientists discovered that volatilization from the fields, and not drift during application, was by far the most likely emission source to nearby Everglades and Biscayne National Parks. This discovery provides scientists, regulators, extension specialists, and producers with information needed to modify agricultural management practices to protect sensitive ecosystems.

Managing manure to reduce runoff phosphorus losses. Manure application to crop land can contribute to runoff losses of phosphorus which can lead to excessive algae growth in lakes and streams. ARS researchers in Marshfield, Wisconsin conducted a series of rainfall simulation experiments to assess how the amount of dissolved phosphorus in runoff would be affected by: 1) phosphorus supplementation of dairy heifer diets; 2) manure application method and rate; and 3) the amount of available phosphorus already in the soil. Phosphorus supplementation in the diet resulted in more phosphorus in manure, which led to two to three times more dissolved phosphorus in runoff. Incorporation of manure into the soil reduced runoff phosphorus concentrations by 85 to 90 percent compared to surface application. These results show that large reductions in phosphorus runoff losses can be achieved by avoiding unnecessary dietary phosphorus supplementation; by incorporation of manure; by limiting application rate when applying to crop land; and by avoiding soils with excessive phosphorus. By adopting these practices, farmers can greatly reduce the amount of phosphorus leaving their farms which subsequently will reduce algae growth and eutrophication in surface waters.

Reducing odor emissions from swine lagoons. Malodorous emissions from swine lagoons are a problem for swine producers and their neighbors. ARS scientists in Clay Center, Nebraska demonstrated that a product derived from soybean, soybean peroxidase, was effective at reducing odorous chemical emissions from swine manure by 68 to 81 percent. The research has resulted in awarding of additional grant funds from the National Pork Board for further development in commercial swine production facilities.

The enzyme polyphenol oxidase improves silage protein uptake by livestock. When grasses are ensiled, excessive protein degrades so that when the silage is fed to ruminants, the inefficient protein use results in excessive nitrogen excretion in feces and urine. Polyphenol oxidase (PPO), a naturally occurring enzyme that causes browning in fruits like apples, can also decrease protein degradation when it combines with other naturally occurring compounds called phenolics. ARS scientists in Madison, Wisconsin co-ensiled the high PPO grass orchardgrass with high phenolic tall fescue grass. When the co-ensiled high PPO and phenolic grass mixture was fed to lambs, total protein utilization was improved 10 to 20 percent over control silages, as indicated by decreased nitrogen excretion in urine. On average, at least $100 million is spent annually to supplement protein lost during ensiling. Incorporating a PPO/phenolic ensiling system would save dairy farmers $10 million to $20 million annually in protein supplements and would decrease waste nitrogen in the environment.

Resistance to stem rust mapped to three chromosomes in perennial ryegrass. Genetic improvement of ryegrass for stem rust resistance has been hampered by a lack of information about the diversity and location of resistance genes in this grass. ARS researchers in Corvallis, Oregon determined that there is an all-or-none resistance gene located on perennial ryegrass chromosome 7 and effective partial resistance genes located on chromosomes 1 and 6 for stem rust. These discoveries lay the groundwork for developing genetic markers to locate stem rust resistance genes. Technology based on these markers will enable breeders to produce rust-resistant varieties of ryegrass, saving growers the expense of purchasing fungicides and reducing the environmental impact of grass seed production. Information about the location of rust resistance genes in grasses will also add to the knowledge base for finding rust resistance genes in cereal grasses such as wheat which is currently threatened with a new strain of stem rust worldwide.

Eastern gamagrass limits excessive weight gain in replacement dairy heifers. Dairy heifer diets that typically contain significant proportions of corn silage or other high energy forages often gain excessive weight that negatively affects their future lactation performance. Consequently, dairy farmers and nutritionists will add straw and other high fiber feeds to rations to cause replacement heifers to limit feed intake and caloric density. ARS researchers in Madison, Wisconsin showed that gamagrass may provide an alternative to purchasing and processing $150/ton straw, and that it can easily be ensiled and blended into mixed forage diets. The feed with gamagrass eliminates undesirable feed sorting behaviors by heifers, potentially neutralizes variations in growth performance among pen mates because less aggressive heifers can access the proper diet whenever they reach the feed bunker, and reduces the total caloric density and dry matter intake of alfalfa/corn silage diets. These factors provide heifer producers with an effective alternative management strategy for managing weight gains by replacement dairy heifers, especially when facilities are overcrowded.

Rangeland Hydrology and Erosion Model tool implemented. ARS scientists in Reno, Nevada in collaboration with ARS scientists in Boise, Idaho and Tucson, Arizona have developed the Rangeland Hydrology and Erosion Model (RHEM) to estimate runoff and erosion rates on non-Federal rangelands in the 17 Western States and provide maps of where targeted place-based conservation practices to reduce soil loss would be most cost effective. The spatially unbiased nature of the range land assessment allows rapid determination of regional needs and identification of where conservation programs may be most cost effective in arresting land degradation. This same concept can be utilized to target specific locations for conservation practices to meet specific goals in cost effective ways. RHEM was used to assess benefits of conservation in Texas from place-based conservation to reduce soil erosion and restore ecosystem services for a demonstration watershed. This work is being highlighted in the USDA National Conservation Program report to be delivered to Congress this winter.

Assessing food cropping and production patterns in the Northeast with new geodatabases. Development of effective regional food systems holds much potential for improving health, nutrition, and economic well-being. But before progress can be made toward improving the access, affordability, and appropriateness of locally produced food in the Northeast, better tools are needed to analyze and assess current and future food production capacity within the region. ARS researchers from Orono, Maine, in cooperation with a team of university researchers and ARS scientists from Beltsville, Maryland, developed a 13 State collection of geodatabases that brings together available spatial information on cropping systems and crop production, soils, land use and quality, and water resources. These mapping products provide integrated information on past and present farm land extents and productivity and are being used with forecasting models for improving future farm and crop productivity. Through integration of multiple layers of useful data in these geodatabases, this work will be used to help improve the access and affordability of locally produced food for the northeast region.

GPS guided drill operation captures runoff on steep slopes. Contour farming has long been recommended as a means of retaining water on hill slopes and preventing soil erosion. A geospatial positioning system method was developed and validated by ARS scientists in Pendleton, Oregon to guide a tractor and its seed drill along the elevation contour lines on a hill slope. Results demonstrated that seeding precisely in one pass on the elevation contour of an upper shoulder slope can effectively capture and hold the runoff from a 100 year, 24 hour storm event. Using terrain map information and GPS-based autosteering systems, contour seeding promises to improve soil and water conservation in many tillage systems. The method can be implemented using commercially available mapping software and autosteering equipment designed for tractors and drills.

Alternatives to methyl bromide for clean commodities in California. Fumigation for insects is necessary to export many kinds of products, and to maintain the wholesomeness of domestic products. For decades, industry has relied on methyl bromide. The advantages of methyl bromide are that it is cheap, penetrates most packaging and commodities to reach insect pests, and kills all stages of most insects. Finding alternatives to methyl bromide that are both effective and do not harm commodities has been a priority. Experiments conducted by ARS researchers in Parlier, California demonstrated the insecticidal efficacy of sulfuryl fluoride and phosphine, dispensed by a Horn generator. These fumigants appear to be the primary chemical alternatives to methyl bromide for postharvest disinfestations of perishable and durable commodities in California. In other research, ARS researchers in Parlier, California, in collaboration with Washington State University, have found a successful alternative treatment that does not require fumigation. The scientists found that a low pressure, low temperature treatment kills codling moth in fresh fruit and results in a higher quality product than when the produce is treated with methyl bromide. This research helps to limit the current need for methyl bromide while protecting American agricultural interests.

Program Evaluations: In 2012, ARS conducted retrospective reviews of selected national programs. Overall, the programs were found to have had high impact (i.e., significant benefit or influence.) The programs were evaluated by a panel of experts who represented government, private industry, and customer/stakeholder groups and the non-profit arena. Performance was evaluated based on the quality of the research leading to actual impact, or progress toward anticipated benefits to end-users, scientific communities, and the broader society. The panel of experts provided recommendations that ARS managers can use in making future management decisions.

Library and Information Services

Current Activities:

The National Agricultural Library (NAL) is the largest and most accessible agricultural research library in the world. It provides services directly to the staff of USDA and to the public, primarily via the NAL Web site, http://www.nal.usda.gov. NAL was created with USDA in 1862 and was named in 1962 a national library by Congress, as “the primary agricultural information resource of the United States.” NAL is the premier library for collecting, managing, and disseminating agricultural knowledge. The Library is the repository of the Nation’s agricultural heritage, the provider of world class information, and the wellspring for generating new fundamental knowledge and advancing scientific discovery. It is a priceless national resource that, through its services, programs, information products, and Web-based tools and technologies, serves anyone who needs agricultural information. The Library's vision is "advancing access to global information for agriculture."

Selected Examples of Recent Progress:

VIVO. This is a semantic, Open Source, application developed at Cornell University that enables the networking of scientists. NAL is coordinating and providing the technical support to modify the VIVO application and make it operational at USDA. VIVO lists the USDA scientists’ research, grants, patents, publications and more. The application is available within USDA and contains content drawn from the targeted five science agencies: ARS, the Economic Research Service, the National Agricultural Statistics Service, NIFA, and the Forest Service. The next data set to be added is the CRIS extramural activities from NIFA. Public availability is scheduled for the fall of 2012. It is currently accessible at http://vivo.usda.gov.

Start2Farm clearinghouse database. In partnership with the American Farm Bureau Federation, NAL’s Alternative Farming and Rural Information Centers has created Start2Farm a Web-based educational clearinghouse at www.start2farm.gov. The Web site is designed to assist people new to or with less than ten years experience in farming or ranching. It contains training materials, curriculum, and events calendar. The project is funded through a grant from the NIFA Beginning Farming and Ranching Development Program.

Life Cycle Assessment Digital Commons. Life Cycle Assessment (LCA) is a technique to assess the environmental aspects and potential impacts associated with a product, process, or service. The goal of the LCA Digital Commons Project is to develop a database and tool set intended to provide data for use in LCAs of food, biofuels, and a variety of other bioproducts. The LCA Digital Commons now contains field crop production unit process data. NAL is

coordinating with other Federal agencies to link database development efforts, and is working with NIFA to require the uploading of research data as part of its bioenergy grants and other data sets. The total Digital Commons Web site is operational and accessible by the general public at www.lcacommons.gov.

AGRICOLA Index expansion through automatic indexing. NAL has chosen and is implementing automated indexing/text analytics software to produce the AGRICOLA Index of agricultural literature. The AGRICOLA Index is publicly accessible and provides subject access to scholarly articles and information in the agricultural sciences. This application combines semantic analysis, machine learning, and human rules to automatically assign subject terms to journal articles. The software passed a rigorous testing procedure and is now being tuned to increase output.

Collection development policy. NAL's Collection Development Policy that governs how the Library grows and maintains its collection has been revised and updated. This process involved input from ARS, USDA, and the scholarly community. The new policy sets forth the scope, level of collecting intensity, and retention factors for NAL. It guides NAL's activities in serving USDA, the U.S. government as a whole, the scholarly community, and the general public at http://www.nal.usda.gov/about/policy/collection_development/NAL_Col_Dev_Policy_2012.pdf.

Proposed Language Changes

The estimates include appropriation language for this item as follows:

Buildings and Facilities:

For acquisition of land, construction, repair, improvement, extension, alteration, and purchase of fixed equipment or facilities as necessary to carry out the agricultural research programs of the Department of Agriculture, where not otherwise provided, $155,000,000 to remain available until expended.

Lead-Off Tabular Statement

BUILDINGS AND FACILITIES

2013 Estimate	-
Budget Estimate, 2014	$155,000,000
Change in Appropriation	+155,000,000

Summary of Increases and Decreases
(Dollars in thousands)

	2011 Actual	2012 Change	2013 Change	2014 Change	2014 Estimate
Discretionary Appropriations:					
Georgia: Biocontainment Laboratory and Consolidated Poultry Research Facility, Athens	-	-	-	+$155,000	$155,000
Total, Appropriation or Change	-	-	-	+155,000	155,000

Project Statement
Appropriations Detail and Staff Years (SY)
(Dollars in thousands)

Program	2011 Actual		2012 Actual		2013 Estimate		Change		2014 Estimate	
	Amount	SY	Amount	SY	Amount	SY	Amount	SY	Amount	SY
Discretionary Appropriations:										
Buildings and Facilities....	$-229,582	-	-	-	-	-	+$155,000	-	$155,000	-
Subtotal.....	-229,582	-	-	-	-	-	+155,000	-	155,000	-
Rescissions and Transfers (Net).....	229,582	-	-	-	-	-	-	-	-	-
Total Appropriation.....	-	-	-	-	-	-	+155,000	-	155,000	-
Rescission.....	-229,582	-	-	-	-	-	-	-	-	-
Bal. Available, SOY.....	257,961	-	$10,098	-	$5,247	-	-5,247	-	-	-
Recoveries, Other (Net).....	313	-	3	-	-	-	-	-	-	-
Total Available.....	28,692	-	10,101	-	5,247	-	+149,753	-	155,000	-
Lapsing Balances.....	-	-	-	-	-	-	-	-	-	-
Bal. Available, EOY.....	-10,098	-	-5,247	-	-	-	-123,000	-	-123,000	-
Total Obligations.....	18,594	-	4,854	-	5,247	-	+26,753	-	32,000 1/	-

1/ In order to maintain laboratory operations throughout the construction, the project is sequenced in 3 phases, with completion of each phase required before the next phase can commence. Because of the size and complexity of the project, the programming/design will take 12 months to complete. In order to expedite the project and award Phase 1 construction in FY 2014, the Phase 1 programming/design will be expedited and completed in 6 months. The Phase 1 construction can then be awarded in FY 2014. The remaining planning/design will require another 6 months to complete, pushing the Phase 2 and 3 construction award into FY 2015. Planning/design award of all 3 phases will be made in FY 2014.

Project Statement
Obligations Detail and Staff Years (SY)
(Dollars in thousands)

Program	2011 Actual		2012 Actual		2013 Estimate		Change		2014 Estimate	
	Amount	SY	Amount	SY	Amount	SY	Amount	SY	Amount	SY
Discretionary Obligations:										
Buildings and Facilities...	$18,594	-	$4,854	-	$5,247	-	+$26,753	-	$32,000 1/	-
Total Obligations.....	18,594	-	4,854	-	5,247	-	+26,753	-	32,000	-
Lapsing Balances.....	-	-	-	-	-	-	-	-	-	-
Bal. Available, EOY.....	10,098	-	5,247	-	-	-	+123,000	-	123,000	-
Total Available.....	28,692	-	10,101	-	5,247	-	+149,753	-	155,000	-
Rescission.....	229,582	-	-	-	-	-	-	-	-	-
Bal. Available, SOY.....	-257,961	-	-10,098	-	-5,247	-	+5,247	-	-	-
Other Adjustments (Net).....	-313	-	-3	-	-	-	-	-	-	-
Total Appropriation.....	-	-	-	-	-	-	+155,000	-	155,000	-

1/ In order to maintain laboratory operations throughout the construction, the project is sequenced in 3 phases, with completion of each phase required before the next phase can commence. Because of the size and complexity of the project, the programming/design will take 12 months to complete. In order to expedite the project and award Phase 1 construction in FY 2014, the Phase 1 programming/design will be expedited and completed in 6 months. The Phase 1 construction can then be awarded in FY 2014. The remaining planning/design will require another 6 months to complete, pushing the Phase 2 and 3 construction award into FY 2015. Planning/design award of all 3 phases will be made in FY 2014.

Justifications of Increases and Decreases

Buildings and Facilities

a) An increase of $155,000,000 for the planning, design, and construction of the Biocontainment Laboratory and Consolidated Poultry Research Facility, Athens, Georgia.

Need for Change

Three major influenza pandemics have swept the globe in the 20th century causing millions of deaths. The next pandemic flu is likely to be a prolonged and widespread outbreak. The severity of the next pandemic cannot be predicted, but modeling studies suggest that its effect in the United States could be severe.

ARS' Southeast Poultry Research Laboratory (SEPRL) in Athens is the major facility in USDA for conducting research on exotic and emerging poultry diseases. SEPRL has conducted crucial research over the past 20 years on exotic poultry diseases, specifically Avian Influenza (including the Hong Kong H5N1 virus) and velogenic Newcastle disease. SEPRL has the only USDA program that provides research support to the APHIS, FSIS, FDA, and CDC for these diseases.

The Richard Russell Agricultural Research Center (RRC), which is adjacent to SEPRL, has three research units that are the primary USDA locations for conducting research on poultry food safety: Antibiotic Resistance Research Unit, Poultry Microbiology Safety Research Unit, and Poultry Processing and Meat Quality Research Unit. The Antibiotic Resistance Research Unit focuses on how antibiotic resistance arises in bacteria from agricultural animals; it develops new methods for preventing the emergence of such resistance. The other two units provide critical pre- and postharvest poultry food safety research on Salmonella typhimurium, Campylobacter jejuni, Clostridium perfringens, and Listeria monocytogenes.

The Avian Disease and Oncology Laboratory (ADOL) in East Lansing, Michigan, conducts research on poultry tumor viruses, Marek's disease, and retroviruses (i.e., Avian Leukosis J, Reticuloendotheliosis and other lymphoid leukosis viruses). Scientists at the laboratory developed the in ovo vaccination technology that protects chickens from Marek's disease. In addition, ADOL has been an international leader in mapping the chicken genome, developing transgenic chickens, and implementing genetic resistance in chickens to tumor viruses.

SEPRL's, RRC's, and ADOL's poultry research facilities are inadequate for addressing highly virulent poultry diseases that require increased biocontainment capabilities and state-of-the-art facilities. SEPRL has Biosafety Level (BSL)-2 Laboratory and BSL-3 Ag facilities that were constructed in 1964 and 1976. These facilities (32 small, inefficient buildings) no longer meet SEPRL's expanded research needs. The buildings which were designed for four scientists and their support staff currently serve twelve scientists and their support staff. Critical, cutting edge research is not being conducted because of facility limitations. RRC's poultry research units lack vital BSL-2 and BSL-3 Ag biocontainment facilities for conducting laboratory and animal studies. ADOL's facilities, some of which were constructed as early as 1939, are out of date and deficient.

At the request of the Secretary of Agriculture and Congress, a review of ARS' facilities was recently completed. The review, reported as the "Capital Investment Strategy," highlighted the agency's aging infrastructure and recommended modernization of selected priority facilities. The highest priority was SEPRL.

The proposed consolidated laboratory's original scope of work has been reduced. The new, modernized facility comprises a smaller main laboratory building with several new or renovated smaller facilities on the site. Part of the reduction is achieved by housing ADOL scientists at RRC. This modernized facility will meet the combined needs of SEPRL and ADOL. It will enable scientists to more adequately address the emerging/exotic poultry diseases which threaten not only the Nation's poultry industry but potentially the health of hundreds of thousands of Americans. The new facility will contain biocontainment space divided

between permanent laboratory space for permanent SEPRL scientists; laboratory space for rotating RRC scientists when working on projects requiring BSL-2 and BSL-3 Ag biocontainment; animal biocontainment space; and administrative/office space. In addition, the facility will include farm to house breeding colonies of disease free chickens used for research.

The estimated total project cost for the Biocontainment Laboratory and Consolidated Poultry Research Facility is $155 million. In 2005, 2008, and 2009, ARS received $1 million, $2.8 million, and $2.4 million respectively for the planning and design of the new facility. In 2011, $5.8 million was rescinded. In 2014, ARS is requesting $155 million for the planning, design, and construction of the facility.

Buildings and Facilities

Classification by Objects
(Dollars in thousands)

		2011 Actual	2012 Actual	2013 Estimate	2014 Estimate
Other Objects:					
25.2	Other services from non-Federal sources.....	-	-	-	$10,000
25.4	Operation and maintenance of facilities.....	$18,594	$4,854	$5,247	22,000
	Total, Other Objects.....	18,594	4,854	5,247	32,000
99.9	Total, new obligations.....	18,594	4,854	5,247	32,000

Status of Construction Projects as of March 2013

Status of research facilities authorized or funded in prior years and reported as uncompleted in the 2013 Explanatory Notes, are as follows:

NOTE: POR: A study/document that defines the research program, associated space and equipment needs and associated design criteria. DESIGN: The design is either a conceptual design - designated as 35% - or a complete design designated as 100%.

Location and Purpose	Year	Amount of Funds Provided	Description
California, Albany	2000 Planning and Design	$2,600,000	Construction of Phases 1-3a of the Research and Development Facility is complete. The re-design of the remaining work (Phases 3b, 4, 5, and 6) completed 1st Quarter 2010. Construction contract award for the final phases 3 thru 6 awarded 3rd Quarter 2010 with ARRA funding and will be completed 1st Quarter 2014.
Western Regional	2001 Construction	4,889,220	
Research Center	2002 Construction	3,800,000	
(R&D Facility)	2009 ARRA	15,624,460	
	Total	26,913,680	
California, Davis	2004 Planning and Design	$2,684,070	POR completed 2nd Quarter 2007. Lease agreement with University is in progress.
Center for Advanced	2005 Construction	2,976,000	
Viticulture and Tree Crop Research	2006 Construction	3,588,750	
	2008 Construction	1,869,819	
	2009 Construction	2,192,000	
	2010 Construction	3,000,000	
	2011 Rescission	($16,062,114)	
	Total	248,525	
California, Salinas	2004 Planning and Design	$4,473,450	Design (100%) completed 2nd Quarter 2007.
Agricultural Research Station	2005 Planning and Design	2,976,000	
	2006 Construction	3,588,750	
	2008 Construction	1,869,819	
	2009 Construction	2,192,000	
	2010 Construction	3,654,000	
	2011 Rescission	($14,937,644)	
	Total	3,816,375	
Connecticut, Storrs	2008 Planning and Design	$1,869,819	POR completed 4th Quarter 2010. Lease agreement with the University has been put on hold due to funding.
Center of Excellence for Vaccine Research	2009 Design & Construction	2,192,000	
	2010 Construction	3,654,000	
	2011 Rescission	($7,221,296)	
	Total	494,523	
District of Columbia	2000 Planning and Design	$500,000	Design (100%) of Bladensburg Road Entrance completed 1st Quarter 2006. The Administrative Building Modernization design completed 1st Quarter 2006. The construction of Phase 2, greenhouse and mechanical support space, completed 1st Quarter 2009. ARRA funds were used to award a construction contract for Administrative Building Modernization 4th Quarter of 2010. Construction will be complete 2nd Quarter 2013.
U.S. National Arboretum	2001 Design & Construction	3,322,674	
	2002 Design & Construction	4,600,000	
	2003 Design & Construction	1,688,950	
	2008 Construction	695,100	
	2009 ARRA	8,041,842	
	2011 Rescission	($2,066,637)	
	Total	16,781,929	

Location and Purpose	Year	Amount of Funds Provided	Description
Florida, Canal Point	2008 Planning and Design	$521,325	POR completed 2nd Quarter 2011. Land purchases complete. Historic preservation consultation
Agricultural Research Service Lab	2009 Planning and Design	1,096,000	needs to be completed before building demolition can occur.
	2010 Construction	3,422,000	
	2011 Rescission	($4,106,211)	
	Total	933,114	
Georgia, Athens	1992 Planning	$400,000	
Southeast Poultry Research	1993 Construction	677,000	Draft POR completed 1st Quarter 2007.
Laboratory	2008 Planning and Design	2,780,400	
	2009 Planning and Design	2,427,000	
	2011 Rescission	($5,832,898)	
	Total	451,502	
Hawaii, Hilo	1999 Planning and Design	$4,500,000	Design of Phases 1 and 2 is complete. Construction of Phase 1 completed 3rd Quarter 2007.
U.S. Pacific Basin	2000 Construction	4,500,000	Construction contract for Phase 2 awarded 4th Quarter 2010 and completed 1st Quarter 2012.
Agricultural Research	2001 Construction	4,989,000	
Center	2002 Construction	3,000,000	
	2003 Design & Construction	2,980,500	
	2004 Construction	4,831,326	
	2005 Construction	2,976,000	
	2006 Construction	3,588,750	
	2008 Construction	1,737,750	
	2009 Construction	1,565,000	
	2010 Construction	5,000,000	
	2011 Rescission	($7,730,452)	
	Total	31,937,874	
Idaho, Hagerman	2005 Planning and Design	$992,000	Lease agreement is in place. POR completed 3rd Quarter 2007.
Aquaculture Facility	2006 Construction	990,000	
	2008 Construction	695,100	
	2009 Construction	544,000	
	2011 Rescission	($2,907,600)	
	Total	313,500	
Illinois, Peoria	2000 Construction Design	$1,800,000	The modernization of the Chemical Wing was completed in 3 segments. The construction of
National Center for	2002 Construction	6,500,000	phases 1 and 2 is complete. Construction for all remaining phases of the Central Wing awarded
Agricultural	2004 Construction	2,684,070	2nd Quarter 2010 using ARRA funding and completed 3rd Quarter 2012.
Utilization Research	2005 Construction	2,976,000	
(Central Wing)	2006 Construction	3,588,750	
	2008 Construction	1,869,819	
	2009 Construction	2,192,000	
	2009 ARRA	16,237,165	
	Total	37,847,804	

Location and Purpose	Year	Amount of Funds Provided	Description
Iowa, Ames	2001 Design & Construction	$8,980,200	The accelerated plan for the completion of the modernization of ARS/APHIS animal facilities is in progress. All major components of the modernization are complete.
National Centers for	2002 Design & Construction	40,000,000	
Animal Health	2002 Construction	50,000,000	
	2002 APHIS Transfers	15,753,000	-Phase 1 Lab/Office (APHIS) completed in 2004.
	(Supplemental)	(14,081,000)	-Large Animal BSL-3Ag facilities construction completed 2nd Quarter 2007.
	(Other Transfers)	(1,672,000)	
	2002 Construction	25,000,000	-Central Utility Plant & Infrastructure, Phase 1 and 2 construction is complete. Phase 3 construction completed 1st Quarter 2009.
	2003 Construction	32,785,500	
	2003 Construction	110,000,000	-Construction of the Consolidated Laboratory Facility completed 2nd Quarter 2009.
	2005 Construction	121,024,000	
	2006 Construction	58,212,000	-Low Containment Large Animal Facility construction completed 1st Quarter of 2009. Demolition of existing facilities on 1st and 2nd St complete 3rd Quarter 2012. Bldgs. 1 & 2 demo will be complete 1st Quarter 2015.
	Total	461,754,700	
Kentucky, Bowling Green	2005 Planning and Design	$2,281,600	POR is complete for total project. Design (100%) for the Headhouse/Greenhouse only was completed 3rd Quarter 2008. Lease agreement is in place. Construction of the GH/HH was awarded 4th Quarter 2010 and was completed 2nd Quarter 2012.
Animal Waste Management	2006 Construction	2,970,000	
Research Laboratory	2008 Construction	1,390,200	
	2009 Construction	1,088,000	
	2010 Construction	2,000,000	
	2011 Rescission	($5,880,338)	
	Total	3,849,462	
Kentucky, Lexington	2005 Planning and Design	$2,976,000	
Forage Animal	2006 Construction	3,960,000	POR is complete. Lease agreement is in progress. Design (100%) was completed 2nd Quarter 2011.
Research Laboratory	2008 Construction	2,085,300	
	2009 Construction	1,632,000	
	2010 Construction	2,000,000	
	2011 Rescission	($9,678,689)	
	Total	2,974,611	
Louisiana, Houma	2004 Planning and Design	$1,342,035	Design (100%) completed 4th Quarter 2007. Repackaging of design to allow for construction of some elements within the available funding was completed 2nd Quarter 2008. Phase 1A construction was completed 4th Quarter 2010. Phase 1b construction awarded 2nd Quarter 2011 and will be complete in the 2nd Quarter 2013.
Sugarcane Research	2005 Construction	2,976,000	
	2006 Construction	3,588,750	
	2008 Construction	1,869,819	
	2009 Construction	2,505,000	
	2010 Construction	3,654,000	
	Total	15,935,604	
Louisiana, New Orleans	1998 Planning and Design	$1,100,000	The 2006 Supplemental funding was appropriated for the design and construction of the Long-Term Restoration (LTR) of facilities damaged by Hurricane Katrina. Design (100%) for the LTR of facilities was completed 4th Quarter 2008. Construction of the LTR was awarded 3rd Quarter 2009 and completed 3rd Quarter 2011.
Southern Regional	1999 Modernization	6,000,000	
Research Center	2000 Modernization	5,500,000	
(Industrial Wing)	2006 Supplemental (design)	4,900,000	
	2006 Supplemental (construction)	20,000,000	
	Total	37,500,000	

Location and Purpose	Year	Amount of Funds Provided	Description
Maine, Orono/Franklin	2001 Planning and Design	$2,494,500	Construction of all facilities at Franklin (Pump House, Storage Tanks, Lab/Office/Tank Bldg.) is complete. Program for the laboratory facility located at the University Campus in Orono, ME needs to be developed.
National Cold Water Marine	2002 Construction	3,000,000	
Aquaculture Center	2003 Construction	9,090,525	
	2004 Design & Construction	2,684,070	
	2005 Design & Construction	2,976,000	
	2006 Design & Construction	2,475,000	
	2011 Rescission	($2,012,504)	
	Total	20,707,591	
Maryland, Beltsville	1988 Design & Construction	$5,750,000	Study to evaluate boiler plants, steam lines, and electrical distribution was completed 4th Quarter 2009. Construction contract for repairs to boiler plants and portions of the steam distribution system was awarded 4th Quarter 2010 with ARRA funding and were completed 2nd Quarter 2012. Design-Build contract for major renovations to Building 306 was awarded 4th Quarter 2010 with ARRA funding and was completed 4th Quarter 2012.
Beltsville Agricultural Research	1989 Design & Construction	6,100,000	
Center, (BARC)	1990 Design & Construction	9,860,000	
	1991 Design & Construction	15,999,792	
	1992 Design & Construction	16,000,000	
	1993 Design & Construction	13,547,000	
	1994 Design & Construction	19,700,000 **	
	1995 Design & Construction	3,960,000	
	1996 Design & Construction	8,000,000	
	1997 Design & Construction	4,500,000	
	1998 Design & Construction	3,200,000	
	1999 Design & Construction	2,500,000	
	2000 Design & Construction	13,000,000	
	2001 Design & Construction	13,270,740	
	2002 Design & Construction	3,000,000	
	2003 Design & Construction	4,152,830	
	2004 Design & Construction	2,684,070	
	2005 Design & Construction	2,976,000	
	2006 Design & Construction	3,588,750	
	2009 Design & Construction	2,192,000	
	2009 ARRA	21,513,046	
	2010 Construction	3,000,000	
	2011 Rescission	($9,831,954)	
	Total	168,662,274	
Maryland, Beltsville	1998 Design & Construction	$2,500,000	Renovation of the NAL building continues. Completed projects include: replacement of the computer room HVAC and fire suppression systems; completion of chiller replacement and brick repairs of three building elevations; and 14th floor window replacements. Construction for the deteriorated building envelope, repair of brick facade, and replacement of the plumbing system was awarded 1st Quarter 2010 using ARRA funding and was completed 3rd Quarter 2012.
National Agricultural	1999 Design & Construction	1,200,000	
Library	2001 Design & Construction	1,766,106	
	2002 Construction	1,800,000	
	2003 Design & Construction	1,490,250	
	2004 Design & Construction	894,690	
	2009 ARRA	6,357,422	
	2011 Rescission	($115,175)	
	Total	15,893,293	

**Appropriated under USDA Rental Payments Account

Location and Purpose	Year	Amount of Funds Provided	Description
Michigan, East Lansing	1992 Planning	$250,000	Design (100%) for this multi-phased facility modernization is complete.
Avian Disease and	1993 Planning	212,000	
Oncology Laboratory	1998 Planning and Design	1,800,000	
	2011 Rescission	($63,193)	
	Total	2,198,807	
Mississippi, Lorman	2006 Planning and Design	$1,980,000	A lease agreement with Alcorn State University for the new facility was completed 4th Quarter
Biotechnology Laboratory	2008 Planning and Design	1,390,200	2009. POR was completed 3rd Quarter 2008.
Alcorn State University	2009 Construction	1,176,000	
	2010 Construction	1,500,000	
	2011 Rescission	($5,798,055)	
	Total	248,145	
Mississippi, Poplarville	2002 Design	$800,000	Construction of the Headhouse/Greenhouse was awarded 4th Quarter 2007 and completed 1st
Thad Cochran Southern	2003 Construction	9,140,200	Quarter 2008.
Horticultural Laboratory	2006 Supplemental	4,300,000	
	2011 Rescission	($9,178)	
	Total	14,231,022	
Mississippi, Starkville	2005 Planning and Design	$2,976,000	Lease agreement is in place. Design (100%) was completed 1st Quarter 2008.
Poultry Science	2006 Construction	4,950,000	
Research Facility	2008 Construction	1,390,200	
	2009 Construction	3,177,000	
	2011 Rescission	($10,345,645)	
	Total	2,147,555	
Mississippi, Stoneville	2004 Construction	$4,831,326	Design (100%) is complete. Construction of Phase 1 is complete. Construction of mechanical,
Jamie Whitten Delta	2005 Construction	2,976,000	electrical, and plumbing systems for phases 2 thru 5 (of 5 total) and repair of deteriorated building
States Research Center	2008 Construction	2,780,400	envelope was awarded 3rd Quarter 2010. Phase 2 and 3 were completed 1st Quarter 2013 and the
	2009 ARRA	36,347,783	remaining phases will be completed 3rd Quarter 2015.
	2010 Construction	4,000,000	
	2011 Rescission	($6,047,327)	
	Total	44,888,182	
Missouri, Columbia	2004 Planning and Design	$2,415,663	Design (100%) was completed 4th Quarter 2008.
National Plant and Genetics	2005 Construction	4,960,000	
Security Center	2006 Construction	3,687,750	
	2008 Construction	2,085,300	
	2009 Construction	1,633,000	
	2010 Construction	3,500,000	
	2011 Rescission	($15,590,075)	
	Total	2,691,638	

Location and Purpose	Year	Amount of Funds Provided	Description
Montana, Bozeman	2005 Planning and Design	$1,984,000	Lease agreement is in place. Conceptual Design (35%) was completed 3rd Quarter 2008.
Animal Bioscience Facility	2006 Construction	3,960,000	
	2008 Construction	1,869,819	
	2009 Construction	2,192,000	
	2010 Construction	3,654,000	
	2011 Rescission	($12,720,879)	
	Total	938,940	
Montana, Sidney	1998 Planning and Design	$606,000	Construction of Phase 1 (Lab/Office Building) was completed in 2003 and Phase 2 (Quarantine Lab) was completed 4th Quarter 2008.
Northern Plains Agricultural	1999 Construction	7,300,000	
Research Laboratory	2004 Design and Construction	2,505,132	
	2011 Rescission	($29,505)	
	Total	10,381,627	
Nebraska, Lincoln	2008 Planning and Design	$1,390,200	POR was completed 3rd Quarter 2011.
Systems Biology Research Facility	2009 Planning and Design	1,088,000	
	2010 Construction	3,760,000	
	2011 Rescission	($5,782,528)	
	Total	455,672	
New York, Geneva	2004 Planning and Design	$2,415,663	Design (100%) was completed 4th Quarter 2007.
Grape Genetics	2005 Construction	2,976,000	
	2006 Construction	3,588,750	
	2008 Construction	1,869,819	
	2009 Construction	2,192,000	
	2010 Construction	3,654,000	
	2011 Rescission	($14,806,870)	
	Total	1,889,362	
New York, Ithaca	2004 Planning and Design	$3,847,167	Design (100%) was completed 2nd Quarter 2008.
Crop-based Health Genomics	2005 Construction	2,976,000	
	2006 Construction	3,588,750	
	2011 Rescission	($7,314,491)	
	Total	3,097,426	
Ohio, Toledo	2005 Planning and Design	$1,984,000	Design (100%) completed 1st Quarter 2010. Lease agreement is in place.
University of Toledo	2006 Construction	1,584,000	
	2008 Construction	1,869,819	
	2009 Construction	2,192,000	
	2010 Construction	3,654,000	
	2011 Rescission	($9,356,845)	
	Total	1,926,974	

Location and Purpose	Year	Amount of Funds Provided	Description
Oklahoma, Woodward	2002 Planning and Design	$1,500,000	Phases 1 and 2 of the three-phased construction project are complete.
Southern Plains Range	2003 Construction	7,948,000	
Research Station	2005 Construction	2,976,000	
	2011 Rescission	($152,556)	
	Total	12,271,444	
Pennsylvania, Wyndmoor	1997 Construction	$4,000,000	Modernization of the Center is being accomplished in nine phases, with construction of Phases 1
Eastern Regional Research Center	1998 Construction	5,000,000	through 7 completed. Construction award for Phases 8 and 9 was made 4th Quarter 2010 with
	1999 Construction	3,300,000	ARRA funding and was completed 2nd Quarter 2012.
	2000 Construction	4,400,000	
	2002 Design & Construction	5,000,000	
	2009 ARRA	15,084,486	
	Total	36,784,486	
South Carolina, Charleston	1988 Feasibility Study	$50,000	Construction of Phase 1 (laboratory) and Phase 2A (Headhouse) is complete. Phase 2B
U.S. Vegetable	1990 Planning and		(Greenhouse) construction was awarded 2nd Quarter 2007 and completed 4th Quarter 2008.
Laboratory	Construction	1,135,000	
	1994 Construction	909,000	
	1995 Construction	5,544,000	
	1996 Construction	3,000,000	
	1997 Construction	3,000,000	
	1998 Construction	4,824,000	
	2000 Construction	1,000,000 ***	
	2002 Construction	4,500,000	
	2003 Design	1,390,900	
	2004 Construction	3,131,415	
	2005 Construction	2,976,000	
	2006 Construction	1,980,000	
	2011 Rescission	($517)	
	Total	33,439,798	
***Reprogrammed from Horticultural Crop and Water Management Research Laboratory, Parlier, CA			
Texas, Kerrville	2008 Planning and Design	$1,390,200	POR was completed 2nd Quarter 2010.
Knipling Bushland Lab	2009 Planning and Design	1,957,000	
	2011 Rescission	($2,768,214)	
	Total	578,986	
Utah, Logan	2008 Planning and Design	$5,560,800	Lease completed 3rd Quarter 2010. POR completed 4th Quarter 2010.
Agricultural Research Center	2009 Design and Construction	4,351,000	
	2010 Construction	4,527,000	
	2011 Rescission	($13,839,929)	
	Total	598,871	

Location and Purpose	Year	Amount of Funds Provided	Description
Washington, Pullman	2004 Planning and Design	$3,936,636	Lease agreement with University is in place. Conceptual Design (35%) is complete.
ARS Research Lab	2005 Construction	2,976,000	
	2006 Construction	3,588,750	
	2008 Construction	1,869,819	
	2009 Construction	2,192,000	
	2010 Construction	3,740,000	
	2011 Rescission	($17,240,830)	
	Total	1,062,375	
West Virginia, Kearneysville	2003 Planning and Design	$471,913	Construction of Phases 1 and 2 (immediate laboratory repairs and renovation) was completed 3rd Quarter 2007. The construction of the Greenhouse was completed 1st Quarter 2008. POR for the new laboratory was completed 2nd Quarter 2010. Conceptual design for new laboratory was completed 3rd Quarter 2011.
Appalachian Fruit Lab	2004 Construction	1,789,380	
	2005 Construction	3,608,896	
	2006 Construction	2,024,550	
	2008 Planning and Design	1,529,220	
	2009 Planning and Design	783,000	
	2010 Construction	2,000,000	
	2011 Rescission	($3,430,725)	
	Total	8,776,234	
West Virginia, Leetown	2002 Design & Construction	$2,200,000	Construction was completed 3rd Quarter 2008.
National Center for Cool	2006 Construction	891,000	
and Cold Water Aquaculture	2011 Rescission	($4,717)	
(Broodstock Facility)	Total	$3,086,283	
Wisconsin, Marshfield	2003 Planning, Design		Design (100%) of Phase 1 and Phase 2 is complete. Phase 1 (Nutrient Lab) construction was completed 4th Quarter 2008. Phase 2 construction (Animal Holding Facility) was awarded 4th Quarter 2007. Phase 2 construction was completed 1st Quarter 2010.
Nutrient Management	and Construction	$2,980,500	
Laboratory	2004 Construction	3,668,229	
	2005 Construction	4,860,800	
	2006 Construction	7,920,000	
	2011 Rescission	($18,229)	
	Total	19,411,300	
Wisconsin, Prairie du Sac	2008 Planning and Design	$2,502,360	POR completed 3rd Quarter 2011
Dairy Forage Agriculture Research	2009 Construction	2,002,000	
Center	2010 Construction	4,000,000	
	2011 Rescission	($7,675,381)	
	Total	828,979	

Summary of Budget and Performance
Statement of Department Goals and Objectives

ARS was established on November 2, 1953, pursuant to authority vested in the Secretary of Agriculture by 5 U.S.C. 301 and Reorganization Plan No. 2 of 1953, and other authorities.

The ARS mission is to conduct research to develop and transfer solutions to agricultural problems of high national priority and to provide information access and dissemination to: ensure high-quality, safe food, and other agricultural products; assess the nutritional needs of Americans; sustain a competitive agricultural economy; enhance the natural resource base and the environment; and provide economic opportunities for rural citizens, communities, and society as a whole.

ARS has strategic goals, management initiatives, and objectives that contribute to the Secretary's Strategic Goals.

USDA Strategic Goals 1 and 3: Assist rural communities to create prosperity so they are self-sustaining, repopulating, and economically thriving; and Help America promote agricultural production and biotechnology exports as America works to increase food security. Note: ARS' New Products/Product Quality/Value Added programs and the agency's management initiatives contribute to the first USDA Strategic Goal; ARS' Livestock/Crop Production programs contribute to both USDA Strategic Goals.

Agency Strategic Goals	Agency Objectives	Programs that Contribute	Key Outcomes
Agency Goal 1: Enhance the Competitiveness and Sustainability of Rural and Farm Economies	Objective 2.1: Expand domestic market opportunities.	New Products/ Product Quality/ Value Added	Key Outcome 2: Technologies to enable dramatic increases in the sustainable production of bioenergy, increased energy security, and reduced energy costs for the agricultural sector. Technologies leading to new and improved foods, fibers, and biobased products that expand agricultural markets and provide new and improved products for consumers here and abroad.
	Objective 2.2: Increase the efficiency of domestic agricultural production and marketing systems.	Livestock/Crop Production	Key Outcome 2: Information and technology producers can use to compete more economically in the marketplace.

Agency Strategic Goals	Agency Objectives	Programs that Contribute	Key Outcomes
Management Initiative 7(1): Provide Agricultural Library and Information Services to USDA and the Nation	Objective 7.1: Ensure provision and permanent access of quality agricultural information for USDA, the Nation, and the global agricultural community via the National Agricultural Library.	Library and Information Services	Key Outcome 7(1): Agricultural information which meets the needs of customers.
Management Initiative 7(2): Provide Adequate Federal Facilities Required to Support the Research Mission of ARS	Objective 7.2: Provide for the construction and modernization of new and/or replacement laboratories and facilities, built in a timely manner and within budget.	Buildings and Facilities	Key Outcome 7(2): Laboratories and facilities which meet the needs of ARS' scientists.

Key Outcome 2: (1) Technologies to enable dramatic increases in the sustainable production of bioenergy, increased energy security, and reduced energy costs for the agricultural sector. Technologies leading to new and improved foods, fibers, and biobased products that expand agricultural markets and provide new and improved products for consumers here and abroad; (2) Information and technology producers can use to compete more economically in the marketplace.

Key Targets:
- Enhanced bioproducts and value-added products.
- Healthier/more efficient agricultural crops and animals.
- Important genetic resources which have been identified and preserved.
- New/expanded markets for improved agricultural products.

Key Outcome 7 (1): Agricultural information which meets the needs of customers.

Key Targets:
- National Digital Library for Agriculture (NDLA) is developed.
- Agricultural Online Access (AGRICOLA) is fully integrated into NDLA.
- Valuable USDA publications are digitally reformatted for preservation.

Key Outcome 7 (2): Laboratories and facilities which meet the needs of ARS' scientists.

Key Targets:
- Laboratories and facilities are constructed/modernized in accordance with ARS' mission and are completed on schedule and within budget.

The following table presents selected performance measures and targets that contribute to the Secretary's Strategic Goals of assisting rural communities, and helping promote agricultural production and biotechnology. (Note: Not all of ARS' performance measures and targets are shown.)

Performance Measure	2012 Estimate	2013 Target	2014 Target
•Create new scientific knowledge and innovative technologies that represent scientific and technological advancements or breakthroughs applicable to bioenergy.	•Enabled new germplasm, varieties, and hybrids of bioenergy with optimal traits. •Enabled new optimal practices and systems that optimizes the sustainable yield of high quality bioenergy feedstocks. •Enabled new, commercially preferred biorefining technologies. •Used the bioenergy crop germplasm and seed collection to phenotype/select high value agronomic/quality traits. •Developed complete systems and life cycle analyses of biomass feedstock production systems.	•Enable new germplasm, varieties, and hybrids of bioenergy with optimal traits. •Enable new optimal practices and systems that optimizes the sustainable yield of high quality bioenergy feedstocks. •Enable new, commercially preferred biorefining technologies. •Use the bioenergy crop germplasm and seed collection to phenotype/select high value agronomic/quality traits. •Develop complete systems and life cycle analyses of biomass feedstock production systems.	•Enable new germplasm, varieties, and hybrids of bioenergy with optimal traits. •Enable new optimal practices and systems that optimizes the sustainable yield of high quality bioenergy feedstocks. •Enable new, commercially preferred biorefining technologies. •Use the bioenergy crop germplasm and seed collection to phenotype/select high value agronomic/ quality traits. •Develop complete systems and life cycle analyses of biomass feedstock production systems. •Enhance the economic viability of bioenergy by increasing the profitability of oilseed-based and carbohydrate-based biorefineries.
Dollars ($)	$13,318,000	$13,399,000	$13,411,000
•Develop cost effective, functional industrial and consumer products, including higher quality, healthy foods, that satisfy consumer demand in the United States and abroad.	•Developed technologies leading to new value-added products from crops and crop residues. •Developed new value-added products from animal byproducts.	•Develop technologies leading to new value-added products from crops and crop residues. •Develop new value-added products from animal byproducts.	•Develop technologies leading to new value-added products from crops and crop residues. •Develop new value-added products from animal byproducts.

Performance Measure	2012 Estimate	2013 Target	2014 Target
	•Developed new biobased products.	•Develop new biobased products.	•Develop new biobased products.
Dollars ($)	$87,223,000	$87,992,000	$71,930,000
•Develop new technologies, tools, and information contributing to improved precision animal production systems to meet current and future food animal production needs of diversified consumers, while simultaneously minimizing the environmental footprint of production systems and enhancing animal well-being.	•Continued to increase stored germplasm resources and increased use of National Animal Germplasm Program. •Increased the number of populations with adequate germplasm stores to enable reconstitution if necessary. •Developed improved semen extenders and artificial insemination methodologies. •Used the completed chicken, cattle, and swine genome sequences to identify genes impacting efficiency of nutrient utilization and adaptation to the production environment. •Developed reduced Single Nucleotide Polymorphism chips to target specific livestock breeds and a particular suite of traits. •Increased depth of sequence coverage in key genomic regions to identify causative mutations. •Used metagenomics to identify microbial genes and microbial pathways affecting feed efficiency, animal health, and odor	•Continue to increase stored germplasm resources and increase use of National Animal Germplasm Program. •Increase the number of populations with adequate germplasm stores to enable reconstitution if necessary. •Develop improved semen extenders and artificial insemination methodologies. •Use the completed chicken, cattle, and swine genome sequences to identify genes impacting efficiency of nutrient utilization and adaptation to the production environment. •Develop reduced Single Nucleotide Polymorphism chips to target specific livestock breeds and a particular suite of traits. •Increase depth of sequence coverage in key genomic regions to identify causative mutations. •Use metagenomics to identify microbial genes and microbial pathways affecting feed efficiency, animal health, and odor emissions in animal production.	•Continue to increase stored germplasm resources and increase use of National Animal Germplasm Program. •Increase the number of populations with adequate germplasm stores to enable reconstitution if necessary. •Develop improved semen extenders and artificial insemination methodologies. •Use the completed chicken, cattle, and swine genome sequences to identify genes impacting efficiency of nutrient utilization and adaptation to the production environment. •Develop reduced SNP chips to target specific livestock breeds and a particular suite of traits. •Increase depth of sequence coverage in key genomic regions to identify causative mutations. •Use metagenomics to identify microbial genes and microbial pathways affecting

Performance Measure	2012 Estimate	2013 Target	2014 Target
	emissions in animal production. •Developed genome sequence resources for catfish, rainbow trout, sheep, and turkey. •Expanded the capacity for high value animal trait evaluation and marker analyses to rapidly identify key genes.	•Develop genome sequence resources for catfish, rainbow trout, sheep, and turkey. •Expand the capacity for high value animal trait evaluation and marker analyses to rapidly identify key genes. •Develop integrated production systems that incorporate enhanced germplasm and pest/pathogen/water/ nutrient management strategies to optimize sustainable animal production. •Enhance livestock production.	feed efficiency, animal health, and odor emissions in animal production. •Develop genome sequence resources for catfish, rainbow trout, sheep, and turkey. •Expand the capacity for high value animal trait evaluation and marker analyses to rapidly identify key genes. •Develop integrated production systems that incorporate enhanced germplasm and pest/pathogen/ water/nutrient management strategies to optimize sustainable animal production. •Use data to achieve improved feed efficiency and reduced antimicrobial resistance in livestock.
Dollars ($)	$76,054,000	$76,519,000	$72,648,000
•Expand, maintain, and protect our genetic resource base, increase our knowledge of genes, genomes, and biological processes, and provide economically and environmentally sound technologies that will improve the production efficiency, health, and value of the Nation's crops.	•Applied new genomic tools to accelerate genetic improvement of 'specialty crops' for superior product quality. •Deployed new breeding strategies or genetic engineering methods based on knowledge of gene function and expression to enhance the	•Apply new genomic tools to accelerate genetic improvement of 'specialty crops' for superior product quality. •Deploy new breeding strategies or genetic engineering methods based on knowledge of gene function and expression to enhance the effectiveness of crop improvement programs.	•Apply new genomic tools to accelerate genetic improvement of 'specialty crops' for superior product quality. •Deploy new breeding strategies or genetic engineering methods based on knowledge of gene function and expression to enhance

Performance Measure	2012 Estimate	2013 Target	2014 Target
	effectiveness of crop improvement programs. •Maintained USDA germplasm collections in a healthy, secure, and easily accessible form. •Distributed germplasm for research purposes. •Increased crop genetic resource regeneration, and safeguarded collection. •Secured more wild relatives of crops in gene banks. •Expanded collections of crop genetic stocks key to genomic research. •Expanded the capacity for high value crop trait evaluation and marker analyses to rapidly identify key genes.	•Maintain and expand USDA germplasm collections in a healthy, secure, and easily accessible form. •Distribute germplasm for research purposes. •Increase crop genetic resource regeneration, and safeguard collection. •Secure more wild relatives of crops in gene banks. •Expand collections of crop genetic stocks key to genomic research. •Expand the capacity for high value crop trait evaluation and marker analyses to rapidly identify key genes. •Develop more productive, disease free floricultural and nursery crops.	the effectiveness of crop improvement programs. •Maintain and expand USDA germplasm collections in a healthy, secure, and easily accessible form. •Distribute germplasm for research purposes. •Increase crop genetic resource regeneration, and safeguard collection. •Secure more wild relatives of crops in gene banks. •Expand collections of crop genetic stocks key to genomic research. •Expand the capacity for high value crop trait evaluation and marker analyses to rapidly identify key genes. •Research maize, other cereals, and perennial grasses to provide better data analysis to accelerate crop yields, feed, and bioenergy. •Research tree fruit vegetable, and food legume crops to provide enhanced data analysis to improve yield, nutrition, quality.

Performance Measure	2012 Estimate	2013 Target	2014 Target
			•Improve sustainability of crop production systems.
Dollars ($)	$129,069,000	$129,859,000	$130,971,000
•The services and collections of the National Agricultural Library continue to meet the needs of its customers.	•Provided additional resources for NAL's digital information services.	•Provide additional resources for NAL's digital information services.	•Provide additional resources for NAL's digital information services.
Dollars ($)	$15,583,000	$15,583,000	$19,031,000
•The National Agricultural Library and partners implement the National Digital Library for Agriculture.	•Page views/searches on NAL's web site exceeded 100 million.	• Improve services, i.e., reference services and material acquisition.	• Establish broad infrastructure capacity within NAL to source, store, manage, and disseminate large and complex environmental, life cycle assessment, genomic, biologic, and other databases for public use.
Dollars ($)	$5,336,000	$5,336,000	$6,484,000
•Selected ARS laboratories/ facilities are repaired/ maintained with R&M available funds.	•Repaired/maintained ARS laboratories/ facilities using Repair and Maintenance funds.	•Repair/maintain ARS laboratories/facilities using Repair and Maintenance funds.	•Repair/maintain ARS laboratories/ facilities using Repair and Maintenance funds.
Dollars ($)	$17,468,000	$17,468,000	$17,468,000

Product Quality/Value Added

Selected Past Accomplishments toward Achievement of the Key Outcome

- Developed a new, rapid digital imaging wheat sorting system.
- Created a computer-based model of the fluid milk process which lowers greenhouse gas emissions.
- Developed a biodegradable solution of protein nanoparticles which is superior to current commercially available window cleaners.
- Developed packaging inserts which release antimicrobial vapor that extends postharvest shelf life of fresh fruit, and reduces water loss and decay while maintaining color and overall quality.
- Developed new, healthy functional foods from oats.
- Developed lowland switchgrass with improved winter hardiness and high biomass yields.
- Engineered a new inhibitor tolerant, pentose utilizing yeast strain for lignocellulose-to-ethanol conversion.
- Estimated potential biomass production from winter rye planted in the fall that can be harvested for cellulosic biofuel prior to planting of corn or soybean in the upper Midwest.

- Discovered laparaxin, a polypeptide produced by *Lactobacillus paracase,* that inhibits growth of bacteria that contaminate ethanol plants.

Note: A more complete explanation of these selected accomplishments is provided under the "Status of Program" section.

Selected Accomplishments Expected at the 2014 Proposed Resource Level

- Enable new germplasm, varieties, and hybrids of bioenergy with optimal traits.
- Enable new optimal practices and systems that maximize the sustainable yield of high quality bioenergy feedstocks.
- Use the bioenergy crop germplasm and seed collection to phenotype/select high value agronomic/quality traits.
- Develop complete systems and life cycle analyses of biomass feedstock production systems.
- Enable new, commercially preferred biorefining technologies.
- Develop technologies leading to new value-added products from crops and crop residues.
- Develop new value-added products from animal byproducts.
- Develop new biobased products.
- Enhance the economic viability of bioenergy by increasing the profitability of oilseed-based and carbohydrate-based biorefineries.

Livestock Production

Selected Past Accomplishments toward Achievement of the Key Outcome

- Developed an alternative to conventional antimicrobials that kill *Staphylococcus aureus* bacteria and multi-drug resistant strains in livestock.
- Took a major step in identifying components affecting genetic variation in cattle, and moved toward developing DNA marker tests which will improve reproduction and production efficiencies in the beef industry.
- Found that temperature humidity index was a useful predictor of growth/weight gain in heavy broiler chickens.
- Found a method of increasing nutritional efficiency and controlling ammonia emissions in dairy cows through diet.
- Developed management options for range livestock producers dealing with drought conditions.
- Found that yeast supplementation for feedlot cattle improves their health and well-being, mitigates dietary endotoxins, and reduces the negative effects of heat stress on growth and feed intake.
- Developed a new processing method to recover high value co-products from grain-based ethanol production.
- Developed and validated split pond production systems which increase catfish production.
- Selectively bred yellow perch which reach market size four months earlier.
- Developed a live attenuated vaccine and in-pond vaccination platform to protect catfish against enteric septicemia.
- Demonstrated that for hybrid striped bass, a diet with higher digestible protein and fat that was supplemented with deficient amino acids, maximized growth and nutrient retention and reduced ammonia waste production.

Note: A more complete explanation of these selected accomplishments is provided under the "Status of Program" section.

Selected Accomplishments Expected at 2014 Proposed Resource Level

- Increase stored germplasm resources and increase use of National Animal Germplasm Program.
- Increase the number of populations with adequate germplasm stores to enable reconstitution if necessary.
- Develop improved semen extenders and artificial insemination methodologies.
- Use the completed chicken, cattle, and swine genome sequences to identify genes impacting efficiency of nutrient utilization and adaptation to the production environment.

- Develop reduced single nucleotide polymorphism (SNP) chips to target specific livestock breeds and a particular suite of traits.
- Increase depth of sequence coverage in key genomic regions to identify causative mutations.
- Use metagenomics to identify microbial genes and microbial pathways affecting feed efficiency, animal health, and odor emissions in animal production.
- Develop genome sequence resources for catfish, rainbow trout, sheep, and turkey.
- Expand the capacity for high value animal trait evaluation and marker analyses to rapidly identify key genes.
- Develop integrated production systems that incorporate enhanced germplasm and pest/pathogen/water/nutrient management strategies to optimize sustainable animal production.
- Use data to achieve improved feed efficiency and reduced antimicrobial resistance in livestock.

Crop Production

Selected Past Accomplishments toward Achievement of the Key Outcome

- Released a new 2012 USDA Plant Hardiness Zone map which is a Web accessible, multi-functional interactive information resource.
- Sequenced the genomes of the domesticated tomato and its wild ancestor.
- Located the regions of the corn genome associated with more than 150 traits of major agronomic importance.
- Developed a novel method for identifying different nitrogen fixing bacteria and determining their benefit to soybean growth and production.
- Conducted research which will enable more effective breeding for increased seed zinc and iron levels in dry beans which will benefit human nutrition.
- Developed a new control strategy that uses RNA interference technology to protect bees against Colony Collapse Disorder.
- Developed an improved technology for producing long cane blackberry plants with more fruit clusters and larger fruit.
- Found that utilization of energycanes for production of cellulosic biomass may be a sustainable rotational crop for sugarcane.
- Field tested soil phosphorus from land applied animal manures for its value as a fertilizer product, and found that the material can be processed into commercial sized fertilizer pellets.

Note: A more complete explanation of these selected accomplishments is provided under the "Status of Program" section.

Selected Accomplishments Expected at the 2014 Proposed Resource Level

- Develop sustainable crop production systems.
- Develop plant varieties and ecologically-based soil/plant management strategies.
- Apply a computer decision support system for crop production that reduces production risks/losses.
- Apply biocontrol technologies to crop plants to enhance disease resistance.
- Apply new genomic tools to accelerate genetic improvement of 'specialty crops' for superior product quality.
- Deploy new breeding strategies or genetic engineering methods based on knowledge of gene function and expression to enhance the effectiveness of crop improvement programs.
- Maintain and expand USDA germplasm collections in a healthy, secure, and easily accessible form.
- Distribute germplasm for research purposes.
- Expand collections of crop genetic stocks key to genomic research.
- Increase crop genetic resource regeneration, and safeguard collection.
- Secure more wild relatives of crops in gene banks.
- Expand the capacity for high value crop trait evaluation and marker analyses to rapidly identify key genes.
- Develop more productive, disease free floricultural and nursery crops.
- Research maize, other cereals, and perennial grasses to provide better data analysis to accelerate crop yields, feed, and bioenergy.

- Research tree fruit, vegetable, and food legume crops to provide enhanced data analysis to improve yield, nutrition, and quality.

Library and Information Services

Selected Past Accomplishments toward Achievement of the Key Outcome

- Made VIVO, a semantic, open source application that enables the networking of scientists, available and operational at USDA.
- Created Start2Farm, a Web-based educational clearinghouse, designed to assist people with less than 10 years experience in farming or ranching.
- Implemented automated indexing/text analytics software to produce the AGRICOLA Index of agricultural literature.
- Revised updated NAL's Collection Development Policy that governs how the library grows and maintains its collection.

Note: A more complete explanation of these selected accomplishments is provided under the "Status of Program" section.

Selected Accomplishments Expected at the 2014 Proposed Resource Level

- Provide additional resources for NAL's digital information services.
- Establish broad infrastructure capacity within NAL to source, store, manage, and disseminate large and complex environmental, life cycle assessment, genomic, biologic, and other databases for public use.

Buildings and Facilities

Selected Past Accomplishments toward Achievement of the Key Outcome

- In 2011, approximately $230 million of Building and Facilities (B&F) funding was rescinded that had been previously appropriated to continue modernization/renovation projects and construction of new facilities at a number of ARS locations. In addition, no B&F funding was provided in 2012 and 2013. The loss of these B&F funds prevented execution of design and construction efforts for modernization and new construction to continue.

  However, in 2013, construction is proceeding from B&F funding provided prior to 2011, on portions of planned construction projects for laboratories/facilitates at the following locations: Hilo, Hawaii (U.S. Pacific Basin Agricultural Research Center); Peoria, Illinois (National Center for Agricultural Utilization Research); Bowling Green, Kentucky (Animal Waste Management Research Laboratory); Houma, Louisiana (ARS Sugarcane Research Laboratory); and Stoneville, Mississippi (Jamie Whitten Delta States Research Center). In 2013, execution of these projects is continuing.

  Planning and design projects are currently on hold pending availability of construction funds, for laboratories/facilities at the following locations: Davis, California (Grape Genomics Research Center); Salinas, California (U.S. Agricultural Research Station); Storrs, Connecticut (Center of Excellence for Vaccine Research); Athens, Georgia (Southeast Poultry Research Laboratory); Canal Point, Florida (Agricultural Research Laboratory); Lincoln, Nebraska (Systems Biology Research Facility); Kerrville, Texas (Knipling-Bushland Laboratory); Logan, Utah (Agricultural Research Center); Hagerman, Idaho (National Trout Production & Evaluation Facility); Lexington, Kentucky (Forage Animal Research Laboratory); Starkville, Mississippi (Poultry Science Research Facility); Columbia, Missouri (National Plant and Genetics Security Center); Bozeman, Montana (Animal Bioscience Facility); Geneva, New York (Center for Grape Genetics); Toledo, Ohio (University of Toledo); Pullman, Washington (ARS Research Laboratory); Washington, DC (U.S. National Arboretum); Kearneysville, West Virginia (Appalachian Fruit Laboratory); and Prairie du Sac, Wisconsin (Dairy Forage Research Center).

Selected Accomplishments Expected at the 2014 Proposed Resource Level

- Under ARS' Buildings and Facilities account, the agency has proposed $155 million in 2014 for the planning, design, and construction of the Biocontainment Laboratory and Consolidated Poultry Research Facility in Athens, Georgia.
- Under ARS' Salaries and Expenses account, using Repair and Maintenance funds, the agency will repair/maintain selected buildings and facilities.

USDA Strategic Goal 2: Ensure our national forests and private working lands are conserved, restored, and made more resilient to climate change, while enhancing our water resources.

Agency Strategic Goals	Agency Objectives	Programs that Contribute	Key Outcomes
Agency Goal 6: Protect and Enhance the Nation's Natural Resource Base and Environment	Objective 6.1: Enhance watersheds' capacities to deliver safe and reliable fresh water.	Environmental Stewardship (Water Quality)	Key Outcome 6: Safe, abundant, and reliable water resources.
	Objective 6.2: Improve soil and air quality to enhance crop production and environmental quality.	Environmental Stewardship (Air/Soil Quality; Global Climate Change)	Key Outcome 6: Enhanced crop production and improved environmental quality.
	Objective 6.3: Conserve and use pasture and range lands efficiently.	Environmental Stewardship (Range/Grazing Lands; Agricultural Systems Integration)	Key Outcome 6: Pasture and range land management systems that enhance economic viability and environmental services.

Key Outcome 6: (1) Safe, abundant, and reliable water resources. (2) Enhanced crop production and improved environmental quality. (3) Pasture and range land management systems that enhance economic viability and environmental services.

Key Targets:
- Tools/technologies which improve the quality of the Nation's surface waters.
- Improved management/conservation practices that conserve soil resources and reduce dust emissions from agricultural operations.
- Management practices/technologies which reduce gaseous emissions for agricultural operations.
- Scientific information for planning and managing carbon storage in soil.
- Improved management practices/technologies for managing pasture and range lands.

The following table presents selected performance measures and targets that contribute to the Secretary's Strategic Goals relating to the Nation's national forests and private working lands. (Note: Not all of ARS' performance measures and targets are shown.)

Note: ARS' Water Quality research programs directly contribute to USDA's Agency Priority Goal: "Accelerate the protection of clean, abundant water resources by advancing USDA's capacity to measure the effectiveness of conservation investments in addressing water resource concerns."

Performance Measure	2012 Estimate	2013 Target	2014 Target
•Develop technology and practices to reduce the delivery of agricultural pollutants by water on farms and ranches and quantify the environmental benefit of conservation practices in watersheds.	•Developed or evaluated a method or technology to assess and conserve water availability through more efficient sensing, supply, delivery, and reuse systems. •Developed or evaluated a method or technology to reduce or prevent nutrient contamination of surface and ground waters. •Developed or evaluated a method or technology that reduces sediment loads to waterways, improves farm land sustainability, and improves or restores stream corridors and riparian ecosystems. •Developed or assessed a system or practice that ameliorates, offsets, or mitigates the impact of agricultural production and processing on water resources. •Expanded the ARS GRACEnet project into U.S. biomass and specialty crops, and into farming systems in one sub-Saharan or Asian country. •Provided a web-accessible management tool based on geospatial information on crop condition, soil moisture, drought monitoring, and hydrologic models for producers, land	•Develop or evaluate a method or technology to assess and conserve water availability through more efficient sensing, supply, delivery, and reuse systems. •Develop or evaluate a method or technology to reduce or prevent nutrient contamination of surface and ground waters. •Develop or evaluate a method or technology that reduces sediment loads to waterways, improves farm land sustainability, and improves or restores stream corridors and riparian ecosystems. •Develop or assess a system or practice that ameliorates, offsets, or mitigates the impact of agricultural production and processing on water resources. •Expand the ARS GRACEnet project into U.S. biomass and specialty crops. •Provide a web-accessible management tool based on geospatial information on crop condition, soil moisture, drought monitoring, and hydrologic models for producers, land managers, and communities needing to use water efficiently and cost-effectively.	•Develop or evaluate a method or technology to assess and conserve water availability through more efficient sensing, supply, delivery, and reuse systems. •Develop or evaluate a method or technology to reduce or prevent nutrient contamination of surface and ground waters. •Develop or evaluate a method or technology that reduces sediment loads to waterways, improves farm land sustainability, and improves or restores stream corridors and riparian ecosystems. •Develop or assess a system or practice that ameliorates, offsets, or mitigates the impact of agricultural production and processing on water resources. •Expand the ARS GRACEnet project into U.S. biomass and specialty crops. •Provide a web-accessible management tool based on geospatial information on crop condition, soil

Performance Measure	2012 Estimate	2013 Target	2014 Target
	managers, and communities needing to use water efficiently and cost-effectively. •Developed sustainable water management strategies.	•Develop sustainable water management strategies. •Enhance the quantity/quality of water resources for agriculture.	moisture, drought monitoring, and hydrologic models for producers, land managers, and communities needing to use water efficiently and cost-effectively. •Develop sustainable water management strategies. •Enhance the quantity/quality of water resources for agriculture. •Enhance data collection, management, analyses, and syntheses for research on watersheds. •Expand research capacity in the earth sciences.
Dollars ($)	$62,034,000	$62,414,000	$72,899,000
•Develop practices and technologies to enhance soil resources and reduce emissions of particulate matter and gases from crop production lands, agricultural processing operations, and animal production systems.	•Developed one technology or decision tool to predict carbon sequestration in the soil. •Developed one management practice or control technology to reduce emissions from agricultural operations. •Developed methods to genotypically and phenotypically characterize large numbers of crop species and varieties in collections to develop high yielding and profitable crops.	•Develop one technology or decision tool to predict carbon sequestration in the soil. •Develop one management practice or control technology to reduce emissions from agricultural operations. •Develop methods to genotypically and phenotypically characterize large numbers of crop species and varieties in collections to develop high yielding and profitable crops.	• Develop one technology or decision tool to predict carbon sequestration in the soil. • Develop one management practice or control technology to reduce emissions from agricultural operations. • Develop methods to genotypically and phenotypically characterize large numbers of crop species and varieties

Performance Measure	2012 Estimate	2013 Target	2014 Target
	•Reduced risks to agricultural production/ecosystem services from interacting climate-related stresses. •Developed one management practice or control technology to reduce emissions from agricultural operations.	•Reduce risks to agricultural production/ ecosystem services from interacting climate-related stresses. •Develop one management practice or control technology to reduce emissions from agricultural operations. •Adapt agricultural systems to climate variability and weather extremes. •Sustain agricultural production capacity for food and energy security and ecosystem services over long periods at landscape scale. •Improve soil and water quality outcomes of USDA Conservation Programs. •Advance the capacity for assessing the impacts of climate and environment on food, feed, and fiber production. •Improve plants for maximum productivity with minimal inputs and increased tolerance to environmental stress.	in collections to develop high yielding and profitable crops. •Reduce risks to agricultural production/ecosystem services from interacting climate-related stresses. • Develop one management practice or control technology to reduce emissions from agricultural operations. •Adapt agricultural systems to climate variability and weather extremes. •Sustain agricultural production capacity for food and energy security and ecosystem services over long periods at landscape scale. •Develop integrated programs to increase the sustainability of food animal and crop production systems. •Reduce agriculture's vulnerability to climate change. •Establish an Earth Observation and Environmental Data Integration Resource Center.
Dollars ($)	$84,892,000	$85,411,000	$102,919,000

Performance Measure	2012 Estimate	2013 Target	2014 Target
•Improved management practices and technologies for managing pasture and range lands to improve economic profitability and enhance environmental values.	•Developed one cost effective practice or strategy to restore degraded range lands. •Developed one method or strategy to measure and monitor pasture and range land health.	•Develop one cost effective practice or strategy to restore degraded range lands. •Develop one method or strategy to measure and monitor pasture and range land health. •Enhance crop land productivity.	• Develop one cost effective practice or strategy to restore degraded range lands. • Develop one method or strategy to measure and monitor pasture and range land health. •Enhance data collection, management, analyses, and syntheses for research on range lands.
Dollars ($)	$42,108,000	$42,366,000	$43,332,000

Environmental Stewardship

Selected Past Accomplishments toward Achievement of the Key Outcome

- Found that fall planted cover crops can improve water quality in the Upper Mississippi River basin.
- Released to the public and the NRCS Version 4.1 of WinSRFR, a surface irrigation software program that can be used to analyze field evaluation data, estimate field infiltration properties, analyze design alternatives, and optimize operations.
- Provided a means of optimizing tillage and fertilizer management practices to reduce nitrous oxide and carbon dioxide and greenhouse gas emissions while maintaining the other benefits of no or reduced tillage.
- Determined that herbicide volatilization (vapor loss to the atmosphere) is greatest under warm, wet soil moisture conditions, and that herbicide volatilization models need to be revised.
- Found that pesticide volatilization, from the fields and not drift during application, is the most likely emission source to the nearby Everglades and the Biscayne National Parks.
- Provided information/practices farmers can adopt to reduce the amount of phosphorus leaving their farms which will reduce algae growth and eutrophication in surface waters.
- Demonstrated that a product derived from soybean, soybean peroxidase, was effective in reducing odorous chemical emissions from swine lagoons.
- Found that the enzyme, polyphenol oxidase, improves silage protein uptake by livestock.
- Conducted research which provides the groundwork for developing genetic markers to locate stem rust resistance genes for producing rust resistant varieties of ryegrass.
- Provided producers with an effective alternative management strategy for managing weight gains in dairy heifers.
- Developed the Rangeland Hydrology and Erosion model to estimate runoff and erosion rates in 17 western States.
- Developed 13 State (in the northeast) collection of geodatabases that brings together available spatial information on cropping systems and crop production, soils, land use and quality, and water resources.
- Showed that oat and rye cover crops substantially reduce the concentration of nitrates in drainage water.
- Developed alternatives to methyl bromide for postharvest disinfestations of perishable and durable commodities in California.

Note: A more complete explanation of these selected accomplishments is provided under the "Status of Program" section.

Selected Accomplishments Expected at the 2014 Proposed Resource Level

- Expand the ARS Greenhouse Gas Reduction through Agricultural Carbon Enhancement Network (GRACEnet) project into U.S. biomass and specialty crops.
- Develop methods to genotypically and phenotypically characterize large numbers of crop species and varieties in collections to develop high yielding and profitable crops.
- Provide a web-accessible management tool based on geospatial information on crop condition, soil moisture, drought monitoring, and hydrologic models for producers, land managers, and communities needing to use water more efficiently and cost-effectively.
- Develop or evaluate a method or technology to assess and conserve water availability through more efficient sensing, supply, delivery, and reuse systems.
- Develop or evaluate a method or technology to reduce or prevent nutrient contamination of surface and ground waters.
- Develop or evaluate a method or technology that reduces sediment loads to waterways, improves farm land sustainability, and improves or restores stream corridors and riparian ecosystems.
- Develop or assess a system or practice that ameliorates, offsets, or mitigates the impact of agricultural production and processing on water resources.
- Develop sustainable water management strategies.
- Develop one technology or decision tool to predict carbon sequestration in the soil.
- Develop one management practice or control technology to reduce emissions from agricultural operations.
- Reduce risks to agricultural production/ecosystem services from interacting climate-related stresses.
- Develop one cost effective practice or strategy to restore degraded range lands.
- Develop one method or strategy to measure and monitor pasture and range land health.
- Adapt agricultural systems to climate variability and weather extremes.
- Sustain agricultural production capacity for food and energy security and ecosystems services over long periods at landscape scale.
- Enhance the quantity/quality of water resources for agriculture.
- Develop one management practice or control technology to reduce emissions from agricultural operations.
- Enhance data collection, management, analyses, and syntheses for research on watersheds and range lands.
- Expand research capacity in the earth sciences.
- Develop integrated programs to increase the sustainability of food animal and crop production systems.
- Reduce agriculture's vulnerability to climate change.

USDA Strategic Goal 4: Ensure that All of America's Children Have Access to Safe, Nutritious, and Balanced Meals.

Agency Strategic Goals	Agency Objectives	Programs that Contribute	Key Outcomes
Agency Goal 4: Enhance Protection and Safety of the Nation's Agriculture and Food Supply	Objective 4.1: Provide the scientific knowledge to reduce the incidence of foodborne illnesses in the U.S.	Food Safety	Key Outcome 4: Reduction in foodborne illness associated with the consumption of meat, poultry, and egg products.

Agency Strategic Goals	Agency Objectives	Programs that Contribute	Key Outcomes
	Objective 4.2: Reduce the number, severity, and distribution of agricultural pest and disease outbreaks.	Livestock/Crop Protection	Key Outcome 4: The knowledge the Nation needs for a secure agricultural production system and healthy food supply.
Agency Goal 5: Improve the Nation's Nutrition and Health	Objective 5.2: Promote healthier eating habits and lifestyles.	Human Nutrition	Key Outcome 5: Eating habits more consistent with *Dietary Guidelines for Americans*.

Key Outcome 4: (1) Reduction in foodborne illness associated with the consumption of meat, poultry, and egg products. (2) The knowledge the Nation needs for a secure agricultural production system and healthy food supply.

Key Targets:
- Intervention strategies which reduce pathogens in animals used for food.
- New methodologies for detecting microorganisms/chemicals affecting food safety.
- Genetic lines of plants/animals which are more disease resistant.
- New vaccines for priority animal diseases.
- New diagnostic tests for economically important plant and animal diseases.
- Improved management/control of emerging plant and animal diseases.

Key Outcome 5: Eating habits more consistent with *Dietary Guidelines for Americans*.

Key Targets:
- New information on the benefits of consuming healthy diets and on effective intervention strategies.
- Better understanding of nutrients and their role in promoting health and preventing obesity and related diseases.
- Revised dietary guidelines.

The following table presents selected performance measures and targets that contribute to the Secretary's Strategic Goals relating to ensuring America's children have access to safe and nutritious food. (Note: Not all of ARS' performance measures and targets are shown.)

Performance Measure	2012 Estimate	2013 Target	2014 Target
•Develop new technologies that assist ARS customers in detecting, identifying, and controlling foodborne diseases that affect human health.	•Used population systems to understand the interrelationships of microorganisms in food environments, and the interrelationships among host, pathogen, and environment. •Used systems biology to understand the basic genetic components of	•Use population systems to understand the interrelationships of microorganisms in food environments, and the interrelationships among host, pathogen, and environment. •Use systems biology to understand the basic genetic components of	•Use population systems to understand the interrelationships of microorganisms in food environments, and the interrelationships among host, pathogen, and environment.

Performance Measure	2012 Estimate	2013 Target	2014 Target
	pathogens, their expression, and directly relate this information to the microorganisms's biology and its potential effect on food safety. •Developed rapid systems to detect food pathogens that may enter through raw materials, contamination during processing, or retail to protect public health. •Developed production and processing intervention systems that may control, mitigate, or reduce biological and chemical contaminants in foods. •Developed methods and models to predict the behavior of microorganisms in foods and may be used to support food safety measures and risk assessment. •Developed rapid systems to detect toxins and chemical contaminants to protect human health and the environment. • Developed and validated: two lab-based multi-platform contaminant detection technologies for the highest priority pathogens, toxins, and chemical residues; two multi-task on/in-line (in field) inspection technologies (for all size	pathogens, their expression, and directly relate this information to the microorganisms's biology and its potential effect on food safety. •Develop rapid systems to detect food pathogens that may enter through raw materials, contamination during processing, or retail to protect public health. •Develop production and processing intervention systems that may control, mitigate, or reduce biological and chemical contaminants in foods. •Develop methods and models to predict the behavior of microorganisms in foods and may be use to support food safety measures and risk assessment. •Develop rapid systems to detect toxins and chemical contaminants to protect human health and the environment. •Develop and validate: two lab-based multi-platform contaminant detection technologies for the highest priority pathogens, toxins, and chemical residues; and two multi-task on/in-line (in field) inspection technologies (for all size processors) that detect contaminants and changes in attributes at required line speeds.	•Use systems biology to understand the basic genetic components of pathogens, their expression, and directly relate this information to the microorganisms's biology and its potential effect on food safety. •Develop rapid systems to detect food pathogens that may enter through raw materials, contamination during processing, or retail to protect public health. •Develop production and processing intervention systems that may control, mitigate, or reduce biological and chemical contaminants in foods. •Develop methods and models to predict the behavior of microorganisms in foods and may be use to support food safety measures and risk assessment. •Develop rapid systems to detect toxins and chemical contaminants to protect human health and the environment.

Performance Measure	2012 Estimate	2013 Target	2014 Target
	processors) that detect contaminants and changes in attributes at required line speeds; three detection methods for mycotoxins in foods to be used by CDC for public health outbreaks and for use in developing countries. • Developed five science-based management practices to prevent preharvest contamination of produce, by enteric pathogens, and implement three intervention strategies to eliminate pathogen contamination: the control and prediction of the fate and transport of pathogens will be determined by specific tools developed; the role of the environment and animals in the prevalence, diversity, and quantity, and survival of pathogens in crops will be determined by specific analytic and field approaches; the specific pathogens and the effect of reduction strategies will be measured. • Developed five innovative processing intervention strategies to assure and maintain postharvest safety and quality. The effect of food processing technologies on overall reduction of pathogens at the end of production is estimated through	• Develop three science-based management practices to prevent preharvest contamination of produce, by enteric pathogens, and implement three intervention strategies to eliminate pathogen contamination: the control and prediction of the fate and transport of pathogens will be determined by specific tools developed; the role of the environment and animals in the prevalence, diversity, and quantity, and survival of pathogens in crops will be determined by specific analytic and field approaches; the specific pathogens and the effect of reduction strategies will be measured. • Develop three innovative processing intervention strategies to assure postharvest safety and quality. The effect of food processing technologies on overall reduction of pathogens at the end of production is estimated through various studies. •Evaluate the role of alternatives to antibiotics. •Identify/evaluate specific intervention strategies through the food production chain.	•Develop and validate: two lab-based multi-platform contaminant detection technologies for the highest priority pathogens, toxins, and chemical residues; and two multi-task on/in-line (in field) inspection technologies (for all size processors) that detect contaminants and changes in attributes at required line speeds. • Develop three science-based management practices to prevent preharvest contamination of produce, by enteric pathogens, and implement three intervention strategies to eliminate pathogen contamination: the control and prediction of the fate and transport of pathogens will be determined by specific tools developed; the role of the environment and animals in the prevalence, diversity, and quantity, and survival of pathogens in crops will be determined by specific analytic and field approaches; the specific pathogens and the effect of reduction strategies will be measured.

Performance Measure	2012 Estimate	2013 Target	2014 Target
	various studies/ approaches.		• Develop three innovative processing intervention strategies to assure and maintain postharvest safety and quality. The effect of food processing technologies on overall reduction of pathogens at the end of production is estimated through various studies/approaches. •Evaluate the role of alternatives to antibiotics. •Identify/evaluate specific intervention strategies through the food production chain. •Control antimicrobial resistance in foodborne pathogens. •Develop/utilize emerging next generation sequencing technologies and molecular methods for identifying/ characterizing strain differences, virulence, and pathogenicity mechanisms, and host-pathogen interactions for fresh produce and animal-related foodborne pathogens.

Performance Measure	2012 Estimate	2013 Target	2014 Target
			•Improve detection technologies for crops at high risk of infestation.
Dollars ($)	$106,210,000	$106,860,000	$119,186,000
•Provide scientific information to protect animals, humans, and property from the negative effects of pests, infectious diseases, and other disease causing entities.	•Identified functional genes that convey specific disease-resistance traits. •Identified/characterized gene functions/ mechanisms responsible for disease-resistance traits. •Implemented an integrated emerging disease research program in pathogenesis, diagnostics, and intervention. •Implemented a technology driven vaccinology research program for control and eradication of biological threat agents. •Discovered genetic profiles that convey protective immunity against infectious diseases/parasites. •Developed control programs for invasive drug resistant nematodes and protozoa. •Modeled the distribution of white-tailed deer and exotic ungulates in Southern Texas in order to be able to target measures to re-eradicate the cattle fever tick.	•Identify functional genes that convey specific disease-resistance traits. •Identify/characterize gene functions/mechanisms responsible for disease-resistance traits. •Implement an integrated emerging disease research program in pathogenesis, diagnostics, and intervention. •Implement a technology driven vaccinology research program for control and eradication of biological threat agents. •Discover genetic profiles that convey protective immunity against infectious diseases/ parasites. •Develop control programs for invasive drug resistant nematodes and protozoa. •Develop alternatives to antibiotics to prevent/treat pathogens affecting poultry health. •Select vaccine candidates for prevention of cattle fever tick infestations. Continue basic research on deer immunology to develop anti-tick vaccines. Determine probable effects of climate change on distribution of livestock	•Identify functional genes that convey specific disease-resistance traits. •Identify/characterize gene functions/ mechanisms responsible for disease-resistance traits. •Implement an integrated emerging disease research program in pathogenesis, diagnostics, and intervention. •Implement a technology driven vaccinology research program for control and eradication of biological threat agents. •Discover genetic profiles that convey protective immunity against infectious diseases/parasites. •Develop control programs for invasive drug resistant nematodes and protozoa. •Select vaccine candidates for prevention of cattle fever tick infestations. Continue basic

Performance Measure	2012 Estimate	2013 Target	2014 Target
	•Refined medicated baits and self treatment devices as tools for treatment of ticks on white-tailed deer, providing practical tools for eradicating the cattle fever tick. •Transformed experimental screwworm flies in Panama using technology developed to create a male-only strain. •Developed waterproof fire and ant baits; characterized biological control agents. •Provided new information on host and pest/pathogen interaction to develop protective mechanisms. •Developed strategies to improve animal well-being.	ticks. Determine associations of soft tick vectors of African swine fever and feral hogs. •Perform tests to achieve FDA licensing of ivermectin medicated bait block for cattle, eliminating the need to dip infected cattle every two weeks. Develop an experimental bait block for deer. •Continue to transform lines of screwworm flies with DNA insertions intended to create lethal, female-linked genes that induce mortality. Evaluate nutritional requirements of screwworm flies to create diets with alternate ingredients. •Develop new and safer insecticides for treatment of livestock and public health pests. •Evaluate biological control of fire ants throughout the Southeastern U.S. Develop tools for control of other invasive ants, including the Argentine ant and the Rasberry Crazy ant. •Determine specific physiology of vector-pathogen associations for viruses that affect livestock. •Identify cryptic species or populations of mosquitos that have different	research on deer immunology to develop anti-tick vaccines. Determine probable effects of climate change on distribution of livestock ticks. Determine associations of soft tick vectors of African swine fever and feral hogs. •Perform tests to achieve FDA licensing of ivermectin medicated bait block for cattle, eliminating the need to dip infested cattle every two weeks. Develop an experimental bait block for deer. •Continue to transform lines of screwworm flies with DNA insertions intended to create lethal, female-linked genes that induce mortality. Evaluate nutritional requirements of screwworm flies to create diets with alternate ingredients. •Develop new and safer insecticides for treatment of livestock and public health pests. •Evaluate biological control of fire ants throughout the Southeastern U.S.

Performance Measure	2012 Estimate	2013 Target	2014 Target
		capabilities as vectors of pathogens. •Improve animal well-being, food safety, and animal health through development and use of IPM tools on house/stable/horn/face flies.	•Develop tools for control of other invasive ants, including the Argentine ant and the Rasberry Crazy ant. •Determine specific physiology of vector-pathogen associations for viruses that affect livestock. •Identify cryptic species or populations of mosquitos that have different capabilities as vectors of pathogens. •Improve animal well-being, food safety, and animal health through development of tools for IPM of house and stable flies. •Develop alternatives to antibiotics to prevent/treat pathogens affecting poultry health. •Develop a Veterinary Insect Genomics Information Center. •Develop alternatives in farm animals to prevent/control animal diseases, reduce antibiotic resistance, and enhance livestock production.
Dollars ($)	$52,950,000	$53,274,000	$54,420,000

Performance Measure	2012 Estimate	2013 Target	2014 Target
•Develop control strategies based on fundamental and applied research to reduce losses caused by plant diseases, nematodes, arthropods, and weeds that are effective and affordable while maintaining environmental quality. Develop technically and economically feasible alternatives to preplant and postharvest use of methyl bromide.	•Developed new genomic approaches to control crop diseases, such as soybean rust, cereal pests, and rusts, and rice blast.	•Develop new genomic approaches to control crop diseases, such as soybean rust, cereal pests, and rusts, and rice blast. •Improve management of stripe rust of wheat and resistant varieties. •Enhance fungal disease protection in beans, sunflowers, and other crops. •Improve disease management of small fruits and nursery crops. •Improve potato production through resistant varieties and new disease management technologies. •Enhance control of invasive weeds, arthropods, and plant pathogens that threaten our food, fiber, and natural ecosystems. •Improve soil microbial ecology and plant disease management.	•Develop new genomic approaches to control crop diseases, such as soybean rust, cereal pests, and rusts, and rice blast. •Improve management of stripe rust of wheat and resistant varieties. •Enhance fungal disease protection in beans, sunflowers, and other crops. •Improve disease management of small fruits and nursery crops. •Improve potato production through resistant varieties and new disease management technologies. •Enhance control of invasive weeds, arthropods, and plant pathogens that threaten our food, fiber, and natural ecosystems. •Reduce insect damage through better data management.
Dollars ($)	$76,776,000	$77,246,000	$71,999,000

Performance Measure	2012 Estimate	2013 Target	2014 Target
•Define the role of nutrients, foods, and dietary patterns in growth, maintenance of health, and prevention of obesity and other chronic diseases. Assess bioavailability and health benefits of food components. Conduct research that forms the basis for and evaluates nutrition standards and Federal dietary recommendations.	•Evaluated dietary patterns useful for preventing obesity. •Conducted research on requirements/ bioavailability of nutrients to define their role in promoting health/preventing obesity. •Examined interaction of dietary intake with genetic predisposition for promoting health. •Released data from dietary supplement database. • Identified genes or genetic markers among ethnic groups that respond to diet and physical activity.	•Evaluate dietary patterns useful for preventing obesity. •Conduct research on requirements/ bioavailability of nutrients to define their role in promoting health/preventing obesity. •Examine interaction of dietary intake with genetic predisposition for promoting health. •Release data from dietary supplement database. • Identify genes or genetic markers among ethnic groups that respond to diet and physical activity. • Enhance nutrition surveillance capability to link USDA/ARS food consumption data with Federal Dietary Policy Guidance.	•Evaluate dietary patterns useful for preventing obesity. •Conduct research on requirements/ bioavailability of nutrients to define their role in promoting health/preventing obesity. •Examine interaction of dietary intake with genetic predisposition for promoting health. •Release data from dietary supplement database. • Identify genes or genetic markers among ethnic groups that respond to diet and physical activity. • Enhance nutrition surveillance capability to link USDA/ARS food consumption data with Federal Dietary Policy Guidance. •Provide the scientific evidence base for USDA's food assistance programs.
Dollars ($)	$35,170,000	$35,385,000	$45,210,000

Food Safety

Selected Past Accomplishments toward Achievement of the Key Outcome

- Conducted a comprehensive survey of *Listeria monocytogenes* in ready-to-eat foods, providing critical data for control of this pathogen.
- Developed a novel probiotic method for inhibiting the growth of campylobacter and salmonella.
- Conducted a survey of the Salinas, California watershed for the presence of *E. coli*, salmonella, and campylobacter.
- Developed a rapid, sensitive diagnostic test for botulinum neurotoxins that can be used in the event of a foodborne outbreak or a bioterrorist threat.
- Conducted research which advanced the development of a vaccine for *E. coli* 0157:H7.
- Investigated the growth of *Cronobacter sakazakii*, a deadly foodborne pathogen found in dehydrated powdered infant formula, and developed predictive models for the presence of the pathogen.

Note: A more complete explanation of these selected accomplishments is provided under the "Status of Program" section.

Selected Accomplishments Expected at the 2014 Proposed Resource Level

- Use population systems to understand the interrelationships of microorganisms in food environments, and the interrelationships among host, pathogen, and environment.
- Use systems biology to understand the basic genetic components of pathogens, their expression, and directly relate this information to the microorganisms's biology and its potential effect on food safety.
- Develop rapid systems to detect food pathogens that may enter through raw materials, contamination during processing or retail to protect public health.
- Develop production and processing intervention systems that may control, mitigate, or reduce biological and chemical contaminants in foods.
- Develop methods and models to predict the behavior of microorganisms in foods that may be used to support food safety measures and risk assessments.
- Develop rapid systems to detect toxins and chemical contaminants to protect human health and the environment.
- Develop and validate: two lab-based multi-platform contaminant detection technologies for the highest priority pathogens, toxins, and chemical residues; and two multi-task on/in-line (in field) inspection technologies (for all size processors) that detect contaminants and changes in attributes at required line speeds.
- Develop three science-based management practices to prevent preharvest contamination of produce by enteric pathogens, and implement three intervention strategies to eliminate pathogen contamination: the control and prediction of the fate and transport of pathogens will be determined by specific tools developed; the role of the environment and animals in the prevalence, diversity, and quantity, and survival of pathogens in crops will be determined by specific analytic and field approaches; and the specific pathogens and the effect of reduction strategies will be measured.
- Develop three innovative processing intervention strategies to assure and maintain postharvest safety and quality. The effect of food processing technologies on overall reduction of pathogens at the end of production is estimated through various studies/approaches.
- Identify/evaluate specific intervention strategies through the food production chain.
- Evaluate the role of alternatives to antibiotics.
- Control antimicrobial resistance in foodborne pathogens.
- Develop/utilize emerging next generation sequencing technologies and molecular methods for identifying/characterizing strain differences, virulence, and pathogenicity mechanisms, and host-pathogen interactions for fresh produce and animal-related foodborne pathogens.
- Improve detection technologies for crops at high risk for infestation.

Livestock Protection

Selected Past Accomplishments toward Achievement of the Key Outcome

- Conducted research on swine influenza A viruses which is critical to assessing and predicting the potential epidemic and/or pandemic threat they pose to humans.
- Investigated dietary phytogenics (i.e., cinnamon, garlic, and aloe vera) as an alternative to antibiotics to enhance poultry immunity.
- Developed tests to screen imported animals and animal products to prevent HOBi-like viruses (from cattle in South America, Southeast Asia, and Europe) into the United States.
- Discovered a genetic marker for reduced susceptibility to porcine reproductive and respiratory syndrome, the most economically significant disease in pigs.
- Used gold nanoparticles to design tests and tools to rapidly identify West Nile virus.
- Identified a new monoclonal antibody that selectively detects *Mycobacterium avium paratuberculosis* from other closely related bacterial strains.
- Developed information that can be used to help mosquito control professionals determine the best method of mosquito control.
- Developed an encapsuled formulation of catnip oil to control immature stable flies developing in animal wastes.
- Showed that bed bug bites can cause a very severe, localized inflammation of blood vessels.
- Completed trials of the most promising vaccines for cattle against cattle fever tick.
- Developed a transgenic strain of the screwworm fly, a damaging pest of livestock, that will only produce males, saving rearing, distribution, and sterilization costs.
- Identified compounds (for insecticides) that closely target sand flies.

Note: A more complete explanation of these selected accomplishments is provided under the "Status of Program" section.

Selected Accomplishments Expected at the 2014 Proposed Resource Level

- Identify functional genes that convey specific disease resistance traits.
- Identify and characterize gene functions/mechanisms responsible for disease resistance traits.
- Implement an integrated emerging disease research program in pathogenesis, diagnostics, and intervention.
- Implement a technology driven vaccinology research program for control and eradication of biological threat agents.
- Discover genetic profiles that convey protective immunity against infectious diseases/parasites.
- Develop control programs for invasive drug resistant nematodes, protozoa, and pests of livestock and poultry.
- Select vaccine candidates for prevention of cattle fever tick infestations. Continue basic research on deer immunology to develop anti-tick vaccines. Determine probable effects of climate change on distribution of livestock ticks. Determine associations of soft tick vectors of African swine fever and feral loss.
- Perform tests to achieve FDA licensing of ivermectin medicated bait block for cattle, eliminating the need to dip infected cattle every two weeks. Develop on experimental bait block for deer.
- Continue to transform lines of screwworm flies with DNA insertions intended to create lethal, female-linked genes that induce mortality. Evaluate nutritional requirements of screwworm flies to create diets with alternate ingredients.
- Develop new and safer insecticides for treatment of livestock and public health pests.
- Evaluate biological control of fire ants throughout the southeastern U.S. Develop tools for control of other invasive ants, including the Argentine ant and the Rasberry Crazy ant.
- Identify cryptic species or populations of mosquitos that have different capabilities as vectors of pathogens.
- Improve animal well-being, food safety, and animal health through development and use of IPM tools on house, stable, horn, and face flies.
- Discover and develop new diagnostic platforms for priority animal diseases.
- Discover and transfer new technologies for protection of animals and humans from biting arthropods.
- Discover and transfer new technologies for protection of animals from priority diseases.

- Conduct research on countering biological threats.
- Develop alternatives to antibiotics to prevent/treat pathogens affecting poultry health.
- Develop a Veterinary Insect Genomics Information Center.
- Develop alternatives in farm animals to prevent/control animal diseases, reduce antibiotic resistance, and enhance livestock production.

Crop Protection

Selected Past Accomplishments toward Achievement of the Key Outcome

- Demonstrated a new soil remediation method for the nursery industry in reducing sudden oak death.
- Developed a diagnostic test for the new boxwood blight pathogen.
- Evaluated more than 18,000 wheat and 5,000 barley lines for resistance to stripe rust.
- Released soybean germplasm line JTN-5203 with resistance to multiple pathogens endemic to the mid-southern United States.
- Developed a postharvest irradiation treatment which controls the light brown apple moth.
- Tested cold treatments which control the coffee berry borer.
- Developed new lures to monitor and control the spotted wing drosophila (an invasive pest of soft fruits) and the brown marmorated stink bug (a pest of many fruits, vegetables, and field crops).
- Improved the efficacy of the sterile insect technique used to control fruit flies.
- Developed new methods to grow and commercially produce a bioinsecticidal fungus to kill root weevils, soil grubs, rootworms, wireworms, fruit flies, and root maggots.
- Enhanced the effectiveness of biological control agents through inbred live technology.

Note: A more complete explanation of these selected accomplishments is provided under the "Status of Program" section.

Selected Accomplishments Expected at the 2014 Proposed Resource Level

- Develop new genomic approaches to control crop diseases, such as soybean rust, cereal pests, and rusts, and rice blast.
- Provide information on emerging diseases and invasive species that will enhance identification, detection, and control.
- Characterize pathogens and invasive species, and determine key events in disease development and infection processes.
- Develop systems which will increase knowledge of the ecology, physiology, epidemiology, and molecular biology of emerging diseases, invasive insects, and invasive weeds, which will be incorporated into pest risk assessments.
- Provide new information on host and pest/pathogen interaction to develop protective mechanisms.
- Improve disease management of small fruits and nursery crops.
- Improve potato production through resistant varieties and new disease management technologies.
- Improve management of stripe rust of wheat and resistant varieties.
- Enhance control of invasive weeds, arthropods, and plant pathogens that threaten our food, fiber, and natural ecosystems.
- Enhance fungal disease protection in beans, sunflowers, and other crops.
- Reduce insect damage through better data management.

Human Nutrition

Selected Past Accomplishments toward Achievement of the Key Outcome

- Found that the current vitamin E requirements are overstated and need to be revised.
- Conducted the first animal model of age-related macular degeneration, the leading cause of blindness among older adults.
- Found that the calories available from almonds are lower than those listed on the food label.
- Found that raising plasma HDL cholesterol does not lower the risk of heart attack.
- Found that mushrooms are not a useful source of vitamin D.
- Found that sodium and potassium consumption in the United States exceeds the *Dietary Guidelines for Americans*.
- Found that breast feeding is best for infant development but formula feeding is almost as good.
- Found that lower flavonoid intake (found in fruits, vegetables, nuts, cocoa, tea, and wine) increases risk of death from cardiovascular disease.

Note: A more complete explanation of these selected accomplishments is provided under the "Status of Program" section.

Selected Accomplishments Expected at the 2014 Proposed Resource Level

- Provide updates of the National Nutrient Database.
- Provide reports from the "What We Eat in America" survey.
- Publish findings on requirements/ bioavailability of nutrients and their role in promoting health/ preventing obesity.
- Publish findings on the individual nutrition intervention strategies.
- Evaluate dietary patterns useful for preventing obesity.
- Conduct research on requirements/ bioavailability of nutrients to define their role in promoting health/preventing obesity.
- Examine interaction of dietary intake with genetic predisposition for promoting health.
- Release data from dietary supplement database.
- Identify genes or genetic markers among ethnic groups that respond to diet and physical activity.
- Publish research on the normal growth and aging process that affect nutrient requirements.
- Conduct research on metabolism that impacts nutritional status.
- Conduct research on immunology that interacts with nutritional status.
- Publish research on development of analytical methods for food composition and metabolism of nutrients.
- Enhance nutrition surveillance capability to link USDA/ARS food consumption data with Federal Dietary Policy Guidance.
- Improve nutrition monitoring by adding functionality to the Food Composition Database.
- Provide the scientific evidence base for USDA's food assistance programs.

Strategic Goal Funding Matrix
(Dollars in thousands)

Program / Program Items	2011 Actual	2012 Actual	2013 Estimate	Increase or Decrease	2014 Estimate
Department Strategic Goal: Assist rural communities to create prosperity so they are self-sustaining, repopulating, and economically thriving					
Product Quality/Value Added	$105,037	$100,541	$101,391	-$16,050	$85,341
Staff Years	835	759	759	-16	743
Livestock Production	40,694	38,027	38,260	-1,938	36,322
Staff Years	225	208	208	-1	207
Crop Production	129,113	127,495	128,275	-465	127,810
Staff Years	976	917	917	-	917
National Agricultural Library	21,343	20,919	20,919	+4,596	25,515
Staff Years	121	105	105	-	105
Repair & Maintenance	17,468	17,468	17,468	-	17,468
Staff Years	-	-	-	-	-
Total Costs, Strategic Goal	313,655	304,450	306,313	-13,857	292,456
Total Staff Years, Strategic Goal	2,157	1,989	1,989	-17	1,972
Department Strategic Goal: Ensure our national forests and private working lands are conserved, restored, and made more resilient to climate change, while enhancing our water resources					
Environmental Stewardship	200,963	189,034	190,191	+28,959	219,150
Staff Years	1,539	1,390	1,390	-	1,390
Total Costs, Strategic Goal	200,963	189,034	190,191	+28,959	219,150
Total Staff Years, Strategic Goal	1,539	1,390	1,390	-	1,390
Department Strategic Goal: Help America promote agricultural production and biotechnology exports as America works to increase food security					
Livestock Production	40,694	38,027	38,259	-1,933	36,326
Staff Years	225	208	208	-1	207
Crop Production	103,129	101,512	102,134	-490	101,644
Staff Years	767	720	720	-	720
Total Costs, Strategic Goal	143,823	139,539	140,393	-2,423	137,970
Total Staff Years, Strategic Goal	992	928	928	-1	927
Department Strategic Goal: Ensure that all America's children have access to safe, nutritious, and balanced meals					
Food Safety	106,789	106,210	106,860	+12,326	119,186
Staff Years	787	783	783	+17	800
Human Nutrition	85,440	85,438	85,961	+9,503	95,464
Staff Years	279	279	279	-	279
Livestock Protection	79,353	76,166	76,632	+3,674	80,306
Staff Years	499	456	456	+5	461
Crop Protection	203,207	193,810	194,996	-15,525	179,471
Staff Years	1,276	1,161	1,161	-4	1,157
Total Costs, Strategic Goal	474,789	461,624	464,449	+9,978	474,427
Total Staff Years, Strategic Goal	2,841	2,679	2,679	+18	2,697
Total Costs, All Strategic Goals	1,133,230	1,094,647	1,101,346	+22,657	1,124,003
Total FTEs, All Strategic Goals	7,529	6,986	6,986	-	6,986

Full Cost by Department Strategic Goal
(Dollars in thousands)

Department Strategic Goal: Assist rural communities to create prosperity so they are self-sustaining, repopulating, and economically thriving

PROGRAM	PROGRAM ITEMS	FY 2011	FY 2012	FY 2013	FY 2014
	Direct Costs:				
	Research and Development	267,509	257,387	259,960	247,489
	Indirect Costs:				
	Program and Administrative/Financial Management	22,563	21,709	21,926	20,874
	USDA Central Charges	6,753	6,498	6,563	6,248
	Task Force, Advisory Committees, and Other Support Costs	407	392	396	377
	Total Indirect Costs	29,723	28,599	28,885	27,499
	Total Costs	**297,232**	**285,986**	**288,845**	**274,988**
	FTEs	2,157	1,989	1,989	1,972

Performance Measures:

Create new scientific knowledge and innovative technologies that represent scientific/technological advancements or breakthroughs applicable to bioenergy.

Develop cost effective, functional industrial and consumer products, including higher quality, healthy foods, that satisfy consumer demand in the United States and abroad.

Develop systems and technologies to reduce production costs and risks while enhancing natural resource quality.

Develop new technologies, tools, and information contributing to improved precision animal production systems to meet current and future food animal production needs of diversified consumers, while simultaneously minimizing the environmental footprint of production systems and enhancing animal well-being.

Expand, maintain, and protect our genetic resource base, increase our knowledge of genes, genomes, and biological processes, and provide economically and environmentally sound technologies that will improve the production efficiency, health, and value of the Nation's crops.

The services and collections of the National Agricultural Library continue to meet the needs of its customers.

The National Agricultural Library and partners implement the National Digital Library for Agriculture.

Priority buildings/facilities projects are completed on schedule and within budget.

Repair and Maintenance		17,116	17,319	17,468	17,468
Miscellaneous Fees		1,496	241	8,970	0
	FTEs	0	0	0	0
	Total Costs for Department Strategic Goal 1 (program, direct, indirect)	**315,844**	**303,546**	**315,283**	**292,456**
	FTEs	**2,157**	**1,989**	**1,989**	**1,972**

Department Strategic Goal: Ensure our national forests and private working lands are conserved, restored, and made more resilient to climate change, while enhancing our water resources

PROGRAM	PROGRAM ITEMS	FY 2011	FY 2012	FY 2013	FY 2014
	Direct Costs:				
	Research and Development	180,424	169,250	171,172	197,235
	Indirect Costs:				
	Program and Administrative/Financial Management	15,218	14,275	14,437	16,636
	USDA Central Charges	4,555	4,273	4,321	4,979
	Task Force, Advisory Committees, and Other Support Costs	275	258	261	300
	Total Indirect Costs	20,047	18,806	19,019	21,915
	Total Costs for Department Strategic Goal 2 (program, direct, indirect)	**200,471**	**188,056**	**190,191**	**219,150**
	FTEs	1,539	1,390	1,390	1,390

Performance Measures:

Develop technology and practices to reduce the delivery of agricultural pollutants by water on farms and ranches and quantify the environmental benefit of conservation practices in watersheds.

Develop practices and technologies to enhance soil resources and reduce emissions of particulate matter and gases from crop production lands, agricultural processing operations, and animal production systems.

Improved management practices and technologies for managing pasture and range lands to improve economic profitability and enhance environmental values.

Department Strategic Goal: Help America promote agricultural production and biotechnology exports as America works to increase food security

PROGRAM	PROGRAM ITEMS	FY 2011	FY 2012	FY 2013	FY 2014
	Direct Costs:				
	Research and Development	128,329	124,169	126,354	124,173
	Indirect Costs:				
	Program and Administrative/Financial Management	10,823	10,473	10,657	10,473
	USDA Central Charges	3,240	3,135	3,190	3,135
	Task Force, Advisory Committees, and Other Support Costs	195	189	192	189
	Total Indirect Costs	14,259	13,797	14,039	13,797
	Total Costs for Department Strategic Goal 3 (program, direct, indirect)	**142,588**	**137,966**	**140,393**	**137,970**
	FTEs	992	928	928	927

Performance Measures:

Develop systems and technologies to reduce production costs and risks while enhancing natural resource quality.

Develop new technologies, tools, and information contributing to improved precision animal production systems to meet current and future food animal production needs of diversified consumers, while simultaneously minimizing the environmental footprint of production systems and enhancing animal well-being.

Expand, maintain, and protect our genetic resource base, increase our knowledge of genes, genomes, and biological processes, and provide economically and environmentally sound technologies that will improve the production efficiency, health, and value of the Nation's crops.

Department Strategic Goal: Ensure that all of America's children have access to safe, nutritious, and balanced meals

PROGRAM	PROGRAM ITEMS	FY 2011	FY 2012	FY 2013	FY 2014
	Direct Costs:				
	Research and Development	426,688	414,204	418,004	426,984
	Indirect Costs:				
	Program and Administrative/Financial Management	35,990	34,936	35,257	36,014
	USDA Central Charges	10,772	10,456	10,552	10,779
	Task Force, Advisory Committees, and Other Support Costs	650	631	636	650
	Total Indirect Costs	47,410	46,023	46,445	47,443
	Total Costs for Department Strategic Goal 4 (program, direct, indirect)	**474,098**	**460,227**	**464,449**	**474,427**
	FTEs	2,841	2,679	2,679	2,697

Performance Measures:

Develop new technologies that assist ARS customers in detecting, identifying, and controlling foodborne diseases that affect human health.

Provide scientific information to protect animals, humans, and property from the negative effects of pests, infectious diseases, and other disease causing entities.

Develop and transfer tools to the agricultural community, commercial partners, and government agencies to control or eradicate domestic and exotic diseases and pests that affect animal and human health.

Develop control strategies based on fundamental and applied research to reduce losses caused by plant diseases, nematodes, arthropods, and weeds that are effective and affordable while maintaining environmental quality. Develop technically and economically feasible alternatives to preplant and postharvest use of methyl bromide.

Provide needed scientific information and technology that is environmentally acceptable to producers of agriculturally important plants in support of exclusion, early detection and eradication, control, and monitoring of invasive arthropods, weeds, nematodes, and pathogens; enhanced sustainability; and restoration of affected areas. Conduct biologically-based integrated and area-wide management of key invasive species.

Provide environmentally sound fundamental and applied scientific information and technologies to action agencies, producers, exporters, and importers of commercially important plant and animal products in support of exclusion, early detection, and eradication of quarantine pests and pathogens that can impede foreign trade.

Monitor food consumption/intake patterns of Americans, including those of different ages, ethnicity, regions, and income levels, and measure nutrients and other beneficial components in the food supply. Provide the information in databases to enable ARS customers to evaluate the healthfulness of the American food supply and the nutrient content of the American diet.

Define the role of nutrients, foods, and dietary patterns in growth, maintenance of health, and prevention of obesity and other chronic diseases. Assess bioavailability and health benefits of food components. Conduct research that forms the basis for and evaluates nutrition standards and Federal dietary recommendations.

Publish research findings not encompassed under the other performance measures for this objective likely to significantly advance the knowledge of human nutrition, extensively influence other researchers in the same or related field, or yield important new directions for research.

Total Costs for all Department Strategic Goals (program, direct, indirect)		**1,133,001**	**1,089,795**	**1,110,316**	**1,124,003**
	FTEs	7,529	6,986	6,986	6,986
Total Costs for Buildings and Facilities		**0**	**0**	**0**	**155,000**
	FTEs	0	0	0	0
Grand Total Costs for all Department Strategic Goals		**1,133,001**	**1,089,795**	**1,110,316**	**1,279,003**
	FTEs	**7,529**	**6,986**	**6,986**	**6,986**