2016 President's Budget
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 (FAIR) (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.
- Create a USDA for the 21st century that is high performing, efficient, and adaptable.

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.

ARS' Headquarters Offices are located in the Washington, D.C. metropolitan area. The agency's research is organized under 17 national programs. Field activities are managed through five area offices. Research is conducted at field locations in the United States, 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, 2014, there were 5,547 permanent, full-time employees including 503 in the Headquarters offices and 5,044 in field offices.

OIG Reports - Completed

50401-0005-11, 12/13/2013, Department of Agriculture's Consolidated Financial Statements for Fiscal Years 2012 and 2013.

50501-0004-12, 11/26/2013, Fiscal Year 2013 Federal Information Security Management Act Audit.

50501-0005-12, 9/26/2014, USDA's Implementation of Cloud Computing Services.

89901-0001-13, 9/25/2014, Review of USDA Contract Databases.

OIG Reports - In Progress

02601-0001-21, Adequacy of Controls to Prevent the Release of Sensitive Technology.

50024-0004-13, Review of the Department's Fleet Charge Card Data.

50401-0007-11, Department of Agriculture's Consolidated Financial Statements for Fiscal Years 2013 and 2014.

50501-0006-12, Fiscal Year 2014 Federal Information Security Management Act Audit.

50601-0002-22, Department's Controls Over Prioritization and Funding of Agricultural Research.

GAO Reports – Completed

GAO-14-87, 1/6/2014, Federal Real Property: Actions Needed to Improve How Agencies Manage Structures.

GAO-14-288, 3/31/2014, U.S. Department of Agriculture: Workforce Decisions Could Benefit from Better Linkage to Missions and Use of Leading Practices.

GAO-14-407, 5/7/2014, Alternative Jet Fuels: Federal Activities Support Development and Usage, but Long-term Commercial Viability Hinges on Market Factors.

GAO-14-430, 5/20/2014, Freshwater: Supply Concerns Continue, and Uncertainties Complicate Planning.

GAO-14-683R, 7/24/2014, Foreign Assistance: Briefing on U.S. International Water-Related Assistance.

GAO-14-736, 9/12/2014, Ocean Acidification: Federal Response Under Way but Actions Needed to Understand and Address Potential Impacts.

GAO Reports - In Progress

361481, Hazardous Waste: Agencies Should Take Steps to Improve Information on USDA's and Interior's Potentially Contaminated Sites.

361531, Climate Change: USDA's Ongoing Efforts Can Be Enhanced with Better Metrics and More Relevant Information for Farmers.

361560, Executive Branch Efforts to Address Fragmentation in Federal Oversight of Food Safety.

361562, Update on Federal Veterinarian Workforce.

361569, Climate Change Impacts on Public Health System.

361600, Federal Actions to Promote Bee Health.

460615, FBI Anthrax Investigation: Scientific and Technical Analysis.

460635, Municipal Water Technologies.

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

Item	2013 Actual		2014 Actual		2015 Enacted		2016 Estimate	
	Amount	SYs	Amount	SYs	Amount	SYs	Amount	SYs
Salaries and Expenses:								
Discretionary Appropriations	$1,101,853	6,381	$1,122,482	6,265	$1,132,625	6,822	$1,191,540	6,947
Buildings and Facilities:								
Discretionary Appropriations	-	-	-	-	45,000	-	205,901	-
Rescission	-29,838	-	-	-	-1,530	-	-	-
Sequestration	-55,067	-	-	-	-	-	-	-
Transfers In	102	-	102	-	-	-	-	-
Adjusted Appropriation	1,017,050	6,381	1,122,584	6,265	1,176,095	6,822	1,397,441	6,947
Balance Available, SOY	14,217	-	12,524	-	13,220	-	35,000	-
Other Adjustments (Net)	970	-	3,678	-	-	-	-	-
Total Available	1,032,237	6,381	1,138,786	6,265	1,189,315	6,822	1,432,441	6,947
Lapsing Balances	-2,739	-	-2,386	-	-	-	-	-
Balance Available, EOY	-12,524	-	-13,220	-	-35,000	-	-84,900	-
Obligations	1,016,974	6,381	1,123,180	6,265	1,154,315	6,822	1,347,541	6,947
Obligations under other USDA appropriations: 1/								
Agricultural Marketing Service	-	-	102	1	102	1	102	1
Agriculture & Food Research Initiative (AFRI)	1,963	8	-	-	-	-	-	-
Animal & Plant Health Inspection Service	15,868	64	17,483	64	17,483	64	17,483	64
Economic Research Service	3,367	14	3,440	12	3,440	12	3,440	12
Food, Nutrition & Consumer Services	2,519	10	1,849	7	1,849	7	1,849	7
Food Safety & Inspection Service	3,128	13	5,631	20	5,631	20	5,631	20
Foreign Agricultural Service	691	3	688	4	688	4	688	4
Forest Service	1,328	5	1,267	5	1,267	5	1,267	5
Hazardous Waste	1,370	5	2,550	9	2,550	9	2,550	9
National Agricultural Statistics Service	4,280	17	4,330	16	4,330	16	4,330	16
National Institute of Food and Agriculture	26,093	106	22,085	80	22,085	80	22,085	80
Natural Resources Conservation Service	2,863	12	4,865	18	4,865	18	4,865	18
Office of the Chief Financial Officer	-	-	545	4	545	4	545	4
Office of the Chief Economist	127	1	338	1	338	1	338	1
Misc., Other USDA Funds	686	3	338	1	338	1	338	1
Total, Other USDA	64,283	261	65,511	242	65,511	242	65,511	242
Total, Agriculture Appropriations	1,081,257	6,642	1,188,691	6,507	1,219,826	7,064	1,413,052	7,189

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

Item	2013 Actual		2014 Actual		2015 Enacted		2016 Estimate	
	Amount	SYs	Amount	SYs	Amount	SYs	Amount	SYs
Other Federal Funds: 1/								
Agency for International Development.	9,938	40	7,344	27	7,344	27	7,344	27
Department of Commerce.....	-	-	816	3	816	3	816	3
Department of Defense.....	7,652	31	7,994	29	7,994	29	7,994	29
Department of Energy.....	1,257	5	1,159	4	1,159	4	1,159	4
Department of Health & Human Services.....	5,435	22	5,793	21	5,793	21	5,793	21
Department of Homeland Security.....	4,603	19	4,529	16	4,529	16	4,529	16
Department of State.....	678	3	1,134	4	1,134	4	1,134	4
Department of the Interior.....	1,544	6	3,108	11	3,108	11	3,108	11
Department of Treasury.....	125	1	-	-	-	-	-	-
Environmental Protection Agency.....	355	1	357	1	357	1	357	1
Federal Emergency Management Agency	-	-	277	1	277	1	277	1
National Aeronautics & Space Administration.....	1,934	8	1,665	6	1,665	6	1,665	6
Strategic Environmental Research Development Program (SERDP).....	463	2	185	1	185	1	185	1
Misc., Other Federal Funds.....	134	1	-	-	-	-	-	-
Total, Other Federal.....	34,118	139	34,361	124	34,361	124	34,361	124
Non-Federal Funds: 1/								
Alabama, University of.....	-	-	191	1	191	1	191	1
Arkansas, University of.....	349	1	251	1	251	1	251	1
Binational Agricultural Research & Development (BARD)....	432	2	492	3	492	3	492	3
Boyce Thompson Institute for Plant Research.....	110	1	-	-	-	-	-	-
California, State of.....	2,319	9	2,456	9	2,456	9	2,456	9
California, University of.....	1,969	8	2,296	8	2,296	8	2,296	8
Chicago, University of.....	134	1	-	-	-	-	-	-
Citrus Research and Development Foundation.....	2,789	11	2,610	9	2,610	9	2,610	9
Commonwealth Scientific and Industrial Research.....	-	-	112	1	112	1	112	1
Clemson University.....	124	1	-	-	-	-	-	-
Cornell University.....	694	3	1,186	4	1,186	4	1,186	4
Cotton Incorporated.....	1,214	5	1,211	4	1,211	4	1,211	4
Dade County Department of Environmental Resource Management.....	-	-	105	1	105	1	105	1
Delaware, University of.....	394	2	372	1	372	1	372	1
Drexel University	-	-	100	1	100	1	100	1

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

Item	2013 Actual		2014 Actual		2015 Enacted		2016 Estimate	
	Amount	SYs	Amount	SYs	Amount	SYs	Amount	SYs
Non-Federal Funds: (continued)								
Florida Citrus Packers Association	-	-	250	1	250	1	250	1
Florida, State of	826	4	1,047	6	1,047	6	1,047	6
Florida, University of	247	1	429	3	429	3	429	3
Georgia, University of	901	4	540	4	540	4	540	4
Hispanic Serving Institutions National Program	1,157	5	2,071	8	2,071	8	2,071	8
Idaho, State of	-	-	104	1	104	1	104	1
Idaho, University of	102	1	124	1	124	1	124	1
Illinois, University of	256	1	348	1	348	1	348	1
Indian River Citrus League	110	1	-	-	-	-	-	-
Iowa State University	1,122	5	2,151	8	2,151	8	2,151	8
Iowa, University of	468	3	-	-	-	-	-	-
Kansas State University	204	1	368	1	368	1	368	1
Kentucky, University of	325	1	-	-	-	-	-	-
Louisiana State University	185	1	229	1	229	1	229	1
Maryland, State of	153	1	-	-	-	-	-	-
Maryland, University of	413	3	213	1	213	1	213	1
Massachusetts General Hospital	117	1	159	1	159	1	159	1
Massachusetts, University of	236	1	143	1	143	1	143	1
Michigan State University	276	1	260	1	260	1	260	1
Minnesota, University of	563	3	383	2	383	2	383	2
Mississippi Soybean Association	107	1	-	-	-	-	-	-
Mississippi State University	119	1	-	-	-	-	-	-
Missouri, University of	109	1	319	1	319	1	319	1
National Peanut Foundation	-	-	277	1	277	1	277	1
National Pork Board	272	1	375	1	375	1	375	1
Nebraska, University of	234	1	629	4	629	4	629	4
North Carolina State University	665	4	314	1	314	1	314	1
North Dakota State University	120	1	242	1	242	1	242	1
Ohio State University	437	3	407	1	407	1	407	1
Oklahoma State University	528	3	842	5	842	5	842	5
Oregon State University	119	1	123	1	123	1	123	1
Pennsylvania State University	306	1	266	1	266	1	266	1
Perdue University	110	1	180	1	180	1	180	1
Revocable Permits & Easements	1,906	-	2,038	-	2,038	-	2,038	-
Rutgers University	125	1	201	1	201	1	201	1
Sale of Animals & Personal Property (Proceeds)	2,284	-	4,961	-	4,961	-	4,961	-

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

Item	2013 Actual		2014 Actual		2015 Enacted		2016 Estimate	
	Amount	SYs	Amount	SYs	Amount	SYs	Amount	SYs
Non-Federal Funds: (continued)								
South Dakota State University	282	1	-	-	-	-	-	-
South Florida Water Management District	300	1	767	5	767	5	767	5
South Illinois University	105	1	118	1	118	1	118	1
Tennessee, University of	226	1	226	1	226	1	226	1
Texas Agrilife Research & Extension Center	408	3	696	4	696	4	696	4
Texas, State of	-	-	110	1	110	1	110	1
Texas Water Resources Institute	172	1	-	-	-	-	-	-
Travel and Miscellaneous Reimbursements	563	3	511	3	511	3	511	3
United Sorghum Checkoff Program	376	2	-	-	-	-	-	-
United Soybean Board	5,755	23	6,076	22	6,076	22	6,076	22
Washington State University	364	1	314	1	314	1	314	1
Washington Tree Fruit Research Commission	332	1	247	1	247	1	247	1
Washington University School of Medicine	-	-	106	1	106	1	106	1
Wisconsin University	249	1	438	3	438	3	438	3
Misc., Non-Federal Funds	3,357	14	3,381	12	3,381	12	3,381	12
Total, Non-Federal Funds	38,119	155	44,365	158	44,365	158	44,365	158
Miscellaneous Contributed Funds:	31,977	122	29,921	104	29,921	104	29,921	104
Total, ARS	1,185,471	7,058	1,297,338	6,893	1,328,473	7,450	1,521,699	7,575

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

Permanent Positions by Grade and Staff Year Summary

Item	2013 Actual			2014 Actual			2015 Enacted			2016 Estimate		
	D.C.	Field	Total	D.C.	Field	Total	D.C.	Field	Total	D.C.	Field	Total
SES.....	14	24	38	11	27	38	11	27	38	11	27	38
GS/GM-15.....	49	657	706	52	658	710	58	726	784	59	741	800
GS/GM-14.....	65	586	651	59	572	631	66	634	700	67	648	715
GS/GM-13.....	126	462	588	130	414	544	144	462	606	148	473	621
GS-12.....	125	295	420	128	255	383	142	286	428	145	293	438
GS-11.....	61	541	602	56	531	587	63	588	651	64	601	665
GS-10.....	2	5	7	1	3	4	1	3	4	1	3	4
GS-9.....	54	928	982	61	914	975	68	1,012	1,080	69	1,034	1,103
GS-8.....	20	358	378	18	333	351	20	370	390	20	378	398
GS-7.....	52	615	667	48	575	623	54	639	693	55	653	708
GS-6.....	17	232	249	17	213	230	19	237	256	19	242	261
GS-5.....	10	131	141	10	112	122	11	126	137	11	129	140
GS-4.....	8	31	39	6	32	38	7	35	42	7	36	43
GS-3.....	1	11	12	-	14	14	-	15	15	-	15	15
GS-2.....	-	7	7	-	10	10	-	11	11	-	11	11
GS-1.....	-	1	1	-	1	1	-	1	1	-	1	1
Other Graded Positions.....	4	-	4	4	-	4	4	-	4	4	-	4
Ungraded Positions.....	-	457	457	-	455	455	-	455	455	-	455	455
Total Perm. Positions.....	608	5,341	5,949	601	5,119	5,720	668	5,627	6,295	680	5,740	6,420
Unfilled EOY..	102	89	191	98	75	173	109	82	191	109	82	191
Total Perm. Full-Time Employment, EOY.....	506	5,252	5,758	503	5,044	5,547	559	5,545	6,104	571	5,658	6,229
Staff Year Est..	527	6,531	7,058	519	6,374	6,893	566	6,884	7,450	578	6,997	7,575

Size, Composition and Cost of Motor Vehicle Fleet

The 2016 Budget Estimates propose the replacement of 5 passenger motor vehicles**.** These acquisitions will replace existing vehicles without increasing the passenger motor vehicles or 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.

Fiscal Year	Number of Vehicles by Type *								Annual Operating Costs ($ in 000)
	Sedans and Station Wagons	Light Trucks, SUVs, and Vans		Medium Duty Vehicles	Ambulances	Buses	Heavy Duty Vehicles	Total Number of	
		4X2	4X4						
****FY2013**	235	1,313	903	694	0	1	148	3,294	3,056
Change	-5	-42	34	4	0	-1	3	-7	2,783
*****FY2014**	230	1,271	937	698	0	0	151	3,287	5,839
Change	0	0	-34	-4	0	1	-3	-40	769
FY2015	230	1,271	903	694	0	1	148	3,247	6,608
Change	0	0	34	4	0	-1	3	40	815
FY2016	230	1,271	937	698	0	0	151	3287	7,423

NOTES:

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

** Figures are gathered from SF-82.

*** Increase in annual operating cost is due to the addition of indirect cost per guidance in GSA Bulletin FMR-B-38. Agency used the optional standard factor of $468 per vehicle per year.

The estimates include appropriation language for this item as follows (new language underscored; deleted matter enclosed in brackets):

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, **[**$1,132,625,000] $1,191,540,000: *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 appropriations hereunder shall be available for granting easements at any Agricultural Research Service location for the construction of a research facility by a non-Federal entity for use by, and acceptable to, the Agricultural Research Service and a condition of the easements shall be that upon completion the facility shall be accepted by the Secretary, subject to the availability of funds herein, if the Secretary finds that acceptance of the facility is in the interest of the United States: *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: *Provided further*, That subject to such terms and conditions as the Secretary of Agriculture considers appropriate to protect the interest of the United States, the Secretary may enter into a lease of Agricultural Research Service land in order to allow for the drilling of not more than three irrigation wells; the term of the lease may not exceed 20 years, but the Secretary may renew the lease for one or more additional 20-year periods.

Lead-Off Tabular Statement

Salaries and Expenses

Budget Estimate, 2016	$1,191,540,000
2015 Enacted	$1,132,625,000
Change in Appropriation	+58,915,000

Summary of Increases and Decreases
(Dollars in thousands)

	2013 Actual	2014 Change	2015 Change	2016 Change	2016 Estimate
Discretionary Appropriations:					
Product Quality/Value Added	$93,102	+$5,654	+$1,400	+$1,459	$101,615
Livestock Production	70,426	+16,258	+175	+7,539	94,398
Crop Production	210,779	+4,387	-	+17,911	233,077
Food Safety	97,962	+13,694	-	+4,505	116,161
Livestock Protection	70,530	+19,102	+1,000	-101	90,531
Crop Protection	179,469	+9,491	+2,453	+3,010	194,423
Human Nutrition	80,328	+6,546	-	-1,678	85,196
Environmental Stewardship	175,047	+25,772	-	+5,333	206,152
National Agricultural Library	20,691	+3,100	-	+937	24,728
Repair and Maintenance	18,614	+1,530	-	+20,000	40,144
Decentralized GSA and DHS Security Payments	-	-	+5,115	-	5,115
Total Discretionary Appropriations	1,016,948	+105,534	+10,143	+58,915	1,191,540

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

Program	2013 Actual		2014 Actual		2015 Enacted		Inc. or Dec.			2016 Estimate	
	Amount	SYs	Amount	SYs	Amount	SYs	Amount		SYs	Amount	SYs
Salaries and Expenses											
Discretionary Appropriations:											
Product Quality/Value Added	$93,102	682	$98,756	699	$100,156	761	+$1,459	(1)	+2	$101,615	763
Livestock Production	70,426	376	86,684	444	86,859	483	+7,539	(2)	+36	94,398	519
Crop Production	210,779	1,477	215,166	1,302	215,166	1,419	+17,911	(3)	+60	233,077	1,479
Food Safety	97,962	783	111,656	659	111,656	718	+4,505	(4)	+15	116,161	733
Livestock Protection	70,530	411	89,632	459	90,632	500	-101	(5)	-3	90,531	497
Crop Protection	179,469	1,047	188,960	1,073	191,413	1,168	+3,010	(6)	+6	194,423	1,174
Human Nutrition	80,328	279	86,874	235	86,874	256	-1,678	(7)	-8	85,196	248
Environmental Stewardship	175,047	1,254	200,819	1,299	200,819	1,414	+5,333	(8)	+14	206,152	1,428
National Agricultural Library	20,691	72	23,791	95	23,791	103	+937	(9)	+3	24,728	106
Repair and Maintenance	18,614	-	20,144	-	20,144	-	+20,000	(10)	-	40,144	-
Decentralized GSA and DHS Security Payments	-	-	-	-	5,115	-	-		-	5,115	-
Subtotal	1,016,948	6,381	1,122,482	6,265	1,132,625	6,822	+58,915		+125	1,191,540	6,947
Funds included for Homeland Security	[33,175]	-	[35,867]	-	[36,861]	-	-		-	[36,861]	-
Total Adjusted Approp	1,016,948	6,381	1,122,482	6,265	1,132,625	6,822	+58,915		+125	1,191,540	6,947
Rescissions, Transfers, and Seq. (Net)	84,905	-	-	-	-	-	-		-	-	-
Total Appropriation	1,101,853	6,381	1,122,482	6,265	1,132,625	6,822	+58,915		+125	1,191,540	6,947
Transfers In:											
Cong. Relations	102	-	102	-	-	-	-		-	-	-
Total	102	-	102	-	-	-	-		-	-	-
Rescission	-29,838	-	-	-	-	-	-		-	-	-
Sequestration	-55,067	-	-	-	-	-	-		-	-	-
Bal. Available, SOY	8,970	-	9,632	-	11,690	-	-11,690		-	-	-
Other Adjustments (Net)	696	-	3,671	-	-	-	-		-	-	-
Total Available	1,026,716	6,381	1,135,887	6,265	1,144,315	6,822	+47,225		+125	1,191,540	6,947
Lapsing Balances	-2,739	-	-2,386	-	-	-	-		-	-	-
Bal. Available, EOY	-9,632	-	-11,690	-	-	-	-		-	-	-
Total Obligations	1,014,345	6,381	1,121,811	6,265	1,144,315	6,822	+47,225		+125	1,191,540	6,947
Staff Years:											
Direct		6,381		6,265		6,822			+125		6,947
Other		677		628		628			-		628
Total, Staff Year Estimate		7,058		6,893		7,450			+125		7,575

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

Program	2013 Actual		2014 Actual		2015 Enacted		Inc. or Dec.		2016 Estimate	
	Amount	SYs	Amount	SYs	Amount	SYs	Amount	SYs	Amount	SYs
Salaries and Expenses										
Discretionary Obligations:										
Product Quality/Value Added	$92,883	682	$98,708	699	$100,156	761	+$1,459 (1)	+2	$101,615	763
Livestock Production	70,261	376	86,642	444	86,859	483	+7,539 (2)	+36	94,398	519
Crop Production	210,172	1,477	215,608	1,302	215,166	1,419	+17,911 (3)	+60	233,077	1,479
Food Safety	97,962	783	111,656	659	111,656	718	+4,505 (4)	+15	116,161	733
Livestock Protection	70,365	411	89,589	459	90,632	500	-101 (5)	-3	90,531	497
Crop Protection	179,048	1,047	188,869	1,073	191,413	1,168	+3,010 (6)	+6	194,423	1,174
Human Nutrition	80,328	279	86,874	235	86,874	256	-1,678 (7)	-8	85,196	248
Environmental Stewardship	174,636	1,254	200,722	1,299	200,819	1,414	+5,333 (8)	+14	206,152	1,428
National Agricultural Library	20,818	72	22,844	95	23,791	103	+937 (9)	+3	24,728	106
Repair and Maintenance	17,762	-	20,104	-	20,144	-	+20,000 (10)	-	40,144	-
Decentralized GSA and DHS Security Payments	-	-	-	-	5,115	-	-	-	5,115	-
Subtotal	1,014,235	6,381	1,121,616	6,265	1,132,625	6,822	+58,915	+125	1,191,540	6,947
Funds included for Homeland Security	[33,175]	-	[35,867]	-	[36,861]	-	-	-	[36,861]	-
Misc. Fees/Supplementals	110	-	195	-	11,690	-	-	-	-	-
Subtotal	110	-	195	-	11,690	-	-11,690	-	-	-
Total Obligations	1,014,345	6,381	1,121,811	6,265	1,144,315	6,822	+47,225	+125	1,191,540	6,947
Lapsing Balances	2,739	-	2,386	-	-	-	-	-	-	-
Bal. Available, EOY	9,632	-	11,690	-	-	-	-	-	-	-
Total Available	1,026,716	6,381	1,135,887	6,265	1,144,315	6,822	+47,225	+125	1,191,540	6,947
Transfers In	-102	-	-102	-	-	-	-	-	-	-
Rescission	29,838	-	-	-	-	-	-	-	-	-
Sequestration	55,067	-	-	-	-	-	-	-	-	-
Bal. Available, SOY	-8,970	-	-9,632	-	-11,690	-	+11,690	-	-	-
Other Adjustments (Net)	-696	-	-3,671	-	-	-	-	-	-	-
Total Appropriation	1,101,853	6,381	1,122,482	6,265	1,132,625	6,822	+58,915	+125	1,191,540	6,947
Staff Years:										
Direct		6,381		6,265		6,822		+125		6,947
Other		677		628		628		-		628
Total, Staff Year Estimate		7,058		6,893		7,450		+125		7,575

Proposed 2016 Program Increases and Decreases
(Dollars in thousands)

	New Prod. Prod. Quality	Livestock Production	Crop Production	Food Safety	Livestock Protection	Crop Protection	Human Nutrition	Environ. Stewardship	NAL	Repair and Maintenance	Decentralized GSA	Grand Total
2015 Base	$100,156	$86,859	$215,166	$111,656	$90,632	$191,413	$86,874	$200,819	$23,791	$20,144	$5,115	$1,132,625
Reductions:												
Project Terminations	-449	-4,033	-4,573	-5,994	-5,662	-8,236	-2,017	-16,419	-	-	-	-47,383
Laboratory Consolidations	-	-1,668	-	-	-	-	-	-711	-	-	-	-2,379
Subtotal, Reductions	-449	-5,701	-4,573	-5,994	-5,662	-8,236	-2,017	-17,130	-	-	-	-49,762
Increases:												
Pay Cost	1,008	640	1,875	949	661	1,546	339	1,870	137	-	-	9,025
Antimicrobial Resistance	-	3,000	-	3,500	500	-	-	-	-	-	-	7,000
Apprentice Farmer Program	-	-	150	-	-	-	-	-	-	-	-	150
Big Data, Earth Sciences, and Earth Observation	-	-	-	-	-	-	-	1,723	800	-	-	2,523
Climate Change Resilient Crops	900	-	2,150	-	-	2,050	-	5,900	-	-	-	11,000
Combating Antibiotic Resistant Bacteria	-	2,000	-	5,000	3,000	-	-	-	-	-	-	10,000
Improving Agricultural Sustainability	-	-	-	-	-	-	-	8,000	-	-	-	8,000
Pollinator Health	-	-	3,000	-	-	4,000	-	-	-	-	-	7,000
Reducing Vulnerability to Climate Change	-	700	2,000	-	700	1,150	-	3,450	-	-	-	8,000
Sustainable Small Farms	-	1,500	3,000	-	700	2,000	-	300	-	-	-	7,500
Transformational Crop and Livestock Genetics	-	5,400	5,250	-	-	-	-	450	-	-	-	11,100
Vertical Farming	-	-	3,450	1,050	-	500	-	-	-	-	-	5,000
Repair and Maintenance	-	-	-	-	-	-	-	-	-	20,000	-	20,000
Laboratory Consolidations	-	-	1,609	-	-	-	-	770	-	-	-	2,379
Subtotal, Increases	1,908	13,240	22,484	10,499	5,561	11,246	339	22,463	937	20,000	-	108,677
Total Changes	1,459	7,539	17,911	4,505	-101	3,010	-1,678	5,333	937	20,000	-	58,915
Grand Total, 2016 Budget	101,615	94,398	233,077	116,161	90,531	194,423	85,196	206,152	24,728	40,144	5,115	1,191,540

Justification of Increases and Decreases

ARS requests for Fiscal Year (FY) 2016, $1,191,540,000 for its Salaries and Expenses, a net increase of $58,915,000 above the FY 2015 enacted level. The 2016 Budget proposes an increase of $97,273,000 for translational crop and livestock genetics; combating antimicrobial resistance; pollinator health; climate change resilience/vulnerability; agricultural sustainability; big data, earth sciences, and earth observation; vertical farming; sustainable small farms; an apprentice farmer program; and repair and maintenance of the agency's laboratories/facilities. Also proposed is an increase of $9,025,000 for pay costs. The proposed program and pay cost increases are detailed below under the agency's major program areas.

Partially offsetting the proposed increases are decreases of $47,383,000 in proposed program redirections and lower priority project terminations. The 2016 Budget proposes the closure of the U.S. Sheep Experiment Station in Dubois, Idaho, and the consolidation of its research activities to three other ARS laboratories in Idaho: The Northwest Irrigation and Soils Research Laboratory in Kimberly; the Small Grains and Potato Germplasm Research Laboratory in Aberdeen; and the Watershed Management Research Laboratory in Boise.

Under its Buildings and Facilities account, the agency requests $205,901,000 for construction of the Biocontainment Laboratory and Consolidated Poultry Research Facility in Athens, Georgia; and the modernization of Building 307 in Beltsville, Maryland; the National Laboratory for Agriculture and the Environment in Ames, Iowa; the Southwest Watershed Research Center in Tucson, Arizona; and the Children's Nutrition Research Center in Houston, Texas. Maintaining and upgrading USDA's research infrastructure is vital for ARS to carry out its mission and responsibilities of conducting quality scientific agricultural research. In a report entitled, "Capital Investment Strategy," requested by the Secretary and Congress, these laboratories were identified by ARS as its highest facilities' priorities. These laboratories and others identified in the report have exceeded their "functional lifespan" and are badly in need of modernization.

New Products/Product Quality/Value Added

(1) An increase of $1,459,000 and two staff years for New Products/Product Quality/Value Added research ($100,156,000 and 761 staff years available in 2015).

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

Continuing New Products/Product Quality/Value Added base funding is essential for ARS to carry out its research mission and responsibilities. Base funding supports ARS' program goals of increasing the economic viability and competitiveness of U.S. agriculture by maintaining and/or enhancing the quality of harvested agricultural commodities; and expanding domestic and global market opportunities through the development of value-added food and nonfood technologies and products including energy and fuels. In addition to the activities and functions specifically described in the budget request, current year and budget year base funds will be used to carry out activities and functions consistent with the full range of authorities and activities delegated to the agency.

ARS' New Products/Product Quality/Value Added 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 many of USDA's Strategic Goals, particularly: Assist Rural Communities to Create Prosperity So They Are Self-Sustaining, Repopulating, and Economically Thriving. The research also directly supports many of the REE Action Plan Goals.

The funding change is requested for the following items:

a) An increase of $1,008,000 for pay costs ($202,000 for annualization of the 2015 pay increase and $806,000 for the 2016 pay increase).

Funding for pay costs is critical for 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 have to reduce spending for much needed laboratory equipment, supplies, and other materials.

b) An increase of $900,000 for Climate Change Resilient Crops.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Environmental Stewardship, Crop Production, Crop Protection, and New Products/Product Quality/Value Added. A full description of the initiative is presented on page 18-36.

c) A decrease of $449,000 from ongoing research projects to support higher priority research initiatives.

The 2016 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 2016 Budget, and will improve program and operational efficiencies.

NY, Ithaca – Dissection of Maize Quality Traits Using Biochemical Genetic and Genomic Approaches (-$449,000)

Livestock Production

(2) An increase of $7,539,000 and 36 staff years for Livestock Production research ($86,859,000 and 483 staff years available in 2015).

ARS' Livestock Production research program is directed toward fostering an abundant, safe, nutritionally wholesome, and competitively priced supply of animal products produced in a viable, competitive, and sustainable animal agriculture sector of the U.S. economy by: safeguarding and utilizing animal genetic resources, associated genetic and genomic databases, and bioinformatic tools; developing a basic understanding of food animal physiology to address priority issues related to animal production, animal well-being, and product quality and healthfulness; and developing information, best management practices, novel and innovative tools, and technologies that improve animal production systems, enhance human health, and ensure domestic food security. 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 the 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.

Continuing Livestock Production base funding is essential for ARS to carry out its research mission and responsibilities. Base funding supports ARS' program goal of providing scientific information and biotechnologies which will ensure an abundant supply of competitively priced animal and aquaculture products. This includes: developing genome analysis tools; identifying economically important genetic traits; preserving agricultural animal genetic resources; improving the efficiency of nutrient utilization and conversion of feeds and forages to animal products; enhancing reproductive performance; and improving aquaculture production systems. In addition to the activities and functions specifically described in the budget request, current year and budget year base funds will be used to carry out activities and functions consistent with the full range of authorities and activities delegated to the agency.

ARS' Livestock Production 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 many of USDA's Strategic Goals, particularly: 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. The research also directly supports many of the REE Action Plan Goals.

The funding change is requested for the following items:

a) An increase of $640,000 for pay costs ($130,000 for annualization of the 2015 pay increase and $510,000 for the 2016 pay increase).

Funding for pay costs is critical for 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 have to reduce spending for much needed laboratory equipment, supplies, and other materials.

b) An increase of $5,400,000 for Translational Crop and Livestock Genetics for Accelerating Advances in Food Production.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Livestock Production, Crop Production, and Environmental Stewardship. A full description of the initiative is presented on page 18-34.

c) An increase of $3,000,000 for Antimicrobial Resistance.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Food Safety, Livestock Production, and Livestock Protection. A full description of the initiative is presented on page 18-41.

d) An increase of $2,000,000 for Combating Antibiotic Resistant Bacteria.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Food Safety, Livestock Protection, and Livestock Production. A full description of the initiative is presented on page 18-37.

e) An increase of $1,500,000 for Sustainable Small Farms.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Crop Production, Crop Protection, Livestock Production, Livestock Protection, and Environmental Stewardship. A full description of the initiative is presented on page 18-40.

f) An increase of $700,000 for Reducing Vulnerability to Climate Change.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Environmental Stewardship, Crop Production, Crop Protection, Livestock Protection, and Livestock Production. A full description of the initiative is presented on page 18-38.

g) A decrease of $1,668,000 resulting from the consolidation of selected laboratories.

The proposed closure of the U.S. Sheep Experiment Station in Dubois, Idaho and the consolidation of its research activities with the Northwest Irrigation and Soils Research Laboratory in Kimberly, Idaho; the Small Grains and Potato Germplasm Research Laboratory in Aberdeen, Idaho; and the Watershed Management Research Laboratory in Boise, Idaho result in a net decrease of $1,668,000 in the Livestock Production research program.

h) A decrease of $4,033,000 from ongoing research projects to support higher priority research initiatives.

The 2016 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 2016 Budget, and will improve program and operational efficiencies.

MD, Beltsville – Identification of Biomarkers for Pre- and Post-Weaning Growth in Swine (-$1,022,000)
MS, Stoneville – Biophotonics – The Application of Novel Imaging Methodologies to Livestock Production Research (-$699,000)
OR, Corvallis – Determine Genetic Diversity and Develop Tools for Genetic Improvement of Oyster Stocks for the Pacific Northwest (-$364,000)
WI, Madison – Combating Viral Hemorrhagic Septicemia and Improving Yellow Perch Aquaculture for the Great Lakes (-$1,480,000)
WV, Leetown – Identifying Biochemical Pathways Using Genetically Modified Trout (-$468,000)

Crop Production

(3) An increase of $17,911,000 and 60 staff years for Crop Production research ($215,166,000 and 1,419 staff years available in 2015).

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 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.

Continuing Crop Production base funding is essential for ARS to carry out its research mission and responsibilities. Base funding supports ARS' program goals of protecting, expanding, and enhancing the Nation's crop genetic resources; increasing scientific knowledge of crop genes, genomes, and biological systems; and delivering technologies that improve the production efficiency, quality, health, and value of the Nation's crops. This includes: developing and maintaining genome databases and informatics tools; managing plant and microbial genetic resources; assessing systematic relationships; enhancing and releasing improved genetic resources and varieties; improving bee health; developing integrative strategies for managing pests, soil, water, nutrient and environmental factors for optimal yield; and determining the biological processes that improve crop productivity. In addition to the

activities and functions specifically described in the budget request, current year and budget year base funds will be used to carry out activities and functions consistent with the full range of authorities and activities delegated to the agency.

ARS' Crop Production 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 many of USDA's Strategic Goals, particularly: 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. The research also directly supports many of the REE Action Plan Goals.

The funding change is requested for the following items:

a) An increase of $1,875,000 for pay costs ($379,000 for annualization of the 2015 pay increase and $1,496,000 for the 2016 pay increase).

Funding for pay costs is critical for 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 have to reduce spending for much needed laboratory equipment, supplies, and other materials.

b) An increase of $5,250,000 for Translational Crop and Livestock Genetics for Accelerating Advances in Food Production.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Livestock Production, Crop Production, and Environmental Stewardship. A full description of the initiative is presented on page 18-34.

c) An increase of $3,450,000 for Vertical Farming.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Crop Production, Food Safety, and Crop Protection. A full description of the initiative is presented on page 18-43.

d) An increase of $3,000,000 for Pollinator Health and Colony Collapse Disorder.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Crop Production and Crop Protection. A full description of the initiative is presented on page 18-42.

e) An increase of $3,000,000 for Sustainable Small Farms.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Crop Production, Crop Protection, Livestock Production, Livestock Protection, and Environmental Stewardship. A full description of the initiative is presented on page 18-40.

f) An increase of $2,150,000 for Climate Change Resilient Crops.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Environmental Stewardship, Crop Production, Crop Protection, and New Products/Product Quality/Value Added. A full description of the initiative is presented on page 18-36.

g) An increase of $2,000,000 for Reducing Vulnerability to Climate Change.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Environmental Stewardship, Crop Production, Crop Protection, Livestock Protection, and Livestock Production. A full description of the initiative is presented on page 18-38.

h) An increase of $1,609,000 resulting from the consolidation of selected laboratories.

The proposed closure of the U.S. Sheep Experiment Station in Dubois, Idaho and the consolidation of its research activities with the Northwest Irrigation and Soils Research Laboratory in Kimberly, Idaho; the Small Grains and Potato Germplasm Research Laboratory in Aberdeen, Idaho; and the Watershed Management Research Laboratory in Boise, Idaho result in a net increase of $1,609,000 in the Crop Production research program.

i) An increase of $150,000 for an Apprentice Farmer program at BARC.

BARC will host two or three apprentices who will be term appointees (up to six months) hired at the WG-5 level (approximately $50,000 including benefits on an annual basis). Their appointment will start early in the spring to allow for involvement in planting activities and will continue throughout the growing season.

BARC will provide hands-on experience in planting, growing, and harvesting crops (mostly beans, rye, and corn) and preparing them for sale, storage, and/or silage. Experience will be gained on basic agricultural practices and equipment usage and maintenance. In addition, apprentices will have the opportunity to participate in the planting, growing, and harvesting of horticultural crops including berries, tomatoes, and cucurbits. Apprentices will also train in greenhouse operations and activities.

In addition to plant/crop training, apprentices will have opportunities for animal care and handling limited to dairy cows, pigs, and poultry. This will provide firsthand knowledge of animal agriculture including breeding, production, and health. There will be opportunities for understanding basic concepts of food safety and how on-farm pathogen reduction is essential to ensure a safe food supply.

Existing ARS farm crew staff will be the primary trainers for these activities. Individuals from the University of Maryland-College Park or the University of Maryland-Eastern Shore will be contacted to see if they would be willing to participate in this program for additional field training opportunities or didactic training on managing a farm.

j) A decrease of $4,573,000 from ongoing research projects to support higher priority research initiatives.

The 2016 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 2016 Budget, and will improve program and operational efficiencies.

CA, Davis – Improvement of Post-harvest Performance of Ornamentals Using Molecular Genetic Approaches (-$289,000)
CA, Salinas – Sugar Beet Germplasm Enhancement, Breeding, and Genetics (-$637,000)
MD, Beltsville – Molecular Approaches to Enhance Plant Nutrient Content, Shelf-Life and Stress Tolerance (-$485,000)
MD, Beltsville – Sustainable Production Systems for Cacao (-$857,000)
MO, Columbia – Functional Genomics for Evaluating Genes and Gene Regulatory Networks of Soybean Quality Traits (-$313,000)
MS, Stoneville – Development of Productive, Profitable, and Sustainable Crop Production Systems for the Mid-South (-$1,532,000)
WI, Madison – Genetic Exchange and Gene Flow Risks From Plants in Agriculture (-$460,000)

Food Safety

(4) An increase of $4,505,000 and 15 staff years for Food Safety research ($111,656,000 and 718 staff years available in 2015).

ARS' Food Safety research program 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 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). 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, including regulatory agencies, industry, and commodity and consumer organizations in detecting, identifying, and controlling foodborne diseases that affect human health.

Continuing Food Safety base funding is essential for ARS to carry out its research mission and responsibilities. Base funding supports ARS' program goal of protecting food from pathogens, toxins, and chemical contamination during production, processing, and preparation. This includes: developing and evaluating technologies for the detection and characterization of microbial contaminants; developing new intervention and control strategies for the reduction of foodborne pathogens; and developing and evaluating detection methods for the reduction and control of veterinary drugs, chemical residues, heavy metals, organic pollutants, and biological toxins derived from bacteria, fungi, and plants. In addition to the activities and functions specifically described in the budget request, current year and budget year base funds will be used to carry out activities and functions consistent with the full range of authorities and activities delegated to the agency.

ARS' Food Safety 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 many of USDA's Strategic Goals, particularly: Ensure that All of America's Children Have Access to Safe, Nutritious, and Balanced Meals. The research also directly supports many of the REE Action Plan Goals.

The funding change is requested for the following items:

a) An increase of $949,000 for pay costs ($192,000 for annualization of the 2015 pay increase and $757,000 for the 2016 pay increase).

Funding for pay costs is critical for 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 have to reduce spending for much needed laboratory equipment, supplies, and other materials.

b) An increase of $5,000,000 for Combating Antibiotic Resistant Bacteria.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Food Safety, Livestock Protection, and Livestock Production. A full description of the initiative is presented on page 18-37.

c) An increase of $3,500,000 for Antimicrobial Resistance.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Food Safety, Livestock Production, and Livestock Protection. A full description of the initiative is presented on page 18-41.

d) An increase of $1,050,000 for Vertical Farming.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Crop Production, Food Safety, and Crop Protection. A full description of the initiative is presented on page 18-43.

e) A decrease of $5,994,000 from ongoing research projects to support higher priority research initiatives.

The 2016 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 2016 Budget, and will improve program and operational efficiencies.

AR, Fayetteville – Alternative Intervention and Control Strategies for Foodborne Pathogens in Poultry and Poultry Products (-$757,000)
GA, Athens – Control of Toxic Endophytic Fungi with Bacterial Endophytes and Regulation of Bacterial Metabolites for Novel Uses in Food Safety (-$1,694,000)
GA, Athens – Molecular Approaches for the Characterization of Foodborne Pathogens in Poultry (-$1,116,000)
GA, Athens – Pre-harvest Interventions For Application During Poultry Production To Reduce Foodborne Bacterial Pathogens (-$982,000)
MD, Beltsville – Molecular Mechanisms of Pathogenic Bacteria Interactions with Plant Surfaces and Environmental Matrices (-$951,000)
MS, Mississippi State – Integration of Site-Specific Crop Production Practices and Industrial and Animal Agricultural Byproducts to Improve Agricultural Competitiveness and Sustainability (-$494,000)

Livestock Protection

(5) An decrease of $101,000 and a reduction of three staff years for Livestock Protection research ($90,632,000 and 500 staff years available in 2015).

ARS' 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 through the discovery and development of diagnostics, vaccines, biotherapeutics, animal genomics applications, disease management systems, animal disease models, and farm biosecurity measures. The research program has the following strategic objectives: establish ARS laboratories into a fluid, highly effective research network to maximize use of core competencies and resources; use specialized high containment facilities to study zoonotic and emerging diseases; develop an integrated animal and microbial genomics research program; establish core competencies in bovine, swine, ovine, and avian immunology; launch a biotherapeutic discovery program providing alternatives to animal drugs; build a technology driven vaccine and diagnostic discovery research program; develop core competencies in field epidemiology and predictive biology; establish a best-in-class training center for our Nation's veterinarians and scientists; and develop a model technology transfer program to achieve the full impact of ARS research discoveries. The ARS animal research program includes the following core components: biodefense research, animal genomics and immunology, zoonotic diseases, respiratory diseases, reproductive and neonatal diseases, enteric diseases, parasitic diseases, and transmissible spongiform encephalopathies.

Continuing Livestock Protection base funding is essential for ARS to carry out its research mission and responsibilities. Base funding supports ARS' program goal of preventing and controlling pests and animal diseases that pose a threat to agriculture, public health, and the well-being of Americans. This includes: identifying genes

involved in animals with disease-resistant phenotypes; improving our understanding of microbial pathogenesis, transmission, and immune responses to develop countermeasures to prevent and control animal diseases; analyzing microbial genomes to better understand host-pathogen interactions; developing new vaccines to prevent disease in aquaculture species; developing new methods to minimize tick bites; identifying measures to restrict the cattle fever tick; developing methods to control stable flies, horn flies, and house flies and their impact on livestock; supporting the screwworm eradication program; and developing control methods for U.S. vectors of Rift Valley fever. In addition to the activities and functions specifically described in the budget request, current year and budget year base funds will be used to carry out activities and functions consistent with the full range of authorities and activities delegated to the agency.

ARS' Livestock Protection 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 many of USDA's Strategic Goals, particularly: Ensure that All of America's Children Have Access to Safe, Nutritious, and Balanced Meals. The research also directly supports many of the REE Action Plan Goals.

The funding change is requested for the following items:

a) An increase of $661,000 for pay costs ($133,000 for annualization of the 2015 pay increase and $528,000 for the 2016 pay increase).

Funding for pay costs is critical for 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 have to reduce spending for much needed laboratory equipment, supplies, and other materials.

b) An increase of $3,000,000 for Combating Antibiotic Resistant Bacteria.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Food Safety, Livestock Protection, and Livestock Production. A full description of the initiative is presented on page 18-37.

c) An increase of $700,000 for Reducing Vulnerability to Climate Change.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Environmental Stewardship, Crop Production, Crop Protection, Livestock Protection, and Livestock Production. A full description of the initiative is presented on page 18-38.

d) An increase of $700,000 for Sustainable Small Farms.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Crop Production, Crop Protection, Livestock Production, Livestock Protection, and Environmental Stewardship. A full description of the initiative is presented on page 18-40.

e) An increase of $500,000 for Antimicrobial Resistance.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Food Safety, Livestock Production, and Livestock Protection. A full description of the initiative is presented on page 18-41.

f) A decrease of $5,662,000 from ongoing research projects to support higher priority research initiatives.

The 2016 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 2016 Budget, and will improve program and operational efficiencies.

AR, Fayetteville – Novel Therapeutic, Diagnostic, and Management Strategies to Reduce Antibiotic Use in Poultry Production (-$627,000)
CA, Albany – Immunodiagnostics to Detect Prions and Other Important Animal Pathogens (-$1,718,000)
IA, Ames – Identification of Host Immune Factors and Intervention Strategies for Mastitis (-$1,312,000)
MD, Beltsville – Development of Genomic Tools to Study Ruminant Resistance to Gastrointestinal Nematodes (-$1,051,000)
MS, Mississippi State – Strategies to Control and Prevent Avian Mycoplasmosis (-$954,000)

Crop Protection

(6) An increase of $3,010,000 and six staff years for Crop Protection research ($191,413,000 and 1,168 staff years available in 2015).

ARS' Crop Protection research program is directed to protect crops from insect and disease loss through research 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 program's research priorities include: identification of genes that convey virulence traits in pathogens and pests; factors that modulate infectivity, gene functions, and mechanisms; genetic profiles that provide specified levels of disease and insect resistance under field conditions; and mechanisms that reduce 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 and to address quarantine issues.

Continuing Crop Protection base funding is essential for ARS to carry out its mission and responsibilities. Base funding supports ARS' program goals of protecting our Nation's crops from arthropods, plant pathogens, nematodes, and weeds; and developing economical alternatives to methyl bromide. In addition to the activities and functions specifically described in the budget request, current year and budget year base funds will be used to carry out activities and functions consistent with the full range of authorities and activities delegated to the agency.

ARS' Crop Protection 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 many of USDA's Strategic Goals, particularly: Ensure that All of America's Children Have Access to Safe, Nutritious, and Balanced Meals. The research also directly supports many of the REE Action Plan Goals.

The funding change is requested for the following items:

a) An increase of $1,546,000 for pay costs ($313,000 for annualization of the 2015 pay increase and $1,233,000 for the 2016 pay increase).

Funding for pay costs is critical for 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 have to reduce spending for much needed laboratory equipment, supplies, and other materials.

b) An increase of $2,050,000 for Climate Change Resilient Crops.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Environmental Stewardship, Crop Production, Crop Protection, and New Products/Product Quality/Value Added. A full description of the initiative is presented on page 18-36.

c) An increase of $4,000,000 for Pollinator Health and Colony Collapse Disorder.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Crop Production and Crop Protection. A full description of the initiative is presented on page 18-42.

d) An increase of $2,000,000 for Sustainable Small Farms.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Crop Production, Crop Protection, Livestock Production, Livestock Protection, and Environmental Stewardship. A full description of the initiative is presented on page 18-40.

e) An increase of $1,150,000 for Reducing Vulnerability to Climate Change.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Environmental Stewardship, Crop Production, Crop Protection, Livestock Protection, and Livestock Production. A full description of the initiative is presented on page 18-38.

f) An increase of $500,000 for Vertical Farms.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Crop Production, Food Safety, and Crop Protection. A full description of the initiative is presented on page 18-43.

g) A decrease of $8,236,000 from ongoing research projects to support higher priority research initiatives.

The 2016 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 2016 Budget, and will improve program and operational efficiencies.

CA, Salinas – Detection and Management of Pathogens in Strawberry and Vegetable Production Systems (-$1,198,000)
IL, Peoria – Semiochemicals for the Management of Agricultural Pests (-$461,000)
MD, Beltsville – Alternative Disease Management Strategies for Soilborne Pathogens of Cucumber (-$506,000)
MD, Beltsville – Methods for Rapid Identification and Functional Analysis of Fungi Causing Post-harvest Decay of Pome Fruit (-$782,000)
MO, Columbia – Development of High Quality, Cost-Effective, Mass Reared Biocontrol Agents for Small and Urban Farms, Organic Farms, and Greenhouses (-$988,000)
MO, Columbia – Eicosanoid-Mediated and Molecular Immune Signaling Inhibitors in Piercing/Sucking Insect Pests of Small and Urban Vegetable Farms (-$748,000)
MO, Columbia – Plant Resistance, Biology, and Resistance Management of Corn Pests, with Emphasis on Western Corn Rootworm (-$264,000)

MT, Sidney – Ecology and Management of Grasshoppers and Other Insect Pests in the Northern Great Plains (-$1,312,000)
ND, Fargo – Insect Cryopreservation, Dormancy, Genetics and Biochemistry (-$1,977,000)

Human Nutrition

(7) An decrease of $1,678,000 and a reduction of eight staff years for Human Nutrition research ($86,874,000 and 256 staff years available in 2015).

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 primary public health concerns in the U.S. 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 requirements but have health-promoting qualities. Four specific areas of research are emphasized: nutrition monitoring; the scientific basis for dietary recommendations; prevention of obesity and related diseases; and life stage nutrition and metabolism, in order to better define the role of nutrition in pregnancy and growth of children, and for healthier aging.

Continuing Human Nutrition base funding is essential for ARS to carry out its mission and responsibilities. Base funding supports ARS' program goal of enabling Americas to make health promoting, science-based dietary choices. This includes: determining food consumption and dietary patterns of Americans; updating U.S. food composition data; enhancing the health promoting quality of the food supply; developing and evaluating strategies to prevent obesity and related diseases; and understanding the mechanisms by which nutrition promotes healthy development. In addition to the activities and functions specifically described in the budget request, current year and budget year base funds will be used to carry out activities and functions consistent with the full range of authorities and activities delegated to the agency.

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 many of USDA's Strategic Goals, particularly: Ensure that All of America's Children Have Access to Safe, Nutritious, and Balanced Meals. The research also directly supports many of the REE Action Plan Goals.

The funding change is requested for the following items:

a) An increase of $339,000 for pay costs ($69,000 for annualization of the 2015 pay increase and $270,000 for the 2016 pay increase).

Funding for pay costs is critical for 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 have to reduce spending for much needed laboratory equipment, supplies, and other materials.

b) A decrease of $2,017,000 from ongoing research projects to support higher priority research initiatives.

The 2016 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 2016 Budget, and will improve program and operational efficiencies.

MD, Beltsville – Effects of Elevated Atmospheric Carbon Dioxide, Environmental Stress, and Edaphic Conditions on Bioactive Compounds in Brassica Crops ($-638,000)
MD, Beltsville – Health Promoting Roles of Food Bio-Active Phenolic Compounds on Obesity-Altered Heart, and Kidney Functions and Physiology (-$1,193,000)
MA, Boston – Rural Aging Study (-$186,000)

Environmental Stewardship

(8) An increase of $5,333,000 and 14 staff years for Environmental Stewardship research ($200,819,000 and 1,414 staff years available in 2015).

ARS' Environmental Stewardship research program emphasis is on developing technologies and systems that support sustainable 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' research also focuses on 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 this program. ARS' range and grazing land research objectives include the conservation and restoration of the Nation's range land 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.

Continuing Environmental Stewardship base funding is essential for ARS to carry out its mission and responsibilities. Base funding supports ARS program goals of providing integrated, effective, and safe water resources; improving the quality of atmosphere and soil resources and understanding the effects of climate change; effectively and safely managing the use of manure and other industrial byproducts that maximize their potential benefits while protecting the environment and human and animal health; and developing and transferring economically viable and environmentally sustainable production and conservation practices, technologies, plant materials, and integrated management strategies that conserve and enhance the Nation's natural resources. In addition to the activities and functions specifically described in the budget request, current year and budget year base funds will be used to carry out activities and functions consistent with the full range of authorities and activities delegated to the agency.

ARS' Environmental Stewardship 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 FY 2016 Interagency Climate Change initiatives and priorities, and many of the Department's Strategic Goals, particularly: Ensure Our National Forests and Private Working Lands Are Conserved, Restored, and Made More Resilient to Climate Change, While Enhancing Our Water Resources. The research also directly supports many of the REE Action Plan Goals.

The funding change is requested for the following items:

a) An increase of $1,870,000 for pay costs ($378,000 for annualization of the 2015 pay increase and $1,492,000 for the 2016 pay increase).

Funding for pay costs is critical for 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 have to reduce spending for much needed laboratory equipment, supplies, and other materials.

b) An increase of $8,000,000 for Improving Agricultural Sustainability.

Need for Change

Over the past several years, the significant challenges facing agriculture in the 21st century—both in the United States and globally—have become clearly evident:

- Earth's population is growing even more rapidly than predicted, with global population now expected to reach 9.7 billion people by 2050 (nine billion was previously predicted).
- Per capita, the agricultural products needed to support this population are also expected to increase, as the standard of living increases in developing countries.
- Over the next 30-50 years, it has been estimated agriculture will need to produce more food, fiber, and fuel than mankind has produced over its entire history.
- In the best of all possible worlds, this increased production would come without further depletion of our natural resource base or degradation of our environment (the UN's Food and Agriculture Organization recently estimated that 25 percent of Earth's lands are already degraded).
- Recent record droughts in California and in the central U.S. have highlighted how fragile agricultural production systems can be in response to extreme climate variability.
- Most recently, Antarctic sea ice has been melting more rapidly than previously expected, with the potential to cause significant increases in sea levels over relatively short time frames that could threaten productive agricultural lands in low lying coastal areas (e.g., the Chesapeake Bay).
- The potential loss of productive agricultural lands in coastal regions is of particular concern because most (more than 75 percent) of the new production needed is expected to come from increasing production on existing agricultural lands, as opposed to bringing new land into production.

As we approach the middle of the 21st century, the challenge of providing sufficient food, fiber, and fuel to support the growing global population is becoming more difficult as our natural resources, environmental health, and available arable land decline and climate changes. The unprecedented nature and increasing difficulty of these challenges heightens the sense of urgency for transformative changes to agriculture, achieving sustainable agricultural systems that maximize production and economic return for producers while minimizing environmental degradation and adapting 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).

In 2012, ARS organized 10 of its existing research watersheds, ranges, and farms into a long-term agro-ecosystem research (LTAR) network in response to longstanding calls from the scientific community to establish a platform for long-term research on sustainable production. In FY 2014, ARS added eight additional sites to the LTAR network, thereby increasing coverage of key agricultural production regions, while strengthening ties between USDA science and the Nation's land grant university system. ARS began the process of transforming existing long-term research infrastructure, both within and outside of USDA, into a sophisticated platform for research to support investigations into how to sustain and/or enhance (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 proposed 2016 funding increase will enhance the functionality of the eight newly designated sites added to the LTAR network, expanding LTAR network coverage to key agricultural regions including the Chesapeake Bay, Florida, the Great Basin, the Great Lakes region, the High Plains (Ogallala) aquifer, the Lower Mississippi River

Basin, the Ohio River Basin, and the Texas Gulf Coast. More importantly, it will enable long-term, cross location experiments to address the underlying components of agricultural sustainability, looking across regional and continental scale gradients of precipitation, temperature, and other factors that are themselves potentially nonstationary. By comparing current, conventional production practices versus novel approaches intended to achieve sustainable intensification across these gradients and over time, adaptively managing both scenarios to reflect changes in local practices, and/or to sustainably maintain or enhance experimental production systems, farmers and ranchers will receive key information, to help them adjust local production systems to reflect these changes; and to maintain or enhance productivity, profitability, and quality of life, while preserving natural resources and maintaining important ecosystem services.

Means to Achieve Change

- Enhance research on benchmark watersheds, experimental range and pasture lands, and research farms to strengthen the LTAR network, and formally establish a common, long-term experiment in agricultural sustainability with an associated collection of a core set of common measurements ($3,600,000).
  - Develop the management and conservation strategies needed to adapt U.S. agriculture to the constraints imposed by long-term changes in: competition for land, water, and other natural resources and ecosystem services (e.g., soil health; pollinator health) from multiple sectors; regional to global scaling of commodities markets and food systems; energy production and demand (e.g., bio-feed stocks; fossil fuels); climate variability and change; and invasive species dynamics.
  - 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.
  - Maintain or enhance environmental quality (i.e., air, soil, and water) in these agricultural landscapes.
  - 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.
  - Enhance the capacity to field test agricultural germplasm 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.

- Link new LTAR sites to the developing LTAR observatory and as a complement to NSF's National Ecological Observatory Network (NEON) ($2,800,000).
  - Establish key observatory (NEON or NEON-comparable) infrastructure (e.g., towers and associated instrumentation) to collect, remotely and automatically, key atmospheric, biological, hydrological, meteorological, and soil-based metrics comparable to those being collected at existing LTAR sites, designed specifically to focus on parameters of interest and importance in agricultural landscapes.
  - Apply this infrastructure specifically to the experimental treatments (i.e., "business-as-usual" and "aspirational") of the cross location sustainability experiment.

- As part of ARS' "Big Data" initiative, connect LTAR observatory data streams to a prototype data portal being established by the National Agricultural Library ($1,600,000).
  - Link LTAR observatory data collection via cyber infrastructure to the prototype NAL data portal to facilitate data access, analysis, publication, storage, and visualization thereby integrating the LTAR network with state-of-the-art informatics capabilities supported by NAL.
  - Use the network and associated LTAR observatory infrastructure to develop up to date syntheses of research findings on how ecosystem structure and condition are linked to the ecosystem functions that contribute to societally 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.

Outcomes

LTAR sites will enable scientists, collaborating across ARS, land grant universities, other research institutions, and/or other Federal agencies to conduct multidisciplinary research and share funding efforts to determine how best to sustain or enhance agricultural productivity, profitability, environmental quality, and ecosystem goods and services, across a wide variety of agro-ecosystems and agricultural landscapes. Doing so will 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.

This investment will continue to transform the nature of USDA research and significantly raise the visibility of USDA within the national and international 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, and to natural resource concerns have the potential to provide significant benefits. Similarly, the LTAR research platform can be used to address research related to each of the above areas. As such, the LTAR network represents an "organizing principle" for U.S. agriculture that has the potential to connect key agricultural science disciplines that are currently separate and distinct.

In addition to the benefits realized by USDA, the LTAR network will also leverage key existing and/or developing infrastructure supported by both USDA and other Federal agencies, most notably the NSF supported Critical Zone Observatory, Long-Term Ecological Research (LTER), and NEON networks, and the DOE supported Ameriflux network, the EPA supported Ammonia Deposition Network, the USDA Climate Hubs, and USDA's GRACEnet, REAP, and Conservation Effects Assessment Project networks.

The proposed initiative directly addresses many of the Department's Strategic Plan Goals as well as REE's Action Plan Goals, particularly REE Goal 1: "Sustainable Intensification of Agricultural Production."

c) An increase of $5,900,000 for Climate Change Resilient Crops.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Environmental Stewardship, Crop Production, Crop Protection, and New Products/Product Quality/Value Added. A full description of the initiative is presented on page 18-36.

d) An increase of $3,450,000 for Reducing Vulnerability to Climate Change.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Environmental Stewardship, Crop Production, Crop Protection, Livestock Protection, and Livestock Production. A full description of the initiative is presented on page 18-38.

e) An increase of $1,723,000 for Big Data, Earth Sciences, and Earth Observation.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Environmental Stewardship, and Library and Information Services. A full description of the initiative is presented on page 18-44.

f) An increase of $450,000 for Translational Crop and Livestock Genetics for Accelerating Advances in Food Production.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Livestock Production, Crop Protection, and Environmental Stewardship. A full description of the initiative is presented on page 18-34.

g) An increase of $300,000 for Sustainable Small Farms.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Crop Production, Crop Protection, Livestock Production, Livestock Protection, and Environmental Stewardship. A full description of the initiative is presented on page 18-40.

h) An increase of $59,000 resulting from the consolidation of selected laboratories.

The proposed closure of the U.S. Sheep Experiment Station in Dubois, Idaho and the consolidation of its research activities with the Northwest Irrigation and Soils Research Laboratory in Kimberly, Idaho; the Small Grains and Potato Germplasm Research Laboratory in Aberdeen, Idaho; and the Watershed Management Research Laboratory in Boise, Idaho result in a net increase of $59,000 in the Environmental Stewardship research program.

i) A decrease of $16,419,000 from ongoing research projects to support higher priority research initiatives.

The 2016 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 2016 Budget, and will improve program and operational efficiencies.

CO, Akron – Sustainable Dryland Cropping System for the Central Great Plains (-$2,201,000)
CO, Ft. Collins – Enhanced System Models and Decision Support Tools to Optimize Water Limited Agriculture (-$1,126,000)
MD, Beltsville – Developing Analytical and Management Strategies to Improve Crop Utilization of and Reduce Losses to the Environment (-$1,646,000)
MD, Beltsville – Regulation of Gene Expression in Alfalfa Development and Stress Tolerance (-$425,000)
ME, Orono – Improved Crop Production Systems for the Northeast (-$1,031,000)
MS, Mississippi State – Integration of Site-Specific Crop Production Practices and Industrial and Animal Agricultural Byproducts to Improve Agricultural Competitiveness and Sustainability (-$2,594,000)
MS, Oxford – Acoustic and Geophysical Technology Development for Improving Assessment and Monitoring of Erosion and Sediment Transport in Watersheds (-$811,000)
MS, Oxford – Improving Computational Modeling in Support of Better Erosion and Sediment Movement Control in Agricultural Watersheds (-$895,000)
MS, Stoneville – Agrochemical and Weed Seed Fate and Transport in Mid-South Crop Production Systems (-$1,037,000)
OR, Corvallis – Multi-Objective Optimization of a Profitable and Environmentally Sustainable Agriculture to Produce Food and Fiber in a Changing Climate (-$1,577,000)
OR, Pendleton – Improved Soil Management Practices for Tilled Summer Fallow in the Pacific Northwest (-$1,002,000)
TX, College Station – Improved Forage and Alternative Use Grasses for the Southern U.S. (-$266,000)
TX, Lubbock – Improving Air Quality of Agricultural Operations and Processes (-$284,000)
TX, Lubbock – Sustainable Agro-Ecosystems that Control Soil Erosion and Enhance the Environment (-$1,146,000)
WA, Pullman – Cultural Practices and Cropping Systems for Economically Viable and Environmentally Sound Oilseed Production in Dryland of Columbia Plateau (-$378,000)

Library and Information Services

(9) An increase of $937,000 and three staff years for Library and Information Services ($23,791,000 and 103 staff years available in 2015).

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 its web site, http://www.nal.usda.gov. NAL was created with the USDA in 1862 and was named a national library in 1962 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 Nation's agricultural heritage, the provider of world class information, and a 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. The Library's vision is "advancing access to global information for agriculture."

Continuing Library and Information Services base funding is essential for NAL to carry out its mission and responsibilities. Base funding supports ARS' goal of ensuring the provision and access of agricultural information for USDA, the Nation, and the global agricultural community. This includes: delivering unified, easy to use, convenient 24/7 digital services; improving information delivery; extending AGRICultural OnLine Access (AGRICOLA); conserving rare and at-risk items; extending partnerships with USDA and other Federal agencies to develop targeted information services; and marketing NAL services to specific audiences. In addition to the activities and functions specifically described in the budget request, current year and budget year base funds will be used to carry out activities and functions consistent with the full range of authorities and activities delegated to the agency.

The funding change is requested for the following items:

a) An increase of $137,000 for pay costs ($28,000 for annualization of the 2015 pay increase and $109,000 for the 2016 pay increase).

Funding for pay costs is critical for retaining top level staff, and carrying out ARS' mission. Absorption of these costs reduces the number of staff personnel essential for conducting the agency's research programs. If pay costs are not fully funded, ARS will have to reduce spending for much needed equipment, books/periodicals, supplies, and other materials.

b) An increase of $800,000 for Big Data, Earth Sciences, and Earth Observation.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Environmental Stewardship, and Library and Information Services. A full description of the initiative is presented on page 18-44.

Repair and Maintenance

(10) An increase of $20,000,000 for the Repair and Maintenance of ARS' Laboratories/Facilities ($20,144,000 available in 2015).

Many of the agency's laboratories/facilities were built in the 1950s and 1960s and are now more than 50 years old. The backlog of ARS' repair and maintenance (R&M) needs exceeds $250 million and continues to grow. The annual R&M funds ARS has received has typically been about $18 to $20 million which has been inadequate to maintain the agency's laboratories/facilities or prevent the growth of deferred maintenance. Industry standards suggest an annual investment of two to four percent of a facilities' plant replacement value (ARS' is $3.7 billion) for sustainability.

The agency's R&M funding is distributed on a priority basis across ARS' entire facility inventory. A portion of the R&M funds ($2 to $3 million) is used annually 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, and physical security upgrades. Most projects, however, are funded in the $50,000 to $500,000 range to address specific equipment or system failures.

The proposed additional $20 million will be used to address specific R&M needs, such as the maintenance, repair, or replacement of: HVAC/electrical/plumbing; the roof; the building envelope; the site utility system; the fire protection system; other safety systems; etc. Many of these systems/items have reached the end of their service life and no longer meet compliance or safety requirements.

In addition to the activities and functions specifically described in the budget request, current year and budget year base funds will be used to carry out activities and functions consistent with the full range of authorities and activities delegated to the agency.

Proposed Laboratory Closures and Consolidations

(11)

Proposed Closure/Consolidation	Laboratory/Location To Which Redirected	Research
U.S. Sheep Experiment Station, Dubois, Idaho (sheep genetics research)	Northwest Irrigation and Soils Research Lab., Kimberly, Idaho	Sugarbeet research
	Small Grains and Potato Germplasm Research Lab., Aberdeen, Idaho	Maintain germplasm resources/enhance commercially important germplasm
	Watershed Management Research Lab., Boise, Idaho	Watershed research

Note: With the closure/consolidation of Dubois, $2,379,000 will be redirected to Kimberly, Aberdeen, and Boise. This represents a reduction of $1,668,000 from Livestock Production research and $711,000 from Environmental Stewardship research currently conducted at Dubois. As a result of the proposed consolidation, Environmental Stewardship research at Boise would increase by $770,000 (a net increase of $59,000 in Environmental Stewardship research overall), and Crop Production research would increase by $1,609,000 at the Aberdeen and Kimberly locations.

PRIORITY INITIATIVES

Translational Crop and Livestock Genetics for Accelerating Advances in Food Production

ARS requests an increase of $11,100,000 for this crosscutting, multidisciplinary initiative that integrates field biology, genetics and genomics, engineering, and computer sciences research from multiple program areas to transform the way crop and animal research and breeding are conducted in the public sector. The automated collection of morphological, physiological, developmental and agronomic data with advanced data processing, sharing, and data mining and modeling will revolutionize the genetic improvement of crops and animals through breeding. Funding increases for this initiative are located under the Livestock Production, Crop Production, and Environmental Stewardship sections of this document.

Need for Change

Current priorities for U.S. crop genetic and genomic research are to enhance domestic production, farmer profitability, and food security. However, excessive genetic uniformity in some crops must be addressed to prevent genetic vulnerability to rapidly changing environmental conditions, emerging diseases and pests, and evolving market demands. To address those challenges, genetics and genomics must transform the capacity of plant breeding to improve the production efficiency, yield, sustainability, resilience, health, product quality, and value of the Nation's crops.

Development of farm animals, including fish, with improved traits relating to health and production efficiency at an accelerated pace using genomics-enabled breeding is transformational. Understanding the genetic basis of complex traits such as growth, behavior, and animal health requires the definition and measurement of key phenotypes in high throughput and highly reproducible systems. Understanding the effect of gut microbiota on feed utilization, animal health, and disease resistance will be key to enhancing animal production.

New systems for automated trait analysis will enable an unprecedented multidisciplinary analysis of U.S. crop and animal germplasm and genetic resources – genetic, physiological and biochemical ─ that will enable breeders to unlock the full potential of our germplasm through new innovations in the application of genomic technologies. Development of bioinformatics expertise and methodology to evaluate complex data will be critical for identifying genetic variation needed for crop and animal improvement. It also leverages recent advances in low cost, high resolution, next generation DNA sequencing.

ARS will establish the Transformational Breeding Initiative (TBI) in support of the recommendations of the President's Council of Advisors on Science and Technology (PCAST) on Agricultural Preparedness, the goals of the Interagency Working Group on Plant Genomics, and the National Plant Genome Initiative. The TBI initiative enables innovation in strategic areas of science and technology for agriculture: new automated systems for high throughput crop and animal trait analyses in the field; genomic and genetic analyses of genetic stocks and germplasm; and bioinformatics and cyber infrastructure.

Means to Achieve Change

- Develop automated high throughput field-based trait analysis systems for data production, data analysis, and data sharing for genomics enabled trait analysis and crop and animal improvement because yield, resilience to weather and disease, and resource use efficiency are complex processes to assess and to engineer ($5,000,000). ARS will provide:
  - A new generation of proximal and remote sensing and imaging platforms, ground and aerial systems; and autonomous high throughput robots for field-based crop and animal analyses that utilize existing sensors and imaging technologies.
  - Automated trait analysis workflows and software for high throughput trait analysis to increase the accuracy, precision and throughput of trait analyses while reducing costs and minimizing labor.
  - Open data sharing and high performance cloud-based cyber infrastructure that enables researchers to share high throughput trait analysis data and models from the individual to ecosystem levels.

  - Integrated high throughput trait analysis across diverse environments and locations with whole genome level sequence analyses, genetic analyses, and advanced modeling for accelerated breeding (e.g., genomic selection).
  - Data harmonization strategies for expanding the scope and enhancing the efficiency with which multidisciplinary data can be applied to research on agricultural systems and modeling.
  - New open data system for trait data management, data sharing, data analytics, and model development for target traits and evaluation including cloud computing.

- Analyze genetic stocks and specialized populations using advanced genomics and genetic technologies to elucidate the genetic control (i.e., number of genes, gene action, and genomic map location) for traits key for accelerated genetic improvement of target crops ($3,000,000).
  - Draw from reference genome sequences and germplasm genotyping data; develop large panels of single nucleotide polymorphisms (SNPs) as powerful, reproducible, easy-to-implement, and relatively inexpensive genetic markers for specialty and "orphan" crops as well as the major commodities.
  - Analyze the inheritance patterns of many new genetic markers and key crop traits to determine the number and genomic location for genes and gene combinations that govern those traits.
  - Develop novel breeding approaches, based on haplotype (arrays of linked genes) selection, that exploit well characterized breeding stocks and knowledge of gene action to accelerate the rate of genetic gain via more effective recombination that yields optimal genotypes.
  - Enlist advanced bioinformatic approaches and database management capacities to construct powerful, stable, and rapidly responding open access genetic and genomic databases and associated web-based analytical tools.

- Intensify animal and fish production by accelerating productivity gains per animal utilizing high throughput trait analyses and advanced genomics enabled breeding strategies ($3,100,000).
  - Develop instruments for performing high throughput trait analyses on animals such as measures of activity, disposition, and energy partitioning.
  - Define and measure traits to determine the genetic basis of adaptation to temperature and water challenges.
  - Increase the rate of genetic improvement for economically valuable traits relating to health, production efficiencies, and animal adaptability by integrating high throughput trait analyses, genomics, and breeding.
  - Accelerate bioinformatic tool development for trait analysis and genomics enabled breeding by providing training and investing in people.
  - Analyze the animal microbiome and its relationship to health, feed utilization, and growth.

Outcomes

The proposed research will generate innovative new technology platforms, and genetic and genomic resources for transforming the speed and effectiveness of crop and animal breeding. Specifically, the research will result in:

  - A new consortium of research and technology development communities – engineering, plant biology, computer science – working collaboratively to decode how variations in DNA sequence information determines crop performance in the field across diverse production environments and management practices, i.e., traits = genotype x environment x management.
  - Fully automated, high throughout, trait analysis.
  - Open access catalog of DNA sequence variation for U.S. crop and animal germplasm, an understanding of how that variation determines gene functions, and the breeding value of genes, and ultimately traits.
  - New, well characterized genetic stocks and populations needed for fundamental genetics/genomics research.
  - New and more powerful genetic and physical maps.
  - New cost effective and easy to implement genetic marker systems.
  - Enhanced knowledge of the genetic control and bases for key traits.
  - Genetic/genomic information systems for maintaining, delivering, and analyzing genetic/genomics.
  - Novel breeding approaches that fully exploit genetics/genomic information.

Partners and collaborators for transformational breeding include the ARS, NIFA, NSF, DOE, USAID, National Association of Plant Breeders, National Sclerotinia Initiative, Floral and Nursery Research Initiative, U.S. Wheat

and Barley Scab Initiative, U.S. Rosaceae Genetics, National Grape and Wine Initiative, Wheat Genomics and Breeding Executive Committee, National Wheat Improvement Committee, Corn Breeding Research Group, Consortium of International Agricultural Research Centers (CGIAR), National Association of Animal Breeders, Poultry Breeders Roundtable, National Institute for Animal Agriculture, American Society of Animal Sciences, American Dairy Science Association, American Poultry Science Association, National Swine Improvement Federation, Beef Improvement Federation, World Aquaculture Society, and Catfish Farmers of America.

The proposed initiative directly addresses many of the Department's Strategic Plan Goals as well as REE's Action Plan Goals, particularly REE Subgoal 1C: "Crop and Animal Genetics, Genomics, Genetic Resources, and Biotechnology."

Climate Change Resilient Crops

ARS requests an increase of $11,000,000 for this crosscutting, multidisciplinary initiative that will integrate research conducted in multiple agency program areas to achieve the expected outcomes. Funding increases for this initiative are located under the Environmental Stewardship, Crop Production, Crop Protection, and New Products/Product Quality/Value Added sections of this document.

Need for Change

Climate change poses a major challenge to U.S. agriculture because of the exposure and sensitivity of agricultural systems to changing climate conditions. As the effects of global climate change intensify, it becomes more challenging to increase and stabilize crop yields and nutritional quality. With the impending impacts of climate change, integration of genetic approaches with crop management practices is a necessary, and most often ignored step in agriculture to effectively exploit crop genetic diversity. We already know how to select high yielding, stress tolerant plants with improved nutritional traits, but to realize those improvements sustainably, concerted efforts are needed to address the potential losses due to changing climatic conditions that can rapidly offset the genetic advancements. Research is lacking to elucidate the underlying physiological and physical elements of exposure to changing climate, outcomes of prolonged exposure to climate extremes, and the sensitivity of these elements to exposure. Such research is essential to derive efficient strategies necessary to limit climate change impacts on the Nation's agriculture.

Management practices such as tillage, crop rotations, nutrient management, and irrigation can enhance crop and livestock resilience to climate change. However, management practices must be derived that maximize any genetic improvements. A balance of genetics research for greater potential yields, with research to identify management practices that enable farmers to realize genetic potential is thus warranted.

In addition to strategies which effectively utilize crop genetic potential and optimize management, additional information on pest pressures in the context of climate change is needed. For example, insects can have very hard and fast genetically programmed based on environmental cues responses while some species (including most pests) have very plastic responses leading to situations where the entire population does not respond uniformly. The genetic plasticity makes them very adaptable. They can spread to new areas or new crops and withstand unusual weather years. Research is needed to better understand the interactions between pest genetics (including epigenetics) and adaptability to climate change. Such insights will enable a more realistic projection of the indirect/biotic effects of climate change on crop yields by crop yield modeling efforts, such as the AGricultural Modeling Intercomparison and improvement Project (AgMIP).

Means to Achieve Change

- Determine the suitability of the current degree of genetic variation of crops to maintain yields and nutritional quality under a changing climate ($3,500,000).
  - Identify gene associated responses driven by the effects of climate change.
  - Develop the basis for novel selection systems to capitalize on genes that enable resilience or adaptation (such as yield responses to drought, heat, CO_2, and ozone).

- Identify and evaluate those management practices that maximize the genetic potential to achieve optimal yield and quality with climate change ($3,500,000).
  - Identify response-based options for crop variety management strategy combinations that synergistically boost agricultural resilience to climate change.

- Advance process level understanding of the effects of climate change on pests and beneficial insects ($3,000,000).
  - Determine climate change exposure and sensitivity of insect populations leading to overwintering dormancy (diapause), the number of generations per year (voltinism), and migration/dispersal.
  - Develop functions expressing the response of insects to climate change effects.
  - Determine the sensitivity of agricultural production to pest pressures exacerbated by climate change.

- Develop models and indices that will enable predictive understanding of the responses of crop variety by management practice combinations to the effects of climate change ($1,000,000).
  - Quantify the interactions of management practices with crop genetic potential.

Outcomes

The proposed research will strengthen the science of how agricultural systems are impacted by and respond to climate change. Specifically, as a result of this research:

- The physiological mechanisms that are the basis for crop responses to climate change will be identified.
- Tools will be developed to enable the design of plants with targeted management strategies that better position agriculture to adapt to environmental changes.
- Plant breeders will be able to evaluate physiological responses to changing climate and evaluate climate resilient management options.
- Dialogue will be enhanced between agricultural production scientists, breeders, and modelers leading to a more interdisciplinary approach to agricultural climate change science.
- Improvements will be made in the precision of predictions of the effects of climate change on agricultural systems leading to more reliable projections of future crop yield by crop modeling efforts, such as AgMIP.
- A greater understanding of responses of agricultural systems to climate change will be achieved which will strengthen analyses, conclusions, and decisions based on earth observations data by efforts, such as the Group on Earth Observations GLobal Agricultural Monitoring (GEOGLAM) project.
- Progress will be made towards closing the gap between yields achieved by farmers and potential yields offered by genetic research.
- The physiological and physical science foundations needed for agricultural sustainability will be strengthened.

The proposed initiative directly addresses many of the Department's Strategic Plan Goals as well as REE's Action Plan Goals, particularly REE Subgoal 2A: "Responding to Climate Variability."

Combating Antibiotic Resistant Bacteria

ARS requests an increase of $10,000,000 for this crosscutting, multidisciplinary initiative that will integrate research conducted in multiple agency program areas to achieve the expected outcomes. Funding increases for this initiative are located under the Food Safety, Livestock Protection, and Livestock Production sections of this document.

Need for Change

Research addressing the development of antibiotic-resistant bacteria is essential for human and animal health, and preserving the use of antibiotics. Research is needed to develop alternatives to antibiotics, understand the development of resistance to antibiotics, and the fate of antibiotic-resistant bacteria in the animal, the environment,

and in food. Research is also needed to understand the impact of different farm management practices on the development of resistant bacteria.

Developing novel alternatives to antibiotics will be challenging since most alternatives are not expected to have broad-based efficacy like antibiotics but will reduce drug use and are less likely to cause resistance. Research addressing microbial ecology to better understand the relationships between microbes and livestock, the environment, and human health are needed to improve agricultural productivity and the safety of food. The proposed research will complement the "Antimicrobial Resistance" initiative. Specifically, it will address gaps in our knowledge about the development of resistance microbes, and the fate of resistant microbes in the environment, enabling the development of a microbial database that will in turn address the 'Big Data' needs that facilitate analysis across research projects to better utilize research information.

The proposed research, which responds to the President's Executive Order 13676 (September 2014), on combating antibiotic resistant bacteria, builds upon the agency's strong food safety and animal health research programs to reduce the development of antibiotic resistant bacteria and reduce the use of antibiotics in animal production.

Means to Achieve Change

- Protect public health by preventing antimicrobial resistance ($10,000,000).
  - Develop alternatives to antibiotics including improved management and husbandry practices; antimicrobial peptides; prebiotics; bacteriophage; modulators of innate and adaptive immunity; and immune modulators, including vaccines. Novel antibiotics and alternative strategies will be deployed to prevent and treat infectious diseases in food animals to safeguard current antibiotics and reduce potential antimicrobial resistance.
  - Develop a microbial database for production animals which will provide a comprehensive source for microbial and resistant element sequence data. This will be available to the entire food safety and research communities to allow the addition and use of the data to better understand antibiotic resistance.
  - Develop mitigation strategies to reduce the development of antibiotic-resistant bacteria in the environment.
  - Develop vaccines and strategies to significantly decrease the levels of important foodborne pathogens, such as salmonella and campylobacter, in both the farm environment and the host animal. By reducing their numbers, it will decrease the risk of the transfer of bacteria and antibiotic resistance to pathogens of concern to human health.
  - Develop effective vaccines for bacterial respiratory diseases in animals since antibiotics are most commonly used to treat respiratory disease, thereby reducing the use of antibiotics.
  - Develop strategies to identify the genetics of the host species that lead to reduced susceptibility to pathogens, to reduce the need for antibiotics.

Outcomes

This research will lead to a better understanding on how bacteria become resistant to antibiotics, and the persistence of resistant bacteria in food, animals, and the environment. The research will also lead to alternative methods and products that enable the production of food with fewer antibiotics resulting in the production of healthier, higher quality food while preserving the efficacy of antibiotics.

Reducing Vulnerability to Climate Change

ARS requests an increase of $8,000,000 for this crosscutting, multidisciplinary initiative that will integrate research conducted in multiple agency program areas to achieve the expected outcomes. Funding increases for this initiative are located under the Environmental Stewardship, Crop Production, Crop Protection, Livestock Protection, and Livestock Production sections of this document.

Need for Change

Historical successes of agricultural production have been possible because of the relative stability of air temperature, water availability, and healthy soils during much of the 20th century. Hence, climatic change including direct environmental changes and increased variability of temperature, rainfall, and extreme weather, as well as concurrent changes in biological pressures, poses unprecedented risks to the production of sufficient food, fiber, and fuel to support the economic and nutritional needs of the U.S. and global populations.

Two aspects of risk and vulnerability to climate change are water availability (e.g., flooding and drought) and the impact of invasive species (i.e., introduced non-native species capable of significant economic and/or environmental damage, such as kudzu, and wooly adelgid). Water availability is one of the factors that is most strongly linked to climate change, with the potential to affect seasonal and annual precipitation rates, the form in which precipitation is delivered (i.e., rain vs. snow), the intensity of individual precipitation events (thereby affecting soil erosion), and the subsequent pressures that may be placed on key groundwater resources (e.g., the Ogallala aquifer). The role of invasive species in the disruption of agricultural systems from range lands to crops is widely acknowledged. Additionally, it is clear that climate change and CO_2 will also enhance the competitive abilities and distribution of invasive species.

To preserve and expand agricultural production in the coming decades it will be necessary to develop and validate research that can assess the vulnerability and increase the resilience of cropping and livestock systems to climate change impacts; and to implement such research to develop decision support systems that allow sustainable intensification of agricultural production while maintaining natural resource stewardship.

Means to Achieve Change

- Conduct synthesis and evaluation of historical datasets, including LTAR data to model long-term weather (e.g., temperature and drought) in the context of production impacts for cropping and livestock systems ($2,000,000).
  - Establish the environmental parameters associated with maximum sustained productivity as a function of soil type for rain-fed and irrigated cropping systems.
  - Model production and past climates through “hind-casting” to assess the vulnerability of cropping and livestock systems to projected climate change including the occurrence of extreme events and sea level rise.
  - Determine the relative degree of production sensitivity among different animal and cropping systems to projected changes of climate.

- Utilize existing expertise on invasive species biology to link ongoing university, Federal, and private industry efforts to control and manage their impact on agronomic systems ($2,000,000).
  - Link ARS and APHIS databases with university data (e.g., EDDSMaps) to establish climate boundaries for invasive species (e.g., kudzu).
  - Use modeling to project the distribution and potential vulnerability of different crop and livestock systems to new invasive species with climate change.

- Develop the means to reduce vulnerability to water supply for major cropping systems ($2,000,000).
  - Develop new or enhance existing knowledge and associated technologies for sustainable use of groundwater resources to support plant and animal production.
  - Predict short and long-term changes in water availability across key agricultural regions in the U.S.
  - Develop means to utilize non-traditional water sources to support plant and animal production.

- Utilize USDA’s Climate Hubs to synthesize and disseminate climate change research results to improve decision support systems on a regional and system level ($2,000,000)
  - Identify those on-farm recommendations (such as tillage, rotations, and planting dates) associated with reduced vulnerability to extreme climatic events.
  - Implement time sensitive recommendations that can be distributed through the USDA regional climate hubs to maintain and sustain production values, and reduce vulnerability to physical and biological impacts associated with climatic change.

- Develop technology for creating maps of the exposure and sensitivity of regional agriculture to climate change using remote sensing and models that serve as a basis for risk analysis.

Outcomes

As a result of this research:

- The vulnerability of different agronomic systems to production losses associated with climate change will be determined. This knowledge will help to determine best use of limited resources and help prioritize research needs.
- Agro-ecosystems most vulnerable to climate induced shifts in invasive species will be identified. Such information will be invaluable in preventing or mitigating the impact and spread of invasives.
- Agricultural vulnerability will be reduced to achieve yield quantity and quality goals, environmental goals, economic viability, and quality of life for rural populations and society as a whole.
- Water management strategies will be developed to reduce unsustainable use of key groundwater resources (e.g., Ogalalla aquifer). Access to non-traditional water sources and tractable water reuse strategies will help maintain or enhance production while reducing agriculture's "water footprint" in terms of freshwater use.
- Technologies will be available to inform producers and strategic decision makers as to climate vulnerability and risk as a function of production system and region.
- Data and decision support systems will be provided to the USDA Climate Hub network. These tools will help provide the guidance needed for resilient production systems.

In performing the proposed research, ARS will collaborate and/or partner with other Federal agencies including USGS, NOAA, APHIS, and NASS; universities; and the private sector.

The proposed initiative directly addresses many of the Department's Strategic Plan Goals as well as REE's Action Plan Goals, particularly REE Subgoal 2A: "Responding to Climate Variability."

Sustainable Small Farms

ARS requests an increase of $7,500,000 for this crosscutting, multidisciplinary initiative that will integrate research conducted in multiple agency program areas to achieve the expected outcomes. Funding increases for this initiative are located under the Crop Production, Crop Protection, Livestock Production, Livestock Protection, and Environmental Stewardship sections of this document.

Need for Change

Small scale farming operations today face formidable challenges to attaining sustainable profitability, absent the advantages that larger producers enjoy from economies of scale. Small scale farms must yield high value products, such as specialty crops and farm animals, and function extremely efficiently to survive. Their products and operations are often tailored for local food production to reduce transportation costs, preserve product quality, and shorten the marketing chain between the producer and consumer.

Means to Achieve Change

- Breed crops and farm animals for small scale farming operations ($3,000,000).
  - Breed enhanced specialty crops (e.g., vegetables, fruits, and nuts) for small scale farms using untapped genetic diversity in USDA's/ARS' crop genebanks.
  - Apply traditional and genomic approaches to accelerate farm animal improvement for meat, milk, and eggs.

- Expand and enhance the National Plant Germplasm System ($1,000,000).
  - Expand genebank collections to meet the needs of specialty crop breeders (i.e., fruits, vegetables, and nuts); maintain new germplasm; evaluate for market quality; and safeguard using new cryopreservation techniques.

  - Acquire and conserve U.S. native crop wild relatives to add genetic diversity to USDA's/ARS' genebanks to provide new raw materials for developing new crops and varieties for small scale farming operations.

- Develop integrated pest management for conventional and organic small scale farming operations ($3,000,000).
  - Develop biocontrol and integrated management approaches to minimize pest damage at all stages of animal production; and include research on flies and ticks and other arthropods that transmit pathogens.
  - Develop approaches to control insect and mite pests that affect small farms; bees that pollinate their crops; and pest control methods for small farms or beekeeping operations, including organic pest control.
  - Develop weed control strategies for small, diversified farms, especially organic and low herbicide operations.

- Provide training/information to Native Americans for conserving and improving traditional and culturally important crops ($500,000).
  - Develop "technology packages" for Native Americans for conserving and improving traditional crops as a means of preserving tribal identities, enhancing nutrition and health, and employment on tribal lands.

Outcomes

ARS' research will improve the competitiveness and sustainability of local and regional small scale farming operations by: developing new specialty crop varieties and farm animal lines tolerant to environmental extremes, resistant to pests and diseases, with superior nutritional quality that yield high quality, high value end products; providing access to genetically superior, locally adapted crop and farm animal germplasm; and lowering production costs. This research supports the FY 2016 budget initiative, "Transformational Crop and Livestock Genetics for Accelerating Advances in Food Production," by leveraging knowledge gained from research investments in field crops for specialty crops and livestock.

In this proposed research, ARS will partner with other agencies (e.g., NIFA, NSF, DOE, and NOAA), land grant and other universities, Native American tribal groups, industry and commodity groups, and scientific professional societies. Proposed research aligns with Administration priorities including Open Data, Open Science, and Open Government.

Antimicrobial Resistance

ARS requests an increase of $7,000,000 for this crosscutting, multidisciplinary initiative that will integrate research conducted in multiple agency program areas to achieve the expected outcomes. Funding increases for this initiative are located under the Food Safety, Livestock Production, and Livestock Protection sections of this document.

Need for Change

Research addressing key questions about the relationships among microbes and livestock, the environment, and human health will improve agricultural productivity, and the value and safety of the food we eat. Microorganisms are ubiquitous in soil, in and on plants, in food processing systems, and in animals and humans. Interactions among different kinds of microbes and their relationships with animals, the environment, and human hosts affects the development of animal diseases, safety of foods and feeds, and the overall health of humans in ways that are poorly understood.

Means to Achieve Change

ARS' "Antimicrobial Resistance" proposal addresses the Administration's priority of reducing the use of antimicrobials and the development of resistant bacteria in food producing animals, and supports the National Strategy for Combating Antibiotic-Resistant Bacteria, Objective 4.1: *Conduct research to enhance understanding of environmental factors that facilitate the development of antibiotic resistance and the spread of resistance genes that are common to animals and humans.* The proposed research builds upon the agency's strong food safety and animal health research programs to reduce the development of antibiotic resistant bacteria and reduce the use of antibiotics in animal production.

- Protect public health by understanding how antimicrobial resistance occurs in animals and the environment ($7,000,000).
  - Map the genome of the gut microbiome of at least one major food animal species to determine the function and ecology of gut microorganisms and their genes including antibiotic resistance and virulence gene transfer. Understanding the gut microbiome will lead to the development of alternative strategies for control and mitigation of pathogenicity, reduce antibiotic use, and antimicrobial resistance.
  - Determine the incidence of antibiotic resistant pathogens in the environment and their impact on development of antimicrobial resistant bacteria in food production animals.
  - Enhance gut health to improve the immune status and productivity.

Outcomes

ARS' research will result in healthier, better quality food; fewer foodborne illnesses; and reduction in the use of antibiotics in food animals with the development of innovative alternatives resulting in improved human health. In performing the proposed research, ARS will collaborate and/or partner with: other Federal agencies (e.g., CDC and FDA), land grant and other universities, industry, and commodity groups.

Pollinator Health and Colony Collapse Disorder

ARS requests an increase of $7,000,000 for this crosscutting, multidisciplinary initiative that will integrate research conducted in multiple agency programs to achieve the expected outcomes. Funding increases for this initiative are located under the Crop Production and Crop Protection sections of this document.

Need for Change

Bees pollinate more than 90 crops in the United States, where they are responsible for $15 billion in added crop value. According the United Nations, pollinators such as the honey bee provide over $200 billion in agricultural gains globally. However, the economic viability of the honey bee pollination industry in the United States and Europe is currently threatened by Colony Collapse Disorder (CCD) and other mortality factors.

CCD was first reported in October 2006, when beekeepers began reporting significant unexpected losses. Annual losses in the United States, from the winter 2006 though 2013, averaged about 30 percent. The causes of the decline remain uncertain although likely involve a combination of parasitism by the varroa mite, poor nutrition, loss of natural forage, and related stress from the need for long distance transportation of bees for pollination and forage, and pesticide exposure.

The Fish and Wildlife Service currently lists more than 90 species of pollinators as threatened or endangered. Significant die-offs of honey bees and other pollinators have brought scientific, industry, public, and governmental attention to the problem. There is an overarching concern about the impacts that the loss of these pollinators will have on ecosystems across the country.

Responding to this emergency, on June 20, 2014, President Obama issued a Pollinator Health Memorandum, "Creating a Federal Strategy to Promote the Health of Honey Bees and Other Pollinators," that directs Federal agencies to develop a National Pollinator Health Strategy with explicit goals and metrics to measure progress. A Pollinator Health Action Plan was completed in December, 2014, that calls for increased research related to the causes of CCD, controlling bee parasites (particularly varroa) and diseases, improving diets and forage to ensure adequate bee nutrition, and reducing exposure of bees to pesticides.

USDA, in conjunction with the EPA, the Department of the Interior and other relevant Federal partners, is currently scaling up efforts to address the decline of honey bee health with a goal of ensuring the recovery of this critical subset of pollinators. As part of this effort, ARS' 2016 Budget requests additional funding to address best management practices that can reduce colony mortality and prevent CCD.

Means to Achieve Change

- Develop best management practices for beekeepers and growers at Federal agricultural research laboratories in cooperation with university scientists and industry ($7,000,000). ARS will:
  - Institute longitudinal studies along major migratory bee routes, and associated sensor and analytical technologies to identify the key factors causing honey bee loss.
  - Determine the sub-lethal effects of pesticides on the honey bee and other bee pollinators and develop cost effective farm practices to reduce bee exposure to pesticides.
  - Determine the optimal bee forage mixes and cover cropping systems to augment the availability of nectar and high quality pollen, and develop supplemental, pollen-based diets to improve honey bee nutrition and ensure pollinator vitality.
  - Develop the means for managing weeds on the Conservation Reserve Program and other non-agricultural lands that are being developed for bee friendly habitat.
  - Improve the means for controlling the varroa mite and other bee pests and pathogens, including breeding for bee resistance, discovery of better miticides, and development of attractant based and non-chemical treatments and strategies.
  - Determine best practices for building managed bee populations prior to spring pollination services.
  - Exploit knowledge of the honey bee genome to protect bees from pests and pathogens and other stressors, and to improve bee nutrition.

Outcomes

The proposed increase will provide critical knowledge of the causes of bee mortality and lead to solutions that ensure the long-term stability of the Nation's pollinator eco-services.

The proposed initiative directly addresses many of the Department's Strategic Plan Goals as well as REE's Action Plan Goals, particularly REE Subgoal 1A, "Crop and Animal Production," and Subgoal 1B, "Crop and Animal Health."

Vertical Farming

ARS requests an increase of $5,000,000 for this crosscutting, multidisciplinary initiative that will integrate research conducted in multiple agency program areas to achieve the expected outcomes. Funding increases for this initiative are located under the Crop Production, Food Safety, and Crop Protection sections of this document.

Need for Change

As the population grows, urbanization increases, and climate change progresses, the need for self contained, energy efficient, low cost food production that is environmentally sustainable is crucial. Vertical farming in enclosed structures addresses that need, providing an opportunity for highly integrated food production systems in the future. These systems are complex and encompass a broad spectrum of research needs, that include: optimizing crops that are suited to unique urban/enclosed environments and high density plantings; incorporating resistance/tolerance to pests and diseases into plants that are safe for consumption; and developing low input, efficient systems for moving air and water, controlling pests and diseases, preventing contamination of products with microbes that may cause foodborne illnesses, and managing nutrients/wastes.

ARS is uniquely suited to conduct research toward developing vertical farming systems in the United States. Interdisciplinary research efforts at ARS locations focus on meeting the needs of crop production in urban areas and in enclosed structures. Relevant efforts across the spectrum of ARS' research programs include: germplasm enhancement and diversification; pest and pathogen control; soil management and reclamation; low input and organic food production; integrated pollinator management; composting; use of industrial byproducts; food nutrition and safety; natural resources management and systems integration; intensive greenhouse management and decision support software; hydroponics; wastewater treatment; nutrient reclamation; and water reuse. ARS is exploring

partnerships with academic, business, and community interests in major U.S. cities to define their urban agriculture research needs.

High value, highly resilient plants with novel combinations of traits will be developed to meet the challenging aspects of this new production system, involving vertical farming. ARS can develop crops that are bred to deliver optimum plant architecture (roots and shoots) and maximized "harvest index" with minimal waste, strong tolerance to temperature and light extremes, and effective host-plant resistance, and with management strategies for controlling pests and diseases that develop under controlled environments, as well as preventing contamination with pathogens causing human foodborne illnesses.

Means to Achieve Change

- Develop high value horticultural varieties that are adapted for growth in greenhouses and other challenging urban conditions, and that will extend the growing season and meet the needs of local food markets ($2,000,000).
  - Identify and screen for germplasm that is resistant to pests, pathogens, and production related environmental stresses, yet is well suited for greenhouse production systems and local food markets.
  - Develop production methods to prevent contamination of plant products with foodborne human pathogens.
  - Adapt innovative ARS low tunnel technology for use in greenhouse production systems for use in urban vertical farming to extend the growing season, particularly in cold climates.

- Provide new methods and technologies for insect and disease control which are the major challenges for greenhouse production systems ($3,000,000).
  - Improve management methods for insects and disease problems that occur during greenhouse production.
  - Expand and develop predictive modeling of foodborne human pathogens in greenhouse production systems so that pathogen targets can be identified and controlled.

Outcomes

The proposed research will help in providing specially adapted plants, advanced greenhouse technologies, and systems that can supply nutrient dense, high value crop products safe for human consumption in urban settings, as well as providing a diverse range of products that support local economies and promote healthy diets.

Big Data, Earth Sciences, and Earth Observation

ARS requests an increase of $2,523,000 for this crosscutting, multidisciplinary initiative that will integrate research conducted in multiple agency program areas to achieve the expected outcomes. Funding increases for this initiative are located under the Environmental Stewardship, and Library and Information Services sections of this document.

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.

Means to Achieve Change

ARS will develop systems to provide new, more efficient ways for the agricultural research community to unlock the potential of satellite data and, in particular, higher resolution satellite swath data. The agency will leverage the ongoing collaboration between the Federation of Earth Science Information Partners (ESIP) Agriculture and Climate Cluster; the LTAR network; USDA's Regional Climate Hubs; the Climate Change Program Office; and other Federal and non-Federal initiatives.

- Develop a Big Earth and Agriculture Data Hub using a sustainable cyber infrastructure which meets the needs of science and society for open, persistent, robust, and secure access to well described and easily discovered agricultural and earth observation data. Hub architecture is built in a spoke and hub configuration which connects and leverages existing data stores for the use/reuse, distribution, and preservation of high value data ($500,000).
  - Develop a hybrid cloud architecture that integrates IT infrastructure and platform services from USDA, academic research institutions, and commercial vendors.
  - Provide an interface for researchers and their delegates to publish data through a guided process, or for data stewards to import via API/harvesting.
  - Develop protected workspaces for in-progress research data collection, analysis, and sharing activities and integrate with emerging ARS Science Network core computing and storage.

- Develop big data applications and investigator toolsets to enable the collection, transformation, input, organization, management, integration, discovery, analysis, dissemination, and preservation of big earth science and agricultural research datasets ($600,000).
  - Apply metadata standards, conventions, and templates ensuring datasets are adequately described thereby enabling interoperability, search, grouping, ranking, and comprehensive data retrieval to maximize effective dataset reuse.
  - Evaluate, adapt, and develop data standards to enable interoperability and facilitate data integration.
  - Develop a Web-based linked open data database (LOD) to facilitate the linkage of datasets between systems and providers, based upon agro-ecological core ontology and cross referenced 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 National Common Land Unit (NCLU).
  - Preserve all datasets managed in the repository through the uniform application of sound data preservation practices consistent with the principles of a trusted repository.

- Develop an earth and agricultural science literature collection. Connect datasets to USDA funded agriculture and related literature through the PubAg centralized repository. These linkages will add context to the data through in-depth historical knowledge. This effort will leverage and extend NAL's Digital Collections ($300,000).
  - Apply ontologies used in describing the earth observation and environmental datasets to indexing the literature. This will maximize comprehensive and accurate linkage between structured and un-structured data and literature.
  - Utilize USDA-VIVO to link datasets directly to researcher profiles to improve transparency and accountability.
  - Make functional linkages between datasets, and between datasets and the literature.
  - Implement standards-based spatial metadata to perform location-based search and content management by place.

- Collaborate and join networks that have shared research strategies, including the LTAR network; EcoInforma; the Long-Term Ecological Research network (LTER), the National Ecological Observatory Network (NEON), Data Observation Network for Earth (DataONE); and others ($500,000).

  - Coordinate infrastructure development for interoperability with NEON, and DataOne for ecological and environmental datasets. Facilitate integration with the LTAR network data.
  - Coordinate data description (metadata) between NEON, DataOne, Project OpenData, LTAR, and other data networks. When needed, semantic and other technologies will be developed and used to bridge differences between applied metadata.
  - Build cross network search tools to facilitate data discovery, and reuse in studies spanning temporal and geographic scales and domains.

- Build a linked and distributed collection capacity with field data collected using the LTAR network to facilitate scaling up of data and analysis results to broader landscape and regional levels. ARS will coordinate with stakeholders while conducting the following activities ($623,000).
  - 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 historic data from the LTAR sites to enable assessments of long term trends of production, environmental quality, and the effects of climate change.
  - Enable the USDA and external stakeholder practitioner community to create and share reusable data layers in the form of Web map services and feature services leveraging a common GIS platform and portal.

Outcomes

Implementation of a Department wide framework for the management of earth observation and related data will ensure compliance in meeting open government mandates. Using a flexible framework which supports interoperability for distributed data archives over a number of institutions provides the technical and cultural environment to optimally leverage and enhance existing systems. Data will be linked directly with associated research publications and descriptive metadata to provide context for its appropriate reuse. One such application is found in modeling systems. These systems can provide scientists and policy-makers with predictive information regarding the spread of deadly human diseases, devastating crop infestations, or drought conditions, and the opportunity to avert emerging crises in our food, agriculture, and human health systems. Modeling systems are dependent upon access to reliable data, data which is interoperable – all of which is best supported through the establishment of a Department wide framework to guarantee coordination of data collection, description, preservation, and access. Long-term data series are particularly sensitive to loss. Recent research finds a 17 percent loss of data every year subsequent to the publication of findings. These findings show data preservation is best achieved in a well coordinated inter-institutional distributed system.

Developing a Big Earth and Agriculture Data Hub will efficiently, cost effectively provide the means to rapidly mature interoperability capabilities; 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. Data discovery will be enhanced through the implementation of intelligent search technologies to maximize data discovery and reuse by researchers; the general public; entrepreneurs; and Federal, State, local, and tribal government decision-makers. A semantic enabled approach supports 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 improve data distribution channels (e.g., mobile and geospatial mapping), accelerating the realization of Digital Strategy objectives. 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.”

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

	2013 Actual		2014 Actual		2015 Enacted		2016 Estimate	
Location	Amount	SY	Amount	SY	Amount	SY	Amount	SY
ALABAMA, Auburn	$5,506	43	$6,104	42	$5,542	46	$5,992	48
ARIZONA								
Maricopa	8,684	67	9,593	65	9,825	74	10,680	78
Tucson	5,492	49	6,264	47	6,320	49	6,791	51
Total	14,176	116	15,857	112	16,145	123	17,470	129
ARKANSAS								
Booneville	1,855	14	3,736	15	3,929	19	4,199	21
Fayetteville	1,553	11	1,928	12	1,862	12	1,067	9
Jonesboro	- -	- -	884	- -	1,424	2	1,784	4
Little Rock	6,929	2	7,770	2	7,759	- -	7,759	- -
Stuttgart	6,899	58	7,547	63	7,888	63	8,518	67
Total	17,236	85	21,865	92	22,862	96	23,327	101
CALIFORNIA								
Albany	33,203	218	38,621	217	38,062	231	37,281	229
Davis	11,402	90	12,133	86	11,523	93	12,118	96
Parlier	10,809	105	10,943	97	11,319	107	11,319	107
Riverside	4,969	36	5,151	36	5,234	36	5,594	38
Salinas	4,997	45	5,075	43	5,877	47	5,710	47
Total	65,380	494	71,923	479	72,017	514	72,023	517
COLORADO								
Akron	1,827	20	1,915	20	1,981	20	1,935	20
Fort Collins	13,108	117	14,258	111	14,915	121	14,127	118
Total	14,935	137	16,173	131	16,896	141	16,062	138
DELAWARE								
Newark	1,981	15	2,767	15	2,000	16	2,000	16
DISTRICT OF COLUMBIA								
National Arboretum	9,695	74	12,146	71	11,663	71	11,663	71
Headquarters Federal Administration	90,369	527	97,551	519	86,222	566	89,211	578
Total	100,064	601	109,697	590	97,885	637	100,874	649
FLORIDA								
Canal Point	2,649	35	2,839	31	2,936	35	2,936	35
Fort Lauderdale	2,287	26	2,565	27	2,446	27	2,446	27
Fort Pierce	13,613	147	13,841	131	13,373	147	13,373	147
Gainesville	11,069	112	12,140	106	11,977	114	13,057	119
Miami	4,417	34	5,447	31	4,578	34	4,578	35
Total	34,035	354	36,832	326	35,308	357	36,388	363
GEORGIA								
Athens	22,187	159	24,497	148	22,510	186	20,897	179
Byron	3,218	33	3,555	28	3,559	33	3,559	33
Dawson	3,555	31	3,698	32	3,760	32	3,760	32
Griffin	2,248	20	2,568	19	2,410	20	2,410	20
Tifton	9,283	86	10,385	86	10,267	89	11,617	95
Total	40,491	329	44,703	313	42,505	360	42,243	359
HAWAII, Hilo	9,606	59	9,490	57	9,360	59	9,990	62

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

	2013 Actual		2014 Actual		2015 Enacted		2016 Estimate	
Location	Amount	SY	Amount	SY	Amount	SY	Amount	SY
IDAHO								
Aberdeen	6,110	47	6,467	46	6,094	47	7,501	51
Boise	2,052	18	2,110	18	1,978	18	3,750	24
Dubois	2,140	19	1,791	16	2,141	16	- -	- -
Kimberly	3,384	34	4,246	35	4,270	36	5,166	37
Total	13,686	118	14,614	115	14,483	117	16,418	112
ILLINOIS								
Peoria	30,789	206	31,497	207	32,471	211	32,506	211
Urbana	5,293	36	5,771	41	5,562	41	6,012	43
Total	36,082	242	37,268	248	38,033	252	38,518	254
INDIANA, W. Lafayette	7,054	62	7,252	60	7,537	63	8,437	67
IOWA, Ames	47,196	395	52,652	388	53,970	420	57,267	432
KANSAS, Manhattan	12,779	103	13,585	101	13,496	110	14,261	113
KENTUCKY								
Bowling Green	2,455	15	2,554	13	2,621	15	2,621	15
Lexington	2,368	14	2,591	13	2,705	14	2,705	14
Total	4,823	29	5,145	26	5,326	29	5,326	29
LOUISIANA								
Baton Rouge	2,923	24	3,013	25	2,987	25	3,257	26
Houma	4,105	49	4,421	46	4,025	49	4,025	49
New Orleans	20,473	151	20,856	143	20,781	152	20,781	152
Total	27,501	224	28,290	214	27,793	226	28,063	227
MAINE, Orono	2,255	15	2,579	14	2,260	14	1,782	12
MARYLAND								
Beltsville	107,806	690	115,264	692	118,338	766	119,817	772
National Ag Library	20,818	72	22,844	95	23,197	95	23,917	98
Frederick	5,797	38	5,878	35	6,096	43	6,096	43
Total	134,421	800	143,986	822	147,631	904	149,830	913
MASSACHUSETTS, Boston	15,126	9	16,662	8	14,993	9	14,826	9
MICHIGAN, East Lansing	4,291	34	4,945	32	5,007	34	6,357	39
MINNESOTA								
Morris	2,537	26	2,655	27	2,530	27	2,530	27
St. Paul	6,473	58	6,927	51	6,677	60	6,677	60
Total	9,010	84	9,582	78	9,207	87	9,207	87
MISSISSIPPI								
Mississippi State	8,534	69	9,305	71	9,252	74	5,614	61
Oxford	12,777	86	14,564	86	14,005	91	13,370	88
Poplarville	5,111	35	5,716	33	5,497	35	6,397	39
Stoneville	34,361	266	37,747	251	38,851	279	35,910	267
Total	60,783	456	67,332	441	67,605	479	61,291	455
MISSOURI, Columbia	8,307	70	9,226	69	9,417	70	10,125	73
MONTANA								
Miles City	3,193	24	3,677	21	3,755	26	4,070	27
Sidney	4,641	40	4,731	41	4,821	43	5,171	44
Total	7,834	64	8,408	62	8,576	69	9,241	71

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

	2013 Actual		2014 Actual		2015 Enacted		2016 Estimate	
Location	Amount	SY	Amount	SY	Amount	SY	Amount	SY
NEBRASKA								
Clay Center	19,377	116	23,648	118	22,752	120	26,937	140
Lincoln	5,597	64	5,768	58	5,612	67	8,087	77
Total	24,974	180	29,416	176	28,363	187	35,023	217
NEVADA								
Reno	2,178	16	2,347	15	2,274	16	2,274	16
NEW MEXICO								
Las Cruces	5,672	46	6,867	47	6,894	51	6,894	51
NEW YORK								
Geneva	3,697	31	4,306	34	3,894	34	4,344	36
Greenport	3,541	29	4,031	29	4,130	31	4,130	31
Ithaca	10,269	56	11,854	53	11,480	59	11,571	59
Total	17,507	116	20,191	116	19,504	124	20,045	126
NORTH CAROLINA								
Raleigh	8,985	77	9,443	70	9,377	78	11,942	88
NORTH DAKOTA								
Fargo	13,932	113	15,178	107	15,624	121	15,465	121
Grand Forks	8,710	45	8,950	42	9,273	48	9,273	48
Mandan	3,344	33	4,018	32	4,166	37	4,436	38
Total	25,986	191	28,146	181	29,064	206	29,175	207
OHIO								
Columbus	1,323	14	1,487	15	1,454	15	2,354	19
Wooster	5,652	45	5,680	44	4,836	45	5,736	49
Total	6,975	59	7,167	59	6,290	60	8,090	68
OKLAHOMA								
El Reno	5,204	40	6,626	41	6,726	41	6,816	41
Stillwater	3,301	28	3,965	29	3,649	29	3,649	29
Woodward	2,343	15	2,178	15	2,219	15	2,219	15
Total	10,848	83	12,769	85	12,593	85	12,683	85
OREGON								
Burns	2,456	23	2,642	23	2,607	23	2,607	23
Corvallis	12,081	103	12,812	99	11,823	105	11,471	105
Pendleton	1,844	19	1,947	19	1,900	19	999	15
Total	16,381	145	17,401	141	16,330	147	15,077	143
PENNSYLVANIA								
University Park	4,017	38	5,464	39	5,857	40	5,857	40
Wyndmoor	30,268	188	32,987	184	31,525	197	31,840	198
Total	34,285	226	38,451	223	37,382	237	37,697	238
SOUTH CAROLINA								
Charleston	4,434	39	4,576	38	4,589	42	5,444	46
Florence	3,868	31	4,855	27	3,919	31	4,279	33
Total	8,302	70	9,431	65	8,508	73	9,723	79
SOUTH DAKOTA								
Brookings	2,853	30	2,956	34	2,824	34	4,084	39

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

Location	2013 Actual		2014 Actual		2015 Enacted		2016 Estimate	
	Amount	SY	Amount	SY	Amount	SY	Amount	SY
TEXAS								
Bushland	5,974	43	6,429	39	6,847	43	6,847	43
College Station	13,854	110	14,754	106	13,125	115	14,506	121
Houston	13,813	7	15,774	7	13,524	7	13,524	7
Kerrville	5,529	51	6,213	41	6,218	53	6,668	55
Lubbock	8,721	93	8,884	88	8,432	93	9,530	98
Temple	3,202	30	3,352	29	3,400	31	4,390	35
Weslaco	825	- -	-	- -	- -	- -	- -	- -
Total	51,918	334	55,406	310	51,546	342	55,464	359
UTAH, Logan	8,444	76	9,454	75	9,271	81	9,991	84
WASHINGTON								
Prosser	3,760	28	3,775	25	- -	- -	- -	- -
Pullman	15,461	112	17,973	105	19,452	134	19,472	136
Wapato	4,436	49	4,625	50	5,885	57	5,885	57
Wenatchee	2,055	21	2,745	20	2,035	22	2,035	22
Total	25,712	210	29,118	200	27,373	213	27,392	215
WEST VIRGINIA								
Kearneysville	7,048	61	7,716	61	7,082	64	7,982	68
Leetown	6,786	33	7,829	35	7,589	35	7,618	35
Total	13,834	94	15,545	96	14,671	99	15,600	103
WISCONSIN, Madison	14,711	110	17,401	104	17,683	123	16,770	119
WYOMING, Cheyenne	1,918	22	3,116	23	3,462	23	3,462	24
PUERTO RICO								
Mayaguez	2,895	33	3,198	37	3,159	37	3,159	37
OTHER COUNTRIES								
France, Montpellier	3,174	2	3,673	1	3,201	2	3,201	2
Extramural and Funds Administered from Headquarters-Held Funds	14,472	- -	23,274	- -	68,548	- -	66,333	- -
Repair & Maintenance of Facilities	17,762	- -	20,104	- -	20,144	- -	40,144	- -
Obligations	1,014,345	7,058	1,121,811	6,893	1,144,315	7,450	1,191,540	7,575
Lapsing Balances	2,739	- -	2,386	- -	- -	- -	- -	- -
Bal. Available, EOY	9,632	- -	11,690	- -	- -	- -	- -	- -
Total Available	1,026,716	7,058	1,135,887	6,893	1,144,315	7,450	1,191,540	7,575

Salaries and Expenses

Classification by Objects
(Dollars in thousands)

		2013 Actual	2014 Actual	2015 Enacted	2016 Estimate
Personnel Compensation:					
Washington D.C.		$42,430	$43,664	$49,536	$50,722
Field		457,625	445,448	505,347	517,455
11	Total personnel compensation	500,055	489,112	554,883	568,177
12	Personal benefits	160,743	159,161	181,871	189,228
13.0	Benefits for former personnel	1,845	1,152	-	-
	Total, personnel comp. and benefits	662,643	649,425	736,754	757,405
Other Objects:					
21.0	Travel and transportation of persons	8,092	10,365	11,024	11,219
22.0	Transportation of things	309	295	247	273
23.1	Rental payments to GSA	39	300	5,155	5,155
23.2	Rental payments to others	430	12	10	11
23.3	Communications, utilities, and misc. charges	42,666	45,192	37,872	41,820
24.0	Printing and reproduction	494	319	296	295
25.1	Advisory and assistance services	989	829	695	767
25.2	Other services from non-Federal sources	7,654	8,945	9,467	8,278
25.3	Other purchases of goods and services from Federal sources	40	348	292	322
25.4	Operation and maintenance of facilities	30,986	44,967	37,702	41,611
25.5	Research and development contracts	141,641	177,633	143,974	156,500
25.6	Medical care	290	322	269	298
25.7	Operation and maintenance of equipment	12,851	15,814	11,065	14,634
25.8	Subsistence and support of persons	175	8	7	7
26.0	Supplies and materials	70,628	95,630	88,495	86,866
31.0	Equipment	19,996	52,375	45,043	48,467
32.0	Land and structures	5,033	5,579	4,675	5,163
41.0	Grants	9,389	13,452	11,273	12,449
	Total, Other Objects	351,702	472,385	407,561	434,135
99.9	Total, new obligations	1,014,345	1,121,810	1,144,315	1,191,540
Position Data:					
Average Salary (dollars), ES Position		$149,368	$127,724	$134,066	$135,012
Average Salary (dollars), GS Position		$69,114	$66,608	$69,915	$70,409
Average Grade, GS Position		10.6	10.6	10.6	10.6

Salaries and Expenses

Shared Funding Projects
(Dollars in thousands)

	2013 Actual	2014 Actual	2015 Enacted	2016 Estimate
Working Capital Fund:				
Administration:				
Material Management Service Center	$164	$132	$172	$166
Mail and Reproduction Services	2,122	1,826	1,620	1,620
Integrated Procurement Systems	1,180	1,161	1,374	1,374
Procurement Operations	5	5	26	30
Subtotal	3,471	3,124	3,192	3,190
Communications:				
Creative Media & Broadcast Center	135	224	285	290
Finance and Management:				
National Finance Center	1,970	2,269	2,180	2,156
Controller Operations	3,084	2,554	2,610	2,788
Financial Systems	2,111	2,001	2,098	2,120
Internal Control Support Services	162	136	113	113
Subtotal	7,327	6,960	7,001	7,177
Information Technology:				
National Information Technology Center	988	1,034	882	982
International Technology Services	275	3	35	35
Telecommunications Services	1,383	1,846	1,635	1,773
Subtotal	2,646	2,883	2,552	2,790
Correspondence Management	112	98	77	67
Total, Working Capital Fund	13,691	13,289	13,107	13,514
Departmental Shared Cost Programs:				
1890 USDA Initiatives	217	210	212	212
Advisory Committee Liaison Services	17	3	4	4
Classified National Security Information	-	-	76	76
Continuity of Operations Planning	153	145	153	153
Identity and Access Management (HSPD-12)	490	484	488	488
Emergency Operations Center	172	166	169	170
Facility and Infrastructure Review and Assessment	31	32	32	32
Faith-Based and Neighborhood Partnerships	29	16	28	29
Federal Biobased Products Preferred Procurement Program	26	25	-	-
Hispanic-Serving Institutions National Program	146	143	144	144
Honor Awards	3	5	6	6
Human Resources Transformation (inc. Diversity Council)	119	123	127	127
Medical Services	16	18	52	54
People's Garden	-	41	53	48
Personnel Security Branch	79	83	71	71
Pre-authorizing Funding	252	260	269	269
Retirement Processor Web Application	42	41	43	43
Sign Language Interpreter Services	61	42	-	-
TARGET Center	67	66	105	105
USDA 1994 Program	57	54	56	56

Salaries and Expenses

Shared Funding Projects
(Dollars in thousands)

	2013 Actual	2014 Actual	2015 Enacted	2016 Estimate
Virtual University	153	140	143	144
Visitor Information Center	64	17	-	-
Total, Departmental Shared Cost Programs	2,194	2,114	2,231	2,231
E-Gov:				
Budget Formulation and Execution Line of Business	7	7	7	7
Enterprise Human Resources Integration	185	161	152	158
E-Rulemaking	-	74	57	37
E-Training	189	200	201	201
Financial Management Line of Business	13	13	12	13
Grants.gov	52	45	39	40
Human Resources Line of Business	21	20	20	20
Integrated Acquisition Environment - Loans and Grants	101	136	137	137
Integrated Acquisition Environment	51	48	48	48
Total, E-Gov	619	704	673	661
Agency Total	16,504	16,107	16,011	16,406

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 2014 and current research activities, including the National Agricultural Library, are detailed below.

Program Evaluations: In 2014, ARS conducted retrospective reviews of its Crop Protection and Quarantine, and Agricultural and Industrial Byproducts 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 nonprofit 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.

New Products/Product Quality/Value Added

Current Activities:

ARS' New Products/Product Quality/Value Added research program is directed toward: Improving the efficiency and reducing the cost for the conversion of agricultural products into biobased products and biofuels; developing new and improved products for domestic and foreign markets; and providing higher quality, healthy foods that satisfy consumer needs in the United States and abroad. The research supports many of USDA's Strategic Goals, particularly: Assist Rural Communities to Create Prosperity So They Are Self-Sustaining, Repopulating, and Economically Thriving. The research also directly supports many of the REE Action Plan goals.

Selected Examples of Recent Progress:

Organic milk is more abundant in healthy omega-3 fatty acids than conventional milk. Scientific evidence shows that omega-3 and other fatty acids in dairy products are advantageous to human health. ARS researchers in Wyndmoor, Pennsylvania, investigated milk from two adjacent dairy farms, one producing conventional milk, the other organic milk from pasture fed cows. Linolenic acid, an omega-3 fatty acid associated with benefiting the brain and a healthy heart, was significantly higher in the organic milk throughout the year. Americans may benefit from including dairy foods having higher levels of healthy fatty acids as part of a balanced diet.

Native Texas shrub produces potent mosquito repellents with a longer lasting effect than the commercial repellent, DEET. Mosquitoes serve as carriers of human diseases such as malaria, dengue fever, and yellow fever. An ARS scientist in Oxford, Mississippi, synthesized an analog of a natural chromene compound that is more repellent than DEET with a longer duration of action. The compound was isolated from *Amyris texana,* a plant native to Texas. A patent for the compound has been filed. In follow-up studies, several chromene derivatives were further synthesized and shown to be even more potent mosquito repellents with longer action than DEET. This study reveals the potential use of chromene analogs and their action as mosquito repellents, and as superior substitutes for DEET.

Native cedar wood oil is a highly effective repellant to several insect pests. The oil from the American native cedar tree, *Juniperus virginiana,* is an effective repellent to several species of ants and houseflies, two cockroach species, and a tick species. ARS scientists in Peoria, Illinois, developed a method to extract cedar wood oil (CWO), a safe, natural, native, renewable and underutilized agricultural resource, and demonstrated its potential use as an insect control agent. In outdoor tests, several species of ants were repelled by smearing CWO on a pole leading to a sugar-water solution. In laboratory tests, invasive, imported red fire ants were repelled by CWO separating them from a food source. Blacklegged tick nymphs were killed by CWO, and more than 90 percent of adult houseflies died after contact with CWO. The crude carbon dioxide-derived CWO extract showed some repellence toward both German and American cockroaches.

Novel microbial oil has antibacterial activity. Antimicrobial resistance, a major health concern, has decreased the effectiveness of therapeutic drugs to treat and prevent infectious disease. As a result, antibiotic alternatives are needed to maintain the health and welfare of animals. ARS scientists in Peoria, Illinois, collaborated with a scientist from Rangsit University in Thailand to test a novel oil produced by the fungus *Aureobasidium pullulans* for antibacterial activity. The oil, called liamocins, was produced through bioconversion of a variety of sugars and lignocellulosic feedstocks and was found to preferentially inhibit the growth of strains of the pathogenic bacteria *Streptococcus*. The antibacterial oil can improve animal health in the dairy, swine, and aquaculture industries, and can support the biorefining industry by providing a new a high value bioproduct.

Changing landfills into biorefineries. To provide sufficient quantities of biomass sources between growing seasons, ARS researchers in Albany, California, developed a large pilot scale biorefinery located at the Salinas, California, Crazy Horse Landfill that converts rural and urban solid waste into ethanol, biogas, compost, and/or value-added recyclables. Each ton of food processing waste at the landfill can be currently converted into 65 gallons of ethanol. If the same biomass source is converted to liquefied natural (bio)gas (which has the same burn rate as 100 percent ethanol) it yields 108 gallons of transportation fuel, which can be used to power diesel turbines. Together, ARS and the city of Salinas are creating an "energy park" that converts both agricultural biomass and curb collected garbage into bioenergy in the same biorefinery, which demonstrates the facility's remarkable flexibility in handling and processing different feedstock supplies.

Sustainable biodiesel additives improves cold weather flow. The cold flow properties of fatty acid methyl esters (biodiesel) are relatively poor and detract from commercial viability of biodiesel as a fuel source during cold weather. Synthetic cold flow improver (CFI) additives made from soybean, canola, and palm oils have been shown to increase the low temperature flowability of biodiesel. ARS scientists in Peoria, Illinois, and Wyndmoor, Pennsylvania, collaborated on the synthesis and testing of CFI additives obtained from non-food resources such as waste cooking oil. Results from this research benefit farmers who supply seed oils for biodiesel conversion by making the fuel more flowable and marketable during cooler seasons. Biodiesel fuel producers, distributors, and consumers will also benefit by improved flowability and performance in cold weather.

Novel yeast strains reduce the price of biomass conversion to ethanol. Traditional yeasts convert sugars in cereal grains to ethanol, but these yeasts cannot use the sugar xylose, which is the second most abundant sugar in corn stover, switchgrass, and lignocellulose feedstocks. In addition, the process of converting sugars to ethanol results in toxic conditions that inhibit all yeast fermenting activities. *Saccharomyces stipitis* is a native pentose-sugar fermenting yeast that ARS scientists in Peoria, Illinois, cultured in an ethanol challenged continuous culture system to force the development of robust yeast isolates. These isolates were able to overcome toxic conditions and produced ethanol using either highly acid- or base-pretreated corn stover or switchgrass. The novel yeast isolates reduced growth lag time, significantly enhanced fermentation rates, improved ethanol tolerance and yield, and rapidly and economically generated recoverable ethanol at acidic pHs (which potentially inhibit ethanol fermentation). Compared to the parent yeasts, these new yeast isolates reduce ethanol selling costs by $0.31/gallon, an accomplishment that advances national efforts in developing renewable fuel systems to stimulate the rural economy, preserve the environment, and reduce dependence on foreign oil.

Livestock Production

Current Activities:

ARS' Livestock Production research program is directed toward fostering an abundant, safe, nutritionally wholesome, and competitively priced supply of animal products produced in a viable, competitive, and sustainable animal agriculture sector of the U.S. economy by: safeguarding and utilizing animal genetic resources, associated genetic and genomic databases, and bioinformatic tools; developing a basic understanding of food animal physiology to address priority issues related to animal production, animal well-being, and product quality and healthfulness; and developing information, best management practices, novel and innovative tools, and technologies that improve animal production systems, enhance human health, and ensure domestic food security. 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 the 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. The research supports many of USDA's Strategic Goals, particularly: 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. The research also directly supports many of the REE Action Plan goals.

Selected Examples of Recent Progress:

Mutations conferring heat tolerance in cattle identified. With global climate change and increasing demands for animal protein worldwide, there is a need to understand and accelerate the adaptation of agricultural animals to the environment. Cattle breeds in subtropical and tropical regions of the world maintain a stable internal deep body temperature that is indicative of a genetic predisposition towards heat tolerance; however, variations in the tolerance of heat are evident between different tropical breeds. ARS scientists in Beltsville, Maryland, in collaboration with scientists at U.S. and foreign universities, identified distinct mutations in genes regulating skin formation, hair growth, and cooler body temperature that are inherited in heat tolerant breeds. Results from the study are being used by producers to guide future breeding decisions, and by researchers to better understand the biological processes involved in adaptation to climate change.

Defining genetic determinants to select for superior resistance to Marek's disease in poultry. Marek's disease, an extremely contagious viral disease is capable of causing major losses to chicken, the second largest agricultural animal commodity in the United States. The disease is currently controlled through vaccines and biosecurity, but enhancing genetic resistance to Marek's disease would be a more effective mode of disease control. ARS scientists in East Lansing, Michigan, in collaboration with scientists at Purdue University, demonstrated that a subset of previously identified genetic markers of Marek's disease influence specific genes considered as primary determinants for genetic resistance. Measuring the marker-gene association had higher accuracy (61 percent improvement) in identifying birds with superior genetic resistance compared to current state-of-the-art methods. If confirmed in commercial poultry lines, this approach could efficiently select for elite, healthy poultry to generate more economical poultry products for U.S. producers and consumers. The model may also have application in addressing genetic resistance to other infectious pathogens.

Selection to reduce ovine progressive pneumonia. Ovine progressive pneumonia, a viral disease, is one of the most costly sheep diseases in North America and management schemes to minimize and eliminate the prevalence of this disease are labor intensive and expensive. ARS researchers in Clay Center, Nebraska, demonstrated that sheep with an unfavorable form of the gene associated with susceptibility to ovine progressive pneumonia had a much higher rate of infection compared to sheep that lacked that form of the gene. The scientists developed technology to identify animals with the high risk gene so that sheep producers can now selectively breed and generate flocks genetically less susceptible to ovine progressive pneumonia. This should enhance the health of sheep flocks and increase economic profits for producers.

Old tool finds new use in reducing nitrogen emissions from dairy farms. Nitrogen is a key component of protein in the diet ration for dairy cattle. Maximum absorption of protein in the gut is crucial to avoiding the excretion of excessive nitrogen containing compounds that may impact air quality or greenhouse gases, and ultimately human health and natural ecosystems. ARS scientists in Madison, Wisconsin, studied the use of milk urea nitrogen, a common tool applied to monitor feed efficiency in dairy herds, to evaluate the relationships between the amount of protein fed to lactating cows, nitrogen compounds in milk, and excreted nitrogen on dairy farms. A high correlation was found between milk urea nitrogen values and excreted nitrogen values. The findings demonstrated that monitoring of milk urea nitrogen on dairy farms can be used to optimize protein use in dietary rations that will reduce feed costs for dairy cows and the negative impacts to the environment

Atlantic salmon evaluated and selected for multiple traits. Commercial salmon producers in the United States use stocks that are not many generations removed from wild, unselected stocks. Since salmon are an endangered species, producers are legally required to culture certified stocks of North American salmon. ARS researchers at the National Cold Water Marine Aquaculture Center at Franklin, Maine, in collaboration with industry, generated a broodstock of fish with North American origin and compared the growth of four year classes of salmon from their

breeding program to a control line in commercial sea cages. Salmon which were selected for increased growth, resistance to sea lice, and improved fillet color, averaged approximately 90 percent larger than the control line. Using improved salmon germplasm is increasing the cost effectiveness, profitability, and sustainability of cold water marine aquaculture in the United States and providing a quality seafood product to consumers.

Development of a vaccination platform to protect catfish against enteric septicemia. Enteric septicemia is the most devastating disease affecting the catfish industry. The development of a new vaccine and feed based delivery platform has resulted in providing exceptional protection against enteric septicemia of catfish with dramatic increases in production efficiency and economic returns. Mississippi State University scientists working in collaboration with scientists at ARS developed a mechanized vaccine delivery system which consistently delivered target immunizing doses in experimental pond trials. The vaccine delivery system was used in commercial field trials during the 2013 production season with excellent results; 2014 production season trials are ongoing. This vaccine will support catfish producers in efforts to control diseases and manage production costs.

Method to produce a protein concentrate from barley is commercialized. Feeds costs are a significant production item in commercial aquaculture. Barley that is too high in protein to be used for malting has the potential to be developed as a protein-based fish feed. A method was developed and patented by ARS scientists at Aberdeen, Idaho, for producing a protein concentrate that can be incorporated into aquaculture feeds. Feeding studies with rainbow trout and Atlantic salmon demonstrated the concentrate is highly digestible and supports rapid fish growth, reducing the need for more expensive ingredients such as fishmeal. A pilot plant for barley concentrate production has been built and is delivering product to commercial farms in Idaho. Two more plants are in the development phase.

Minimal impacts of oyster aquaculture to eelgrass at the landscape scale. Submerged aquatic vegetation such as eelgrass provides valuable habitat for estuarine fish and invertebrates in estuaries, particularly for juvenile salmon on the west coast of the United States. ARS researchers in Newport, Oregon, used Geographic Information Systems layers for tidal heights, cumulative wave stress, salinity, distance to the river mouth, and distance to the nearest channel to quantify the distributions of eelgrass and bivalve aquaculture in Willapa Bay, Washington. The impact of bivalve aquaculture on eelgrass at the landscape scale was measured over a period of five years. While oyster harvest methods had demonstrable effects on eelgrass over time at the individual bed scale, oyster aquaculture reduced eelgrass cover by less than one percent in any given year over the whole estuary. This information promotes sustainable shellfish culture and is enabling managers and regulators to evaluate the potential effects of existing and expanded oyster aquaculture on estuarine habitat.

Crop Production

Current Activities:

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 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. The research supports many of USDA's Strategic Goals, particularly: 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. The research also directly supports many of the REE Action Plan goals.

Selected Examples of Recent Progress:

Conventionally bred sweet orange like hybrid and new rootstocks with tolerance to citrus greening released. Citrus greening or huanglongbing (HLB) is the most serious threat to citrus production worldwide and has reduced Florida citrus production by 50 percent. No inherent genetic protection for citrus trees has been available for U.S. citrus growers. However, in 2014 ARS researchers at Ft. Pierce, Florida, released a new hybrid sweet orange with high quality fruit that displays excellent tolerance to HLB disease. These trees have been propagated at a commercial nursery and will be placed in 2015 in replicated plantings on six grower sites with other advanced sweet orange like selections. Nine new citrus rootstocks have also been developed that display much higher sweet orange fruit productivity and tree health in field trials growing in areas severely affected by HLB. These rootstocks have been entered into the Florida clean budwood program, and are being propagated for entry into large scale grower trials in 2015. Release of the tolerant hybrid and rootstocks offers a new option for citrus growers for production management in the presence of citrus greening.

Impact of climate change on crop nutritional quality. Producers and nutritionists are concerned about how climate change might affect the nutritional qualities of food crops. ARS researchers at Aberdeen, Idaho; Urbana, Illinois; and multinational collaborators determined how climate change could affect the nutritional qualities of several staple crops, including wheat, rice, maize, sorghum and soybean. They grew these crops to maturity under varying levels of atmospheric carbon dioxide which are expected to become elevated because of climate change. In the first assessment of its kind, seed nutrient content relevant to zinc, iron, and protein nutrition was evaluated. Scientists also measured seed phytic acid content which is critically important for determining iron and zinc bioavailability. Study results indicated that while seed phytic acid was not largely altered by elevated carbon dioxide levels, seed zinc, iron, and protein levels declined. Iron and zinc deficiencies are significant global public health challenges that impair the health of an estimated two billion people worldwide. These findings, which were published in the journal *Nature*, provide important new information for understanding how climate change could impact nutritional quality of crops.

Release of new apple rootstock with tolerance to apple replant disease. Diseases affecting U.S. apple crops have been impacting yields and profits. ARS and Cornell University researchers at Geneva, New York, have developed and released a new apple rootstock, named G.814, which is dwarfing, productive, early bearing, and highly yield efficient. It is the most recent product from a series of disease resistant and productive apple rootstocks developed by the Geneva breeding program. This rootstock is resistant to fire blight and crown rot, two serious diseases that infect apple trees with serious economic consequences. Most importantly, G.814 has shown tolerance to the apple replant disease complex. This rootstock was tested for 15 years to evaluate rootstock productivity levels as compared to standard cultivars. Based on preliminary trials in the United States, G.814 will increase production of larger, high quality fruit in marginal replanted orchard land which will help apple producers increase yields and profits.

New yield genes from a soybean wild relative found in the USDA soybean collection. The narrow genetic base of the soybean crop limits progress in developing higher yielding varieties. ARS scientists at Urbana, Illinois, discovered and transferred into cultivated soybean, unique yield genes from Glycine *tomentella* (a very distant, perennial relative of soybean). These two species are so genetically different that direct progeny from these crosses are sterile, and special procedures, including several backcrosses to the soybean parent, were needed to produce fertile progeny. Each new plant from these crosses is likely to have a different complement of G. *tomentella* chromosomes and could be genetically quite different. In tests at seven locations across four States, ten lines were identified that yielded significantly more than the commercial soybean parent – as much as by seven bushels/acre. This is the first report of soybean lines derived from perennial G. *tomentella*. Increasing yield is the most important objective for soybean breeders, and the genes to increase yield that were transferred from G. *tomentella* are now available to soybean breeders for the first time.

Intelligent spraying system for nursery and orchard applications. Conventional spray application requires excessive amounts of pesticide to achieve effective pest control in floral, nursery, and fruit crop productions. ARS researchers in Wooster, Ohio, invented an automated, variable rate, air assisted, precision sprayer that minimizes human

involvement in determining the amount of sprays needed for applications. This intelligent spraying system characterizes the presence, size, shape, and foliage density of target trees and applies the optimum amount of pesticide. Field experiments have shown that the intelligent sprayer reduces the variation in spray deposition due to changes in tree structure and species, and increases the uniformity of spray deposition on targets at different growth stages. The pest control efficacies of the new sprayer provide an environmentally responsible approach. The new sprayer also reduces average pesticide use by up to 68 percent, for an annual average cost savings of $230 per acre.

Grapevine yield estimation automated. Worldwide, grapes are the most planted fruit crop and rank third in tonnage produced. It is important to estimate yield in vineyards to allow for contract negotiation, harvest logistics, and marketing projections. ARS scientists in Prosser, Washington, developed a trellis tension monitoring system that can be used to estimate crop yields that is as good as or better than the current labor intensive method used for estimating yield. This system monitors the tension in the trellis wire as the fruit increases in size. Fruit yields can be estimated before veraison (the onset of ripening) to within 20 percent of actual yields. This information is being used to optimize processing capacity and predict labor needs.

Honey bee protein supplements not as good as natural pollen. In addition to the parasites and pathogens that attack honey bees, poor nutrition adds to honey bee stress and is thought to be a contributing factor to colony decline. When pollen, a source of honey bee nutrition, cannot be collected due to the absence of flowering plants, beekeepers will often feed their honey bee colonies a protein supplement. ARS scientists in Tucson, Arizona, demonstrated that these supplements have less protein than pollen and are not digested as well by the honey bees. Furthermore, bees in colonies fed protein supplements experienced a higher incidence of disease and queen loss and overall had higher mortalities than those colonies that consumed pollen. These findings underscore the need to supply bees with pollen. This information will be used by beekeepers and extension agents working with honey bees to ensure colonies are receiving proper nutrition.

A rotating cross arm trellis system for blackberry production. Blackberry production in the midwestern United States is limited by low winter temperatures that kill the fruit buds and vines. ARS researchers in Kearneysville, West Virginia, developed a rotating, cross arm trellis system that allows the vines to be rotated to the ground and covered with a protective, floating row cover as needed to protect dormant vines from extreme temperatures. This new production system reduces the risks of crop failure and major crop losses from extreme and untimely cold temperatures. In January-February 2014, much of the Midwest experienced temperatures below 20 C, which killed blackberry plants grown in conventional systems with no winter protection leaving less than 10 percent of a normal crop to be harvested. In contrast, growers who are using the rotating, cross arm trellis and winter protection system saw little winter damage and harvested 80 percent of a normal crop in 2014. Since 2010, 120 hectares of new blackberry plantings on 40 farms (1 to 10 hectares in size) from Pennsylvania to Iowa have been established using the rotating, cross arm trellis system. In 2014 alone, these new plantings are expected to generate $60,000 a hectare.

Food Safety

Current Activities:

ARS' Food Safety research program 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 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). 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, including regulatory agencies, industry, and commodity and consumer organizations in detecting, identifying, and controlling foodborne diseases that affect human health. The research supports many of USDA's Strategic Goals, particularly: Ensure that All of America's Children Have Access to Safe, Nutritious, and Balanced Meals. The research also directly supports many of the REE Action Plan goals.

Selected Examples of Recent Progress:

New analytical method for nitrosamines and risk assessment by USDA. Nitrosamine levels in fried bacon were a major concern 30 years ago before steps were taken to reduce their formation, however, nitrosamines levels have not been monitored since the 1990s. The USDA Office of Inspector General (OIG) requested the Food Safety Inspection Service (FSIS) to conduct a survey of nitrosamine formation from cooked bacon and an accompanying risk assessment to check if the situation had changed. The previous analytical methods used for nitrosamines were unwieldy and used archaic specialized equipment that was unavailable. At the request of the Food Safety Inspection Service (FSIS), ARS scientists at Wyndmoor, Pennsylvania developed and validated a new sensitive, rapid, and easy test for assessing nitrosamine levels in fried bacon. An innovative new approach detected as little as 0.1 ng/g levels of the nitrosamines of concern in the complex samples. FSIS regulators performed a risk assessment using the survey results and demonstrated that frying bacon did not generate levels of nitrosamines that posed a health risk. As a result of this work, nitrosamines in fried bacon do not need to be routinely monitored. Testing and survey methods will be readily available to FSIS and others if another survey is needed. ARS' research also helped close out the longest OIG audit in FSIS.

Impact of tetracycline on Salmonella. Multi-drug resistant (MDR) salmonella, a bacterium that can cause foodborne illness, is an important food safety concern. The development of antibiotic resistance to tetracycline, which is a commonly used antibiotic in both humans and animals, is very common. ARS scientists in Ames, Iowa, examined the impact of tetracycline on the virulence of MDR salmonella typhimurium and found that tetracycline promoted the ability of some MDR salmonella to invade host cells. This suggests that tetracycline may play a role in increasing the virulence of MDR salmonella, and highlights the need to develop alternative treatments for Salmonella and other bacterial diseases.

E. coli O157:H7 strains from contaminated raw beef trim during "high event periods." The U.S. beef processing industry has developed and implemented effective antimicrobial interventions that have dramatically reduced the incidence of beef trim contamination by E. coli O157:H7, a pathogen that can cause severe foodborne illness. However, individual processing plants still experience sporadic peaks in contamination rates where clusters of multiple finished product contamination occur in a short time frame. These peaks have been referred to as "high event periods" (HEP) of contamination. ARS scientists from Clay Center, Nebraska, determined that each HEP is linked to one type of E. coli O157:H7 isolate that is responsible for most, if not all, of the contamination. This is in contrast to the range of different strains identified on the hides of cattle entering processing plants and poses a potential challenge to the current model for finished product contamination during beef processing. In addition, it was found that a high proportion of HEP are caused by strain types associated with human illness. This research indicates that beef processing plants will need additional support in developing tools and techniques to control HEP.

Vaccine trials to reduce risk of salmonella in swine. Salmonella is a leading cause of bacterial foodborne disease. In the United States, more than 50 percent of the swine farms experience salmonella contamination. On-farm interventions are needed to reduce the levels of salmonella in swine production and limit the potential risk of foodborne disease in humans. A rationally attenuated *s. typhimurium* vaccine has been developed by ARS researchers in Ames, Iowa, and is currently undergoing efficacy trials. To date, vaccine trial analysis indicates that swine vaccination reduces disease severity and gastrointestinal colonization due to challenges with both wild type *S. typhimurium and S. choleraesuis*. One advantage of the vaccine is that it still allows the use of an industrial test, salmonella lipopolysaccharide, which is used in Europe to monitor salmonella status at the herd level. Consequently, the new vaccine can still be used to differentiate infected from vaccinated animals.

Livestock Protection

Current Activities:

ARS' 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 through the discovery and development of diagnostics, vaccines, biotherapeutics, animal genomics applications, disease management systems, animal disease models, and farm

biosecurity measures. The research program has the following strategic objectives: establish ARS laboratories into a fluid, highly effective research network to maximize use of core competencies and resources; use specialized high containment facilities to study zoonotic and emerging diseases; develop an integrated animal and microbial genomics research program; establish core competencies in bovine, swine, ovine, and avian immunology; launch a biotherapeutic discovery program providing alternatives to animal drugs; build a technology driven vaccine and diagnostic discovery research program; develop core competencies in field epidemiology and predictive biology; establish a best-in-class training center for our Nation's veterinarians and scientists; and develop a model technology transfer program to achieve the full impact of ARS research discoveries. The ARS animal research program includes the following core components: biodefense research, animal genomics and immunology, zoonotic diseases, respiratory diseases, reproductive and neonatal diseases, enteric diseases, parasitic diseases, and transmissible spongiform encephalopathies. The research supports many of USDA's Strategic Goals, particularly: Ensure that All of America's Children Have Access to Safe, Nutritious, and Balanced Meals. The research also directly supports many of the REE Action Plan goals.

Selected Examples of Recent Progress:

Cytokines as an alternative to antibiotics to prevent and combat infectious disease. The use of cytokines, small proteins that are important in cell signaling and that affect the behavior of other cells, to stimulate the immune system as alternatives to antibiotics is a promising area for biotherapeutic use to prevent and combat infectious disease. ARS scientists in Ames, Iowa, investigated the potential value of using the granulocyte colony stimulating factor (G-CSF) as a potential alternative to antibiotics in food animal production for controlling pathogenic bacteria in which neutrophils (white blood cells that are the first line of defense against bacterial infections) can provide protection. G-CSF enhances the production and release of neutrophils from bone marrow and is already licensed for use in humans. A limitation of cytokines is their short half life, which may limit their usefulness as a one time injectable in production animal medicine. The scientists found that the administration of recombinant G-CSF induced a transient increase in neutrophils (neutrophilia) in pigs, however, delivery of porcine G-CSF inserted in a replication defective adenovirus (Ad5) vector significantly increased the effect of neutrophilia. Pigs given one injection of the Ad5-G-CSF had a neutrophilia that peaked between three to 11 days post-treatment and neutrophil counts remained elevated for more than two weeks. Neutrophils from Ad5-G-CSF treated pigs were fully functional based on laboratory tests, demonstrating that G-CSF may be an effective alternative to antibiotics for treating bacterial pathogens susceptible to neutrophils.

Amino acid changes in a viral protein determine the evolution of swine influenza A H3N2 viruses. Swine influenza A virus is an endemic and economically important pathogen in pigs with the potential to infect other host species, including humans. Pigs may also become infected with human influenza A viruses. The viral hemagglutinin (HA) protein binds viruses to cells and is the primary target of protective immune responses and the major component in swine influenza A vaccines. However, as a result of genetic mutations known as antigenic drift, vaccine virus strains must be regularly updated to reflect currently circulating strains. Characterizing how different virus strains in pigs are to the seasonal influenza virus strains in humans is important in assessing the relative risk of interspecies transmission. ARS scientists in Ames, Iowa, found that two primary swine influenza virus strains are currently circulating in the U.S. pig population, but with enough diversity between the HA proteins to suggest updates in vaccine strains are needed. The scientists identified specific changes in the HA protein that are likely responsible for differences between the two viruses. The differences between current seasonal influenza H3N2 strains in humans and those endemic in swine is enough that population immunity is unlikely to prevent the introduction of human viruses into pigs and vice versa, reinforcing the need to continuously monitor and prepare for influenza A viruses in both species.

Development of a Rift Valley fever virus challenge model to evaluate vaccines in sheep and goats. Rift Valley fever virus (RVFV) is transmitted by mosquitoes and causes severe to fatal disease in ruminants and humans which can be preventable by vaccination. Ruminants are known to amplify RVFV and are a potential source of infection for humans. Availability of a challenge model is a pre-requisite for vaccine efficacy trials. Several modes of inoculation were tested by ARS scientists in Manhattan, Kansas, in collaboration with scientists with the Canadian Food Inspection Agency. Differences in development of infections in sheep and goats were observed between animals inoculated with RVFV produced in mosquito cells compared to mammalian cells. Only RVFV produced in mosquito cells led to development of virus in the blood (viremia) in all inoculated animals. The insect cell produced

RVFV appeared to be more infectious with earlier onset of viremia, especially in sheep, and may also more closely represent a field situation. These finding were used to develop a challenge protocol suitable for evaluating the efficacy of RVF vaccines in sheep and goats.

Evaluation of the risk of indigenous ticks transmitting equine piroplasmosis. Equine piroplasmosis was eradicated from the United States in the late 1980s. However, a recent outbreak in Texas caused significant economic loss to the equine industry and suggested that some ticks indigenous to the United States could play a role in transmission. ARS scientists in Pullman, Washington, in collaboration with Texas A&M University, collected and colonized ticks from horses at the Outbreak Ranch. The scientists demonstrated that these indigenous ticks were able to acquire and transmit the parasite to naïve horses. These results confirm introduction of infected horses into the U.S. with competent indigenous vectors can result in dissemination of the parasite and thus disease to the nation's equine population.

Improved uniforms to protect U.S. military personnel from mosquitoes. Throughout much of the world, mosquitoes transmit a wide variety of disease causing agents. U.S. deployed military personnel must rely upon synthetic insecticide sprays to kill blood feeding pests, and/or topical repellents for personal protection. ARS scientists in Gainesville, Florida, worked with the Department of Defense to test the useful life of U.S. Marine Corp and Navy military uniforms that were impregnated with the insecticide permethrin. They demonstrated that after 50 washings, the treated uniforms still retained their ability to repel biting mosquitoes. This information is essential to protecting U.S. deployed troops from arthropod-borne diseases.

Occurrence of cattle fever ticks in white tailed deer. Texas cattle fever is a devastating protozoan disease of domestic cattle transmitted by certain types of ticks, termed cattle fever ticks. By 1961, an eradication effort effectively eliminated the ticks and the disease causing pathogen from Texas and the southeastern United States, though a quarantine area along the Texas-Mexico border that is still maintained by Federal personnel as part of the Cattle Fever Tick Eradication Program. Originally, the cattle tick and its parasite was thought to infest only cattle. However, recent evidence has shown that white tailed deer can also serve as hosts for these ticks. ARS researchers at Kerrville, Texas, in collaboration with scientists from Northern Arizona University, examined the genetic relationships between ticks collected from cattle and ticks collected from deer. They found these ticks to be genetically similar, which explains why tick populations have persisted over time in the quarantine zone. Molecular techniques were also used to determine the invasive potential of ticks into major cattle producing areas in the United States. This information will be useful to scientists and government agencies charged with maintaining tick eradication quarantine areas and disease free zones in the United States.

Genetics of screwworm control. Infestations with immature screwworms (maggots) devastated the United States livestock industry until a sterile male release technique eradicated screwworms in the 1960s. Sterile insect techniques are still currently used to prevent re-entry of screwworms into the United States. This method requires the mass production, sterilization, and release of millions of sterilized, adult males at a cost of millions of dollars, annually. ARS scientists at Kerrville, Texas, in collaboration with scientists at North Carolina State University, used genetic techniques to produce male only screwworms, making the rearing and release program more efficient and affordable. Maintaining an effective barrier against screwworms re-entering the United States ensures benefits exceeding $1.5 billion annually for North American livestock producers.

Ability of U.S. mosquito to transmit Rift Valley fever virus. Rift Valley fever is a potentially fatal viral disease that infects humans and is transmitted by mosquitoes. The virus can also negatively impact livestock health. Though largely restricted to the African continent, experts are concerned that the Rift Valley virus could be introduced and established in the United States. In laboratory studies, ARS scientists in Gainesville, Florida, evaluated eight species of mosquitoes commonly found in the United States for their ability to transmit the Rift Valley fever virus. They found that some species of mosquitoes have a greater ability to transmit the virus than other species, a finding that has a direct impact on the risk assessment of disease transmission to humans and livestock. These results will allow mosquito control assets to target the mosquito species most likely to be involved in disease transmission if Rift valley fever is ever found in the United States.

Crop Protection

Current Activities:

ARS' Crop Protection research program is directed to protect crops from insect and disease loss through research 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 program's research priorities include: identification of genes that convey virulence traits in pathogens and pests; factors that modulate infectivity, gene functions, and mechanisms; genetic profiles that provide specified levels of disease and insect resistance under field conditions; and mechanisms that reduce 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 and to address quarantine issues. The research supports many of USDA's Strategic Goals, particularly: Ensure that All of America's Children Have Access to Safe, Nutritious, and Balanced Meals. The research also directly supports many of the REE Action Plan goals.

Selected Examples of Recent Progress:

New technology provides nematode resistance in potatoes. Potato cyst nematodes (PCNs) are devastating pests impacting the U.S. potato production which is valued at $4 billion. Methods for effective PCN control are limited and often rely on toxic chemicals so there is a major need to develop new methods to protect potatoes from these nematodes. ARS researchers at Ithaca, New York, have identified genes that are critical for nematode infection. They have employed a plant mediated RNAi technology to silence theses nematode genes which resulted in the development of a nematode resistant potato cultivar. This technology, which was patented, provides a valuable new tool for plant researchers working to protect potato growers and the industry from costly nematode losses.

Increasing access to new genetic resources to protect sugarcane. Sugarcane producers and industry need access to new genetic crop diversity to thwart numerous endemic and invasive pests, diversify onto marginal land, and adapt to climatic change. However, sugarcane germplasm imports to the United States have been restricted to "seed cane," or cane pieces, which has limited U.S. access to genetic diversity. In 2014 ARS scientists at Houma, Louisiana, and at Canal Point, Florida, working with university and international sugarcane researchers, determined the risk of importing pathogens on true seed (termed "fuzz"), which was previously unknown. All test results were negative, and no seedling from parents infected with known pathogens was found to be infected. These results contributed to a decision made by APHIS that fuzz can now be imported into the United States under approved protocols. The result is that major new genetic diversity can now be provided to all sugarcane breeding projects in the United States which will help can producers manage disease, respond to climate challenges, and protect profits.

New discovery of the genetic factors that confer Ug99 wheat stem rust resistance.

Durable resistance to wheat stem rust in adult wheat plants is highly desired to protect wheat production from major stem rust losses. In 2014, scientists at ARS' Cereal Disease Laboratory identified and determined that a combination of genetic factors can confer adult resistance to wheat stem rust in wheat varieties adapted for the United States. These results can be used by wheat breeders to develop new wheat varieties with even more effective genetic resistance to Ug99 and other wheat stem rusts.

National Sclerotinia Initiative develops effective screening tools to accelerate sclerotinia protection in sunflower. The sclerotinia diseases are some of the most important diseases of sunflower in the Northern Great Plains. ARS scientists in Fargo, North Dakota, together with Sclerotinia Initiative funded collaborators have developed a standardized regional approach to identify significant differences in the susceptibility of sunflower hybrids to sclerotinia. Building on that successful result, the researchers have developed field scale inoculation procedures and misting systems that have enabled U.S. sunflower breeders to identify sunflower hybrids with resistance to sclerotinia. The system has been effectively implemented to assess sclerotinia resistance of newly released

commercial hybrids at five regional "common garden" nurseries, providing growers with site specific and overall performance characteristics of individual sunflower hybrids, and facilitating the release of new oilseed sunflower genetic lines with improved head rot resistance. The standardized assessments have significantly increased the number of hybrids identified with improved levels of sclerotinia resistance for U.S. sunflower growers whose 2012 crop production was valued at $727.8 million.

Controlling the Asian citrus psyllid, the insect vector of citrus greening disease. Citrus greening is now found in all citrus growing regions of Florida, and is responsible for a decrease in marketable fruit by more than 50 percent. ARS scientists in Fort Pierce, Florida, are targeting their research to disrupt transmission of the disease by the Asian citrus psyllid, a small insect that sucks the plant's juices. In 2014, they identified natural products with potential to block the ability of the psyllid to feed. A promising strategy is the application of non-transgenic, RNAi to inhibit transmission of the disease and the viability of the psyllid. The scientists developed delivery systems for the RNAi for root drench, foliar spray, and trunk injection. Results show evidence of psyllid mortality within two to four weeks after root drench and trunk injection. These results can be integrated into multi-pronged methods for the industry to combat the psyllid to avoid transmission of the citrus greening disease.

Methyl bromide alternative developed for walnut planting. Just before walnut orchards are planted, soil fumigation with methyl bromide has been used to reduce walnut diseases caused by soil parasites and pathogens. The phase out of methyl bromide has created a need for alternative fumigants. In an eight year (ongoing) walnut replant trial in the San Joaquin Valley, University of California and ARS scientists determined that 1,3-dichloropropene and 1,3-dichloropropene plus chloropicrin were effective methyl bromide alternatives through the time period monitored which included one year of harvestable yield. First year yield was roughly doubled by optimized combinations of the alternatives. Also, the trial identified two rootstocks that perform better in a replanted orchard than the current commercial standard. The data from the trial will help walnut orchard managers to optimize their replanting decisions in the absence of methyl bromide.

Enhanced protection and preservation of bee germplasm. A decline in the numbers of managed honey bee colonies worldwide as well as in the populations of many indigenous bee pollinators has created an urgent need for germplasm preservation methods for honey bees and solitary bees. ARS researchers in Fargo, North Dakota, in collaboration with researchers at North Dakota State University, have developed a technique for the cryopreservation of honey bee sperm that yields 100 percent survival of the sperm after thawing. This technique will enable the conservation of not only honey bee genetic diversity but also that of other bee pollinators, and will be used by customers and stakeholders in the honey bee and solitary bee industry to maintain genetic diversity and preserve species.

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 primary public health concerns in the U.S. 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 requirements but have health promoting qualities. Four specific areas of research are emphasized: nutrition monitoring; the scientific basis for dietary recommendations; prevention of obesity and related diseases; and life stage nutrition and metabolism, in order to better define the role of nutrition in pregnancy and growth of children, and for healthier aging. The research supports many of USDA's Strategic Goals, particularly: Ensure that All of America's Children Have Access to Safe, Nutritious, and Balanced Meals. The research also directly supports many of the REE Action Plan goals.

Selected Examples of Recent Progress:

The current standard for calorie intake in children is set too high. Current Dietary Reference Intake (DRI) standards are based on previous studies that only included two 3-year olds and two 4-year olds and did not address how substantial differences in physical activity level might affect energy needs. ARS funded researchers in Houston, Texas, determined that DRI standards overestimate the calories required to meet the energy needs of preschool children. The researchers included 97 children in their study of total energy expenditure, short-term metabolic needs, and long-term metabolic needs. Results indicated not only that the current DRI for energy overestimates caloric need, but that physical activity has a large role in determining those needs and sometimes can increase caloric demand by almost 600 calories per day. This research will support nutritionists in providing guidance on the appropriate caloric intake levels for children which may help stem the increase in childhood obesity over the last 30 years.

Physical activity benefits elderly adults at high risk for impaired mobility. Sarcopenia is the loss of skeletal muscle mass in the elderly, and it contributes to declines in physical capacity and performance with advancing age. The economic impact of sarcopenia has been estimated at $18.5 billion, annually. ARS-funded researchers in Boston, Massachusetts have determined that structured physical activity is a feasible and effective intervention to reduce the burden of disability among vulnerable older persons in late life. This investigation included participants from the Lifestyle Interventions and Independence for Elders (LIFE) study which is the largest and longest randomized trial of physical activity in older persons to date. It is a multi-center controlled study that compares how two programs – a moderate intensity physical activity program and a successful aging health education program – affect the incidence of mobility loss in high risk adults. Men and women (age 70 to 89 years) who were able to walk were assigned to either a moderately intense physical activity that included aerobic, resistance, and flexibility training activities or to a health education program that included workshops on topics relevant to older adults and upper extremity stretching exercises. Thirty percent of the participants engaging in the physical activity program exhibited major mobility impairments, while a higher percentage (36 percent) of the participants in the health education program exhibited major mobility impairments. Notably, a subgroup with lower physical function at the beginning of the study received considerable benefit from the physical activity intervention. These results support USDA's goal of improving health and safety for citizens of all ages.

Gut microbiota affects vaccine responses. The role of the human biome—all the microorganisms that live in the human body – in maintaining human health is receiving a great deal of scientific attention. Research by ARS scientists and colleagues indicate that the composition of the microbial community inhabiting the human intestine is likely to have a profound influence on both infant and adult health. ARS scientists in Davis, California, worked with collaborating scientists and the World Health Organization to conduct a study among healthy Bangladeshi infants up to 15 weeks of age to determine if intestinal microorganisms are associated with standard vaccine responses. Based on DNA obtained from feces, the scientists determined that a high abundance of certain types of intestinal bacteria was associated with stronger responses to several vaccines, including oral polio vaccine, tetanus toxoid vaccine, and tuberculosis vaccine. Multiple measures of vaccine response were affected, including the antibody response, the hypersensitivity skin test response, and the T-cell proliferative response. These findings suggest interventions that use live bacteria or appropriate foods to promote a healthy microbial community in the gut by may improve the efficacy of vaccination programs which could have positive impacts on childhood health.

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

Current Activities:

ARS' Environmental Stewardship research program emphasis is on developing technologies and systems that support sustainable 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' research also focuses on 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 this program. ARS' range and grazing land research objectives include the conservation and restoration of the Nation's range land 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. The research supports USDA's FY 2016 Interagency Climate Change initiatives and priorities, and many of the Department's Strategic Goals, particularly: Ensure Our National Forests and Private Working Lands Are Conserved, Restored, and Made More Resilient to Climate Change, While Enhancing Our Water Resources. The research also directly supports many of the REE Action Plan goals.

Selected Examples of Recent Progress:

Operational implementation of a global root zone soil moisture monitoring system. Soil moisture is a key component of Earth's water cycle that is essential for plant life, affecting global energy flux, and influencing weather and climate. Monitoring the availability of soil moisture in the rooting zone is critical for forecasting variations in agricultural productivity which can affect global food prices and food availability. ARS scientists in Beltsville, Maryland, designed a system to globally estimate the availability of soil moisture in the rooting zone, and produced new worldwide soil moisture maps that reveal how the wetness of the land fluctuates seasonally and with changes in weather. These maps are being given to the public to support a wide range of agricultural and hydrologic applications, from advancing climate models and weather forecasts to improving flood warning systems. USDA Foreign Agricultural Service analysts implemented this system in April 2014 to improve their operational forecasts of global agricultural yield and productivity. These forecasts are critically important to commodity markets, and to decision-makers who must depend on crop production information to plan for disasters such as drought, which can lead to food deficits in countries that may require food assistance.

Mitigating phosphorus loss to ensure the availability of safe drinking water. The midwestern United States has some of the most productive agricultural soils in the world, but because of its climate much of this region would be unable to support agriculture without drainage; high water tables would both damage crops and prevent the access of machinery in the fields at critical times. While drainage is designed to remove excess water as quickly as possible, it can also provide a conduit for the rapid loss of agrochemicals, particularly phosphorus that can subsequently degrade the quality of key drinking water supplies. ARS scientists in West Lafayette, Indiana, used a combination of field and modeling investigations to provide information on how to mitigate phosphorus losses from tile drained croplands in conservation tillage. As researchers, policy-makers, and farmers search for ways to reduce phosphorus loadings to surface waters such as Lake Erie, these studies highlight the importance of treating both surface runoff and tile drainage to minimize harmful algal blooms.

A new model, iSnobal, for managing snowmelt in the western United States. Water supplies from western mountainous watersheds are in extremely high demand for agricultural production, clean electricity, and domestic uses. To optimize water supply management, traditional methods of stream flow forecasting must be improved. ARS scientists in Boise, Idaho, developed a new more sophisticated model, iSnobal, that goes beyond simple empirical relationships, that has not been used for management purposes due to its high computational demands and the expertise required to simulate snow accumulation and melt patterns over large areas. Over the past year, ARS scientists successfully integrated the iSnobal model into the U.S. Bureau of Reclamation's forecasting procedures for the 2,500 square mile Boise River Basin in Idaho. Also, weekly updates of snow cover density over a large region of the southern Sierra Nevada Mountains are now being provided for NASA's Alpine Snow Observatory program. This represents a major change in the commitment of western water managers toward using more sophisticated process-based modeling in their future river forecasting programs.

Controlling atrazine losses in agricultural watersheds underlain by restrictive layer (clay pan) soils. Atrazine is one of the most prevalent soil applied herbicides used in corn cultivation. Its widespread use has led to significant

contamination of surface and ground water resources across the U.S. corn belt. Restricted layer (clay pan) soils in northeastern Missouri are particularly vulnerable to the transport of both soil and atrazine in surface runoff. To find ways of controlling atrazine losses in these landscapes, a team of ARS scientists in Columbia Missouri, assembled 15 years of data from the 28 square mile Goodwater Creek Experimental Watershed. Researchers from this team isolated and confirmed the identity of an atrazine degrading compound (DIBOA-Glc) from eastern gamagrass that could lead to the development of a commercial product to enhance atrazine degradation in soils. The team also found that a commercially available tillage implement (a rotary harrow) substantially reduced atrazine loss, but did not significantly increase erosion compared to no-till. This research provides key information on atrazine movement, particularly in restricted drainage soils, thus providing mechanisms to help farmers both enhance atrazine degradation and prevent its loss in runoff, while simultaneously maintaining the erosion control benefits of reduced tillage. These findings have the potential to greatly improve the region's most persistent water quality problems, improving the sustainability of crop production while maintaining or increasing farmer profitability.

Climate impacts on agricultural crops assessed for the Midwest. Regional baseline assessments of crop vulnerability to regional climate changes are needed to provide a foundation for developing adaptation strategies. As part of the Midwest Climate Change Hub activities hosted by ARS in Ames, Iowa, climate impacts on annual grain crops, specialty crops, and perennial crops were evaluated across the Midwest. Soil water availability was found to be the most significant factor affecting production in the Midwest. Additionally, the findings showed that within season weather effects on annual production depend on when stress is imposed. Corn and soybean are more tolerant of stress conditions during the vegetative stage than the reproductive stage. Vegetables are affected throughout their growth cycle by weather variations that affect insect pest populations and plant diseases. Perennial crops are affected early in the growing season by below normal temperatures, and late in the growing season by temperature and water stress. These findings indicate that practices that increase soil water storage capacity can help cropping systems become more resilient to climate-related variables during the growing season, and provide guidance for strategies to develop climate smart crop varieties and management systems.

Determination of the "upper lethal growing season average air temperature" for wheat. Adapting wheat production to conditions associated with climate change will require determining how higher air temperatures affect wheat and incorporating this knowledge into growth models. ARS scientists in Maricopa, Arizona, in collaboration with scientists at the University of Arizona in Tucson, conducted a "Hot Serial Cereal Experiment." On six planting dates for the experimental wheat crops, infrared heaters were deployed above some of the plots to provide additional warming. Results showed that yields decreased as season average air temperatures increased above 15°C, and that crops failed once temperatures reached 32°C. These results provide much needed information on the environmental limits for wheat production and will serve as a benchmark for researchers developing new varieties and new management strategies for adapting wheat to the higher air temperature resulting from global change. This research also provides more realistic projections of future climate change effects on wheat, and data for the Agricultural Modeling Intercomparison and Improvement Project.

Corn stover harvest effects on nutrient concentrations in central Iowa. Proponents of cellulosic biofuel need to understand how soil nutrient levels will be affected by removing corn stover for use as feedstock for cellulosic biofuel. More than 500 site years of corn plant samples were collected by ARS scientists in Ames, Iowa, who divided plant samples into different parts (stems, leaves, and grain). All samples were analyzed to determine nutrient concentrations. The results showed that compared to harvesting only the grain, harvesting corn stover increased nitrogen (N), phosphorus (P), and potassium (K) loss by 14, 1.4, and 16 pounds per ton, respectively. The losses of N and P are not considered enough to change current N and P fertilization practices for stover harvest rates of one ton/acre. However, the K loss is sufficiently high to warrant routine soil testing and plant analysis to monitor available K levels. This information provides guidelines for the acquisition of sufficient feedstock supplies to operate emerging cellulosic biofuel investments in a sustainable manner.

Conservation farming mitigates erosion impacts from extreme rainfall events. Although conservation farming practices have substantially reduced erosion and sediment loss, these benefits may be threatened by more frequent high intensity rainfall events. ARS scientists in Tifton, Georgia, evaluated runoff and sediment loss from conventionally tilled (CT) and conservation strip tilled (ST) fields in a Southern Atlantic Coastal Plain landscape during a 10 year rotational cotton peanut production with a rye winter cover crop. Over the 10 years, the mean annual amount of solid material transported by runoff was 87 percent higher in CT fields than in ST fields. Total

runoff from ST fields was 41 percent less than total runoff from the CT fields. The maximum rate of annual soil erosion that still enables continued crop production, known as the soil tolerance value, was exceeded in 3 out of 10 years by CT, but was never exceeded by ST. Extreme rainfall events accounted for 61 to 72 percent of the CT system sediment load and 73 to 84 percent of the ST system sediment load. These results demonstrate that ST management is less susceptible to sediment loss from extreme events than CT systems, and that ST systems are still more effective at reducing sediment loss in this landscape than CT systems. More specifically, the results point to the continued use of cover crops and strip tillage as essential best management practices as the frequency of high intensity rainfall events increases.

Identifying areas that can reduce phosphorus loss on dairy farms. Loss of phosphorus from runoff on dairy farms can pollute local waters; it is difficult to identify the areas on a particular site that are most responsible for these losses. ARS scientists in Madison, Wisconsin, monitored phosphorus runoff from cattle pastures and extensively surveyed four pasture-based dairy farms over a multi-year period. Data on runoff and farm management were combined with topographical information to develop advanced computer models to quantify phosphorus loss from a particular site. The research demonstrated that surveys such as this, in combination with new advanced models, can reliably and quickly determine phosphorus loss from runoff and identify those areas in the greatest need of alternative management.

Early warning of unintended discharge from holding ponds. Unintentional discharge from feedlot runoff holding ponds can potentially contaminate soil and groundwater. Working with the Nebraska's Cattleman's Association, Nebraska's Department of Environmental Quality, and Agra Tek LLC, ARS scientists in Clay Center, Nebraska, developed an automated resistivity array that can be used as an early warning system of these emissions. The technology allows sub-surface observations and greatly expands the surface area monitored compared with traditional monitoring. The system can notify land managers via modem or cell phones when a spill occurs, improving response and clean-up times.

Better computer tools to estimate ammonia emissions from beef cattle feed-yards. Ammonia losses from cattle feed-yards represent both an air pollutant and a loss of nitrogen that could be recycled as a soil amendment. Ammonia emissions will be regulated by the Environmental Protection Agency in the near future, however, the EPA currently lacks an effective model to determine ammonia emissions or estimate management strategies on ammonia fluxes from agricultural operations. ARS scientists in Bushland, Texas, in conjunction with ARS researchers in State College, Pennsylvania, have improved the Integrated Farm Systems Model to estimate feed-yard ammonia emissions. This model is more accurate than current EPA emission models and has the potential to be adapted by regulators, consultants, and producers to better estimate ammonia emissions and determine the effectiveness of different ammonia management strategies to minimize ammonia losses in feed-yards.

New switchgrass hybrid expands opportunities in northern climates and marginal environments. Switchgrass is one of the leading candidates for bioenergy feedstock production, especially in marginal environments where field crops are neither profitable nor sustainable. However, many of those marginal lands are in the more northern USDA Hardiness Zones 3 and 4 where switchgrass is not as productive as it is in the more southern Hardiness Zones 5 and 6. Recent field experiments by ARS scientists in Madison, Wisconsin, demonstrated that biomass yields in Zones 3 and 4 can be increased and competitive to those grown in Zones 5 and 6 through directed selection and breeding for high biomass yield and winter survival following harsh winters. The greatest gains in biomass yield, up to a 50 percent increase, were achieved with hybrid switchgrass that combined the high yield of a southern strain with the winter hardiness of a northern strain. This research provides the first documentation that high yielding switchgrass strains can be productive in Hardiness Zones 3 and 4.

Tools and techniques for multi-scale inventory, monitoring, and assessment of western range lands. Standardized approaches are needed to monitor range lands that enable agencies to share data and address policy needs. ARS scientists in Las Cruces, New Mexico, led in the implementation of ARS developed core land monitoring indicators, field methods, and sample design techniques within the Bureau of Land Management (BLM), which included its national guidance for monitoring solar and oil/gas development impacts and sage grouse habitat. In addition, ARS led in the integration of BLM's monitoring efforts with existing the USDA Natural Resources Conservation Service's (NRCS) National Resources Inventory private land monitoring program. ARS scientists at the Jornada Experimental Range also created Web-based tools for monitoring data analysis and reporting, mobile and tablet-

based data collection applications, and extensive training modules that are deployed with other U.S. agencies and international partners. The inventory, monitoring, and assessment techniques and tools developed at the Jornada Experimental Range are providing managers and policy-makers with information needed to manage resources at local to national scales.

New sand bluestem forage variety released for the arid Southern Plains Region. Under field conditions, soil moisture is often inadequate for the satisfactory establishment of native grass seedlings. These dry soil conditions limit a range land manager's ability to reestablish native grasses after a disturbance, such as drought or energy exploration. ARS scientists in Woodward, Oklahoma, in cooperation with the NRCS in Knox City, Texas, and Manhattan, Kansas, have developed a variety of sand bluestem (a native, perennial, warm season bunch grass) that has superior field emergence and plant density when planted in dry soil conditions. The new variety, named "Centennial," was developed using traditional breeding techniques, and is expected to help increase establishment success with its improved seed germination under dry soil conditions. This variety has demonstrated increased emergence and 17 percent higher plant density compared to other varieties, providing range land managers another viable option when attempting to establish native grasses on disturbed lands.

Linking land use practices to stream and river water quality. Assessing how land use alters water quality of nearby streams and rivers is an important aspect of pollution monitoring and natural resource stewardship. Tools are needed that can quantify how land use alters stream and river water quality over long time periods. ARS scientists in Corvallis, Oregon, collected data over an eight year period to define 56 land use patterns of crops, forests, and urban development that represented 99 percent of the Willamette River Basin of western Oregon. The data which were collected were incorporated into the Soil and Water Assessment Tool model. In validation tests, the model showed an increased capability to predict how land management altered nutrient and sediment load in streams and rivers. Researchers will now be able to determine the environmental consequences of changing land use patterns.

Increasing the efficiency of nitrogen applications in deficit irrigation. When water is limited, nitrogen requirements to maximize crop production changes which makes it economically important to know the appropriate amount of nitrogen to apply. ARS researchers in Fort Collins, Colorado, updated the ARS Root Zone Water Quality Model 2 (RZWQM2) to determine the optimal amounts of nitrogen to be applied to match seven different levels of available soil moisture. Validation of this model with field data indicated that RZWQM2 could be used to optimize nitrogen application rates to different levels of available soil moisture for corn producers in Colorado.

Management practices to improve production in dryland malt barley. Soil degradation reduces production levels and can limit available soil nutrients. Conventional tillage with malt barley fallow rotation has reduced soil quality and annual grain yield by contributing to the loss of soil organic matter. ARS scientists in Sidney, Montana, have identified a robust management practice that includes a no-till barley pea rotation that can minimize soil degradation. Implementation of this practice can reduce the need for nitrogen fertilization by 54 percent, and nitrogen losses through leaching, volatilization, and denitrification by 125 percent. At the same time, this practice was found to increase soil carbon storage by 11 percent and enhance malt barley yield and quality as much as 44 percent compared with traditional tillage practices. Implementation of this practice by producers can reduce chemical input and energy needs, enhance soil quality, and sustain dryland malt barley yield and quality.

Conservation tillage can increase soil carbon sequestration in the southeastern United States. The ability of soil to sequester carbon can improve long-term soil health while acting to mitigate greenhouse gas emissions. Conservation systems that utilize minimal soil disturbance combined with high residue cover crops enhance carbon sequestration, but no tool is available to determine carbon sequestration amounts across specific conservation systems. ARS scientists in Auburn, Alabama, compared numerous conservation tillage systems and winter cover crops to derive a means to quantify and compare how much carbon each system sequestered. They determined that cover crops added an average of 2,500 kilograms of carbon per hectare, while corn residue only added 1,340 kilograms of carbon per hectare to the soil each year. The scientists concluded that a number of winter cover crops have significant potential to sequester additional carbon. The findings demonstrate that the use of conservation systems that include cover crops can improve soil health and could offset CO_2 emissions across degraded coast plain soils for the southeastern United States.

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 its web site, http://www.nal.usda.gov. NAL was created with the USDA in 1862 and was named a national library in 1962, 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 Nation's agricultural heritage, the provider of world class information, and a 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. The Library's vision is "advancing access to global information for agriculture."

Selected Examples of Recent Progress:

PubAg. NAL launched a preliminary version of PubAg, a portal for literature searches and full-text access of more than 40,000 scientific journal articles written by USDA researchers, mostly from 1997 to 2014. PubAg also provides access to 340,000 peer reviewed, agriculture-related scientific articles, published primarily between 2002 and 2012. Each article citation in PubAg includes an abstract, NAL Thesaurus subject terms, and a link to the article if available from the publisher. This initial group of highly relevant, high quality literature from the four million bibliographic citations in the AGRICOLA Index database was used to establish PubAg. PubAg can be found at http://PubAg.nal.usda.gov.

Automated indexing. NAL is continuously improving full scale production—automated indexing/text analytics software to generate the AGRICOLA Index of agricultural literature. This application combines semantic analysis, machine learning, and human constructed rules to automatically assign NAL Thesaurus subject terms to journal article citations. This metadata facilitates effective literature classification, management, search, and retrieval. In FY 2014, NAL used the system to index 185,006 articles, an increase of 78,000 articles over FY 2013 production.

i5K Workspace at NAL. In FY 2014, NAL launched the i5K (insect 5,000 genome) Workspace (https://i5k.nal.usda.gov/) to meet the initiatives needs for genome hosting and other bioinformatics services. The Workspace currently hosts 35 genomes with several more in the pipeline. Approximately 200 researchers are involved in community annotation. Content is accessible via organism pages, genome browsers, and a completely updated and improved BLAST search engine, implemented via the open source Tripal framework, a Web interface for the underlying Chado database schema.

VIVO. In FY 2014, NAL publically launched VIVO, a Web application used internally by USDA scientists since 2012, to allow for better national networking across disciplines and locations. USDA VIVO will be a "one-stop shop" for Federal agriculture expertise and research outcomes. This efficient networking tool enables scientists to more easily locate others with a particular expertise that may contribute to a project's success. VIVO also makes it possible to quickly identify scientific expertise to address and rapidly mobilize a response on emerging agricultural issues, such as specific plant and animal diseases or pests.

Digitization of NAL collections. NAL is in the midst of a large scale digitization project to digitize agricultural literature and provide online access to the general public. Important and distinctive items were selected from the NAL collection, with an initial focus on USDA issued publications and nursery and seed trade catalogs. In FY 2014, NAL successfully digitized and created citation information for 38,698 items (1,508,812 pages). Publications are accessible at https://archive.org/details/usdanationalagriculturallibrary.

NAL Digital Collections. As of the end of FY 2014, NAL's digital repository of full text content comprises nine collections, including nearly 50,000 peer reviewed journal articles authored by USDA researchers, and more than 30,000 historical documents and reports. Citizens downloaded nearly three million full text items during the year.

DigiTop. In FY 2014, NAL obtained contributions from across USDA to purchase nearly $4.5 million in licensed full text databases to support research and scientific discovery. Just over two years ago, NAL launched a new component of DigiTop, called Navigator, that enables cross searching of multiple bibliographic databases. This system includes AGRICOLA, AGRIS, BIOSIS, CAB Abstracts, Fish, Fisheries & Aquatic Biodiversity Worldwide, Food Science and Technology Abstracts, GEOBASE, GeoRef, MEDLINE, Wildlife & Ecology Studies Worldwide, Scopus, and Zoological Record. The Navigator service allows researchers to access nearly 79 million records at once and is updated weekly.

The estimates include appropriation language for this item as follows (new language underscored; deleted matter enclosed in brackets):

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, [$45,000,000] $205,901,000, to remain available until expended.

Lead-Off Tabular Statement

Buildings and Facilities

Budget Estimate, 2016	$205,901,000
2015 Enacted	45,000,000
Change in Appropriation	+160,901,000

Summary of Increases and Decreases
(Dollars in thousands)

Program	2013 Actual	2014 Change	2015 Change	2016 Change	2016 Estimate
Discretionary Appropriations:					
Arizona: Southwest Watershed Research Center, Tucson	-	-	-	+$12,400	$12,400
Georgia: Biocontainment Laboratory and Poultry Research Facility, Athens	-	-	+$45,000	+68,701	113,701
Iowa: National Laboratory for Agriculture and the Environment, Ames	-	-	-	+13,500	13,500
Maryland: Beltsville Agricultural Research Center, Building 307, Beltsville	-	-	-	+37,100	37,100
Texas: Children's Nutrition Research Center, Houston	-	-	-	+29,200	29,200
Total	-	-	+45,000	+160,901	205,901

Buildings and Facilities

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

Program	2013 Actual		2014 Actual		2015 Enacted		Inc. or Dec.		2016 Estimate	
	Amount	SYs	Amount	SYs	Amount	SYs	Amount	SYs	Amount	SYs
Discretionary Appropriations:										
Buildings and Facilities.....	-	-	-	-	$45,000	-	+$160,901	-	$205,901	-
Subtotal.....	-	-	-	-	45,000	-	+160,901	-	205,901	-
Rescissions, Transfers, and Seq. (Net).....	-	-	-	-	-	-	-	-	-	-
Total Appropriation.....	-	-	-	-	45,000	-	+160,901	-	205,901	-
Rescission.....	-	-	-	-	-1,530	-	+1,530	-	-	-
Bal. Available, SOY.....	$5,247	-	$2,892	-	1,530	-	+33,470	-	35,000	-
Recoveries, Other (Net).....	274	-	7	-	-	-	-	-	-	-
Total Available.....	5,521	-	2,899	-	45,000	-	+195,901	-	240,901	-
Lapsing Balances.....	-	-	-	-	-	-	-	-	-	-
Bal. Available, EOY.....	-2,892	-	-1,530	-	-35,000	-	-49,900	-	-84,900	-
Total Obligations.....	2,629	-	1,369	-	10,000	-	+146,001	-	156,001	-

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

Program	2013 Actual		2014 Actual		2015 Enacted		Inc. or Dec		2016 Estimate	
	Amount	SYs	Amount	SYs	Amount	SYs	Amount	SYs	Amount	SYs
Discretionary Obligations:										
Buildings and Facilities...	$2,629	-	$1,369	-	$10,000	-	+$146,001	-	$156,001	-
Total Obligations.....	2,629	-	1,369	-	10,000	-	+146,001	-	156,001	-
Bal. Available, EOY.....	2,892	-	1,530	-	35,000	-	+49,900	-	84,900	-
Total Available.....	5,521	-	2,899	-	45,000	-	+195,901	-	240,901	-
Rescission.....	-	-	-	-	1,530	-	-1,530	-	-	-
Bal. Available, SOY.....	-5,247	-	-2,892	-	-1,530	-	-33,470	-	-35,000	-
Other Adjustments (Net).....	-274	-	-7	-	-	-	-	-	-	-
Total Appropriation.....	-	-	-	-	45,000	-	160,901	-	205,901	-

Justifications of Increases and Decreases

Buildings and Facilities

(1) An increase of $205,901,000 for ARS' Buildings and Facilities.

As the principal intramural scientific research agency of the Department, ARS operates an extensive network of more than 100 Federally-owned research facilities. These facilities are strategically located throughout the United States, reflective of the wide geographic diversity and site specificity of agricultural production; distinct climatic and agroecosystem zones; and responsive to the numerous research partners, cooperators, and customers/users with which ARS works. ARS' laboratory infrastructure, consisting of 4,600 individual buildings and structures on over 400,000 acres of Federal land, is now valued at nearly $3.7 billion.

In April 2012, ARS completed an extensive review of the agency's laboratory portfolio and developed a plan for future capital investments at the request of the Secretary and Congress. The review, reported as the "Capital Investment Strategy" (CIS), highlighted the agency's aging infrastructure and recommended modernization of selected priority facilities. Many of these facilities are at the limit or well in excess of their "functional lifespan" according to engineering standards. The highest priority in the CIS report was ARS' Southeast Poultry Research Facility (SEPRL) in Athens, Georgia.

The funding change is requested for the following items:

a) An increase of $113,701,000 for the construction of the Biocontainment Laboratory and Consolidated Poultry Research Facility, Athens, Georgia.

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.

SEPRL 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 Biological Safety Laboratory (BSL)-2 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.

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 $158.7 million. In 2015, ARS has allocated $45 million toward the planning and design of the entire facility, and Phase 1A which includes: construction of a BSL-3 animal building/laboratory, waste contamination facility, incubation/growing building, breeding building, and utility infrastructure. In 2016, ARS requests $113.7 million to complete construction of the entire facility which includes: Phase 1B – construction of a BSL-2 laboratory and administration building ($36 million); Phase 1C – demolition of six buildings, and construction of a hatchery, duck breeding building, feed storage building, and breeding/brooding building ($26 million); Phase 2 – demolition of 17 buildings, and construction of a BSL-2 animal building/laboratory, and two production buildings ($32 million); and Phase 3 – demolition of the waste treatment facility, modernization of 10 existing buildings, and completion of site work and roadways ($19.7 million).

b) An increase of $37,100,000 for the modernization of Building 307, Beltsville Agricultural Research Center, Beltsville, Maryland.

Beltsville Agricultural Research Center's (BARC) Building 307 currently serves as the IT hub for the BARC-East Campus. The IT hub supports ARS' programs and activities as well as the activities of other tenants including the Secret Service, NRCS, APHIS, and the U.S. Geological Survey.

Design and construction of Building 307 is among the highest priority facility needs identified in the CIS report. The new building will be used for a mix of office and generic laboratory space, consolidating animal science, human nutrition, and honey bee research which is currently dispersed and housed in much smaller, energy inefficient buildings. This project is consistent with the BARC master plan, and represents a major step in consolidating ARS' laboratories and offices along the Powder Mill Road corridor.

In 2016, ARS requests $37.1 million to fully fund the design and construction of Building 307. Design ($1.5 million) will be completed in 2016, with construction ($35.6 million) beginning in 2017 and completed in 2018.

c) An increase of $13,500,000 for the modernization of the National Laboratory for Agriculture and the Environment, Ames, Iowa.

In 2016, ARS is proposing an additional $13.5 million to fully fund the design and construction efforts to modernize the National Laboratory for Agriculture and the Environment in Ames, Iowa. The laboratory conducts research that addresses critical problems in agriculture and watershed management which leads to improved environmental quality, sustainability, and enhanced agricultural system efficiency.

The Ames, Iowa laboratory is among the agency's highest priority facility needs, after the Biocontainment Laboratory and Consolidated Poultry Research Laboratory in Athens, Georgia, and Building 307 at the Beltsville Agriculture Research Center in Beltsville, Maryland. The laboratory was constructed in 1987 and is a now 27 years old. There are serious safety problems related to outdated systems and equipment

including the water distribution system, fire alarm system, emergency generation equipment, and HVAC system. The current laboratory space is also in need of reconfiguration, as increased space for IT and analytical equipment is required.

d) An increase of $12,400,000 for the modernization of the Southwest Watershed Research Center, Tucson, Arizona.

The Center develops watershed systems/technologies which help maintain or enhance the Nation's Southeastern Central Plains' natural resources upon which the region's agriculture depends. The laboratory's principal focus is on hydrologic processes related to or affected by the climate, soils, geology, or watershed structure. Research is conducted on the fate and transport of agri-chemicals, such as nitrogen and phosphorus, that are used in agriculture; and on the physical and biological structure and function of watershed ecosystems.

The Center currently consists of a number of small, aging buildings constructed over 40 years ago that are spread over the complex. The buildings' systems (including plumbing, HVAC, and fire safety) have exceeded their expected life service. The new building (20,000 gross square feet) would replace the outdated facilities and satisfy the Center's space requirements, bringing together all the scientists and staff into one building.

In 2016, ARS requests $12.4 million to fund the design and construction of the Southwest Watershed Research Center.

e) An increase of $29,200,000 for the modernization of the Children's Nutrition Research Center, Houston, Texas.

The Children's Nutrition Center researches the dietary needs of pregnant and lactating women, and children from conception though adolescence. Research is conducted to: determine the role of nutrition in prenatal development, and in optimal health and growth; identify childhood dietary habits that contribute to long-term health and the prevention of diet-related diseases; and investigate the developmental origins of obesity, cardiovascular diseases, and chronic illnesses. The Nutrition Center and its research is one of the agency's top program priorities.

The Center was constructed in 1986. Many of the Center's systems are obsolete and need to be replaced. Items that need to be replaced include the Center's elevators; the building roof; the biosafety cabinets and fume hoods; the laboratory exhaust system; the air handlers, and the fire alarm system.

In 2016, the agency requests $29.2 million for the modernization of the Children's Nutrition Research Center.

Buildings and Facilities

Classification by Objects
(Dollars in thousands)

		2013 Actual	2014 Actual	2015 Enacted	2016 Estimate
Other Objects:					
25.2	Other services from non-Federal sources.....	$418	-	-	-
25.4	Operation and maintenance of facilities.....	2,106	-	-	-
32.0	Land and structures.....	105	$1,369	$10,000	$156,001
	Total, Other Objects.....	2,629	1,369	10,000	156,001
99.9	Total, new obligations.....	2,629	1,369	10,000	156,001

Status of Construction Projects as of December 2014

Status of research facilities authorized or funded in prior years and reported as uncompleted in the 2015 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) was completed 1st Quarter 2010. Construction contract award for the final phases 3 thru 6 was awarded 3rd Quarter 2010 with ARRA funding and will be completed 3rd Quarter 2015.
Western Regional	2001 Construction	4,889,220	
Research Center	2002 Construction	3,800,000	
(R&D Facility)	2009 ARRA	15,624,460	
	2015 Rescission	($166)	
	Total	26,913,514	
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 completed 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)	
	2015 Rescission	($149,125)	
	Total	783,989	
Georgia, Athens	1992 Planning	$400,000	Draft POR completed 1st Quarter 2007. The current POR must be revised to reduce
Southeast Poultry Research	1993 Construction	677,000	scope to meet approved funding. Revised POR will be awarded in the 3rd quarter of
Laboratory	2008 Planning and Design	2,780,400	2015 and completed in the 4th qtr of 2015. Design will be awarded in the 4th qtr of 2015
	2009 Planning and Design	2,427,000	and completed in the 3rd quarter of 2016.
	2011 Rescission	($5,832,898)	Construction of Phase 1A will be awarded in the 4th quarter of 2016
	2015 Planning,Design,Const.	45,000,000	and completed in the 1st quarter of 2018.
	Total	45,451,502	
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)	
	2015 Rescission	($129,570)	
	Total	31,808,304	
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	

Location and Purpose	Year	Amount of Funds Provided	Description
	2009 ARRA	16,237,165	
	2015 Rescission	($142,565)	
	Total	37,705,239	
Iowa, Ames	2001 Design & Construction	$8,980,200	The accelerated plan for the completion of the modernization of ARS/APHIS animal facilities is in
National Centers for	2002 Design & Construction	40,000,000	progress. All major components of the modernization are complete.
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
	2003 Construction	32,785,500	construction completed 1st Quarter 2009.
	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
	2015 Rescission	($1,108,686)	of existing facilities on 1st and 2nd St complete 3rd Quarter 2012. Bldgs. 1 & 2 demo will be
	Total	460,646,014	complete 1st Quarter 2016.
Kentucky, Bowling Green	2005 Planning and Design	$2,281,600	POR is complete for total project. Design (100%) for the Headhouse/Greenhouse only was
Animal Waste Management	2006 Construction	2,970,000	completed 3rd Quarter 2008. Lease agreement is in place. Construction of the GH/HH was
Research Laboratory	2008 Construction	1,390,200	awarded 4th Quarter 2010 and was completed 2nd Quarter 2012.
	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
Research Laboratory	2008 Construction	2,085,300	2011.
	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
Sugarcane Research	2005 Construction	2,976,000	some elements within the available funding was completed 2nd Quarter 2008. Phase 1A
	2006 Construction	3,588,750	construction was completed 4th Quarter 2010. Phase 1b construction awarded 2nd Quarter 2011
	2008 Construction	1,869,819	and completed in the 3rd Quarter 2013.
	2009 Construction	2,505,000	
	2010 Construction	3,654,000	
	2015 Rescission	($100)	
	Total	15,935,504	
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
Southern Regional	1999 Modernization	6,000,000	Restoration (LTR) of facilities damaged by Hurricane Katrina. Design (100%) for the LTR of

Location and Purpose	Year	Amount of Funds Provided	Description
Research Center	2000 Modernization	5,500,000	facilities was completed 4th Quarter 2008. Construction of the LTR was awarded 3rd Quarter 2009
(Industrial Wing)	2006 Supplemental (design)	4,900,000	and completed 3rd Quarter 2011.
	2006 Supplemental (construction)	20,000,000	
	Total	37,500,000	
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
National Cold Water Marine	2002 Construction	3,000,000	complete. Program for the laboratory facility located at the University Campus in Orono, ME needs
Aquaculture Center	2003 Construction	9,090,525	to be developed.
	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
Beltsville Agricultural Research	1989 Design & Construction	6,100,000	2009. Construction contract for repairs to boiler plants and portions of the steam distribution
Center, (BARC)	1990 Design & Construction	9,860,000	system was awarded 4th Quarter 2010 with ARRA funding and were completed 2nd Quarter 2012.
	1991 Design & Construction	15,999,792	Design-Build contract for major renovations to Building 306 was awarded 4th Quarter 2010 with ARRA funding and was completed 4th Quarter 2012.
	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	

**Appropriated under USDA Rental Payments Account

Location and Purpose	Year	Amount of Funds Provided	Description
Maryland, Beltsville National Agricultural Library	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.
	1999 Design & Construction	1,200,000	
	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	
Michigan, East Lansing Avian Disease and Oncology Laboratory	1992 Planning	$250,000	Design (100%) for this multi-phased facility modernization is complete.
	1993 Planning	212,000	
	1998 Planning and Design	1,800,000	
	2011 Rescission	($63,193)	
	Total	2,198,807	
Mississippi, Lorman Biotechnology Laboratory Alcorn State University	2006 Planning and Design	$1,980,000	A lease agreement with Alcorn State University for the new facility was completed 4th Quarter 2009. POR was completed 3rd Quarter 2008.
	2008 Planning and Design	1,390,200	
	2009 Construction	1,176,000	
	2010 Construction	1,500,000	
	2011 Rescission	($5,798,055)	
	Total	248,145	
Mississippi, Poplarville Thad Cochran Southern Horticultural Laboratory	2002 Design	$800,000	Construction of the Headhouse/Greenhouse was awarded 4th Quarter 2007 and completed 1st Quarter 2008.
	2003 Construction	9,140,200	
	2006 Supplemental	4,300,000	
	2011 Rescission	($9,178)	
	Total	14,231,022	
Mississippi, Starkville Poultry Science Research Facility	2005 Planning and Design	$2,976,000	Lease agreement is in place. Design (100%) was completed 1st Quarter 2008.
	2006 Construction	4,950,000	
	2008 Construction	1,390,200	
	2009 Construction	3,177,000	
	2011 Rescission	($10,345,645)	
	Total	2,147,555	
Mississippi, Stoneville Jamie Whitten Delta States Research Center	2004 Construction	$4,831,326	Design (100%) is complete. Construction of Phase 1 is complete. Construction of mechanical, electrical, and plumbing systems for phases 2 thru 5 (of 5 total) and repair of deteriorated building envelope was awarded 3rd Quarter 2010. Phase 2 and 3 were completed 1st Quarter 2013, Phase 4 will be completed in the 2nd quarter of 2015, and Phase 5 will be completed in the 4th Quarter 2015.
	2005 Construction	2,976,000	
	2008 Construction	2,780,400	
	2009 ARRA	36,347,783	
	2010 Construction	4,000,000	
	2011 Rescission	($6,047,327)	
	2015 Rescission	($134)	
	Total	44,888,048	

Location and Purpose	Year	Amount of Funds Provided	Description
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	
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
Northern Plains Agricultural	1999 Construction	7,300,000	Lab) was completed 4th Quarter 2008.
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	

Location and Purpose	Year	Amount of Funds Provided	Description
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	
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	
	2015 Rescission	($2)	
	Total	36,784,484	
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	

Location and Purpose	Year	Amount of Funds Provided	Description
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	
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, objectives, performance measures, and targets that contribute to the Department's Strategic Goals. Not all of ARS' performance measures and targets are shown here.

USDA 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.

Agency Strategic Goal	Agency Objectives	Programs that Contribute	Key Outcomes
Agency Goal Area 2: Natural Resources and Sustainable Agricultural Systems	Objective 2.1: Integrated, effective, and safe water resource management.	Water Availability and Watershed Management	Key Outcome 2.1: Safe, abundant, and reliable water resources.
	Objective 2.2: Improve quality of atmosphere and soil resources, and understand effects of climate change.	Climate Change, Soils, and Emissions Research	Key Outcome 2.2: Enhanced crop production and improved environmental quality.

USDA Strategic Objective: Lead Efforts to Mitigate and Adapt to Climate Change, Drought, and Extreme Weather in Agriculture and Forestry. (Objective 2.2)

Key Performance Measures:

Improve the quality of atmosphere and soil resources; and understand the effects of climate change through the development of knowledge and technologies.

2012 Actual	2013 Actual	2014 Actual	2015 Target	2016 Target
•Developed one technology or decision tool to predict carbon sequestration in the soil.	•Developed one technology or decision tool to predict carbon sequestration in the soil.	• Developed one technology or decision tool to predict carbon sequestration in the soil.	•Develop one technology or decision tool to predict carbon sequestration in the soil.	•Create and make openly available, a database of air emissions from crop land agricultural production systems.

2012 Actual	2013 Actual	2014 Actual	2015 Target	2016 Target
•Reduced risks to agricultural production/ ecosystem services from interacting climate-related stresses. •Adapted agricultural systems to climate variability and weather extremes. •Advanced the capacity for assessing the impacts of climate and environment on food, feed, and fiber production. •Developed one management practice or control technology to reduce emissions from agricultural operations. •Developed methods to genotypically/ phenotypically characterize large numbers of crop species and varieties in collections to develop high yielding and profitable crops.	•Reduced risks to agricultural production/ ecosystem services from interacting climate-related stresses. •Adapted agricultural systems to climate variability and weather extremes. •Advanced the capacity for assessing the impacts of climate and environment on food, feed, and fiber production.	•Reduced risks to agricultural production/ ecosystem services from interacting climate-related stresses. •Adapted agricultural systems to climate variability and weather extremes. •Reduced agriculture's vulnerability to climate change. •Developed and deploy common standards for data formats and common vocabulary; ontologies that support Germplasm (G), Environmental (E), and Management (M) data integration, thus enabling the generation of computational models for plant and animal production that integrate genotype, environmental and production factors into the adaptation of agriculture to climate change. •Developed and applied database mining and data integration methods to combine ecogeographical and agroclimatic information from	•Reduce risks to agricultural production/ ecosystem services from interacting climate-related stresses. •Develop technologies/ practices to adapt agricultural systems to climate variability and weather extremes. •Reduce agriculture's vulnerability to climate change.	•Demonstrate the utility of approaching agricultural climate change adaptation through the Genetics -- Environment -- Management -- approach. •Improve soil resources by managing microbes in the environment. •Determine the potential effects of various climate change scenarios on the transmission of animal, food, and waterborne diseases, and on the micronutrient composition of plant foods. •Determine the suitability of the current degree of genetic variation of crops to maintain yields/nutritional quality under a changing climate. •Identify/evaluate management practices that maximize the genetic potential to achieve optimal yield/quality with climate change. •Advance understanding of the effects of climate change on pests.

2012 Actual	2013 Actual	2014 Actual	2015 Target	2016 Target
		GIS databases with trait and genotypic data in GRIN-Global. This accelerated the delivery of germplasm with specific adaptations/ tolerances to abiotic stresses, such as drought and heat. •Expanded and integrated research teams of breeders, bioinformaticists, geneticists, genebank customers, and modelers to support the breeding of climate resilient crops and livestock.		•Utilize USDA's Climate Hubs to disseminate climate change research results. •Determine the vulnerability of different agronomic systems to production losses associated with climate change.

<u>USDA Strategic Objective</u>: Contribute to Clean and Abundant Water by Protecting and Enhancing Water Resources on National Forests and Working Lands. (Objective 2.3)

<u>Key Performance Measures</u>:

Develop technology and practices to promote improvement of integrated, effective, and safe water resource management.

2012 Actual	2013 Actual	2014 Actual	2015 Target	2016 Target
•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	•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	•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	•Develop tools and technologies to improve the effectiveness of agricultural water management. •Improve the scientific understanding of erosion, sedimentation, and contaminant transport processes from agricultural fields and	•Continue to develop tools and technologies to improve the effectiveness of agricultural water management. •Continue to improve the scientific understanding of erosion, sedimentation, and contaminant transport processes from agricultural fields and landscapes to facilitate the

2012 Actual	2013 Actual	2014 Actual	2015 Target	2016 Target
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. •Provided 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.	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. •Provided 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. •Developed sustainable water management strategies.	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. •Provided 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. •Developed sustainable water management strategies.	landscapes to facilitate the development of tools and technologies to better protect agricultural water quality. •Develop strategies to improve the effectiveness of agricultural conservation efforts by developing new or improved conservation practices, improving practice placement to maximize effectiveness and minimize cost, and developing a better understanding of the effects of agricultural conservation at the landscape scale. •Conduct research to improve watershed management and ecosystem services in agricultural landscapes.	development of tools and technologies to better protect agricultural water quality. •Continue to develop strategies to improve the effectiveness of agricultural conservation efforts by: developing new or improved conservation practices; improving practice placement to maximize effectiveness and minimize cost; and developing a better understanding of the effects of agricultural conservation at the landscape scale. •Continue to conduct research to improve watershed management and ecosystem services. •Conserve water resources and manage drought for small farms using improved tools and technologies. •Develop the means to reduce the vulnerability of the water supply for major cropping systems.

2012 Actual	2013 Actual	2014 Actual	2015 Target	2016 Target
•Developed sustainable water management strategies. •Enhanced the quantity/quality of water resources for agriculture.	•Enhanced the quantity/quality of water resources for agriculture.	•Enhanced the quantity/quality of water resources for agriculture. •Enhanced data collection, management, analyses, and syntheses for research on watersheds. •Expanded research capacity in the earth sciences.		

Environmental Stewardship

Selected Past Accomplishments toward Achievement of the Key Outcome

- Implemented a global root zone soil moisture monitoring system, and soil moisture maps that are critically important for commodity markets, improving flood warning systems, and forecasting disasters such as droughts.
- Reduced phosphorus loss from agricultural lands to ensure and increase the availability of safe drinking water.
- Developed a new model for managing snow melt in the western United States.
- Controlled atrazine (the most prevalent soil applied herbicide used in corn cultivation) losses in agricultural watersheds, thereby improving water quality and crop production.
- Assessed climate impacts on agricultural crops in the Midwest.
- Provided information on the environmental limits for wheat production which is needed for developing new varieties, and new management strategies for adapting wheat to the higher temperatures resulting from global change.
- Developed advanced computer models to quantify phosphons loss from runoff and identify those areas in need of alternative management.
- Developed an automated resistivity array that can be used as an early warning system of unintended discharge from feedlot runoff holding ponds which can contaminate soil and groundwater.
- Developed a model that demonstrates how land management alters nutrient and sediment loads in streams and rivers.
- Determined that conservation practices that include cover crops can increase soil carbon sequestration in the Southwestern United States.

Selected Accomplishments Expected at the 2016 Proposed Resource Level

- Demonstrate the utility of agricultural climate change adaptation through the Genetics, Environment, Management (GEM) approach.
- Determine the potential effects of various climate change scenarios on the transmission of animal, food, and waterborne diseases, and on the micronutrient composition of plant foods.
- Determine the suitability of the current degree of genetic variation of crops to maintain yields/nutritional quality under a changing climate.
- Identify/evaluate management practices that maximize the genetic potential to achieve optimal yield/quality with climate change.

- Advance understanding of the effects of climate change on pests.
- Utilize USDA's Climate Hubs to disseminate climate change research results.
- Determine the vulnerability of different agronomic systems to production losses associated with climate change.
- Develop tools and technologies to improve the effectiveness of agricultural water management.
- Improve the scientific understanding of erosion, sedimentation, and containment transport processes from agricultural fields and landscapes to facilitate the development of tools and technologies to better protect agricultural water quality.
- Improve watershed management and ecosystem services.
- Conserve water resources and manage drought for small farms using improved tools and technologies.
- Develop the means to reduce the vulnerability of the water supply for major cropping systems.
- Develop grazing management strategies better adapted to drought.
- Manage water resources across spatial and temporal scales.

USDA Strategic Goal: Help America Promote Agricultural Production and Biotechnology Exports as America Works to Increase Food Security.

Agency Strategic Goal	Agency Objectives	Programs that Contribute	Key Outcomes
Agency Goal Area 3: Crop Production and Protection	Objective 3.1: Enhance the crop genetic resource base; increase knowledge of crop genes, genomes, and biological processes/ systems; and deliver technologies that improve production quality, health, and value of the Nation's crops.	Plant Genetic Resources, Genomics, and Genetic Improvement Crop Production	Key Outcome 3.1: Information and technology producers can use to compete more economically in the marketplace.
Agency Goal Area 4: Animal Production and Protection	Objective 4.1: Provide scientific information and biotechnologies to enhance management practices that will ensure an abundant supply of competitively priced animal/aquaculture products.	Food Animal Production Aquaculture	Key Outcome 4.1: Information and technology producers can use to compete more economically in the marketplace.

USDA Strategic Objective: Ensure U.S. Agricultural Resources Contribute to Enhanced Global Food Security. (Objective 3.1)

Key Performance Measures:

Develop knowledge, strategies, systems, and technologies that maximize the production efficiency of our annual, perennial, greenhouse, and nursery cropping systems. Develop new technologies and tools contributing to improving these systems to meet current and future food crop production needs of diversified consumers, while ensuring economic and environmental sustainability and production efficiency, health, and value of our Nation's crops.

2012 Actual	2013 Actual	2014 Actual	2015 Target	2016 Target
•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 effectiveness of crop improvement programs. •Maintained and expand USDA germplasm collections in a healthy, secure, and easily accessible form. •Distributed germplasm for research purposes. •Increased crop genetic resource regeneration, and safeguard collection. •Secured more wild relatives of crops in gene banks.	•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 effectiveness of crop improvement programs. •Maintained and expand USDA germplasm collections in a healthy, secure, and easily accessible form. •Distributed germplasm for research purposes. •Increased crop genetic resource regeneration, and safeguard collection.	•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 effectiveness of crop improvement programs. •Maintained and expanded USDA germplasm collections in a healthy, secure, and easily accessible form. •Distributed germplasm for research purposes. •Increased crop genetic resource regeneration, and safeguard collection.	•Develop leading edge genomic technologies, and breed superior, new crops, varieties, and enhanced germplasm and genetic resources. •Devise innovative approaches to crop genetic improvement and trait analysis. •Expand crop genomic information resources and advanced bioinformatic capabilities. •Expand fundamental knowledge of plant biological and molecular processes. •Maintain and expand USDA germplasm collections in a healthy, secure, and easily accessible form.	•Devise innovative approaches to crop genetic improvement and trait analysis. •Expand crop genomic information resources and advanced bioinformatic capabilities. •Expand fundamental knowledge of plant biological and molecular processes. •Maintain and expand USDA germplasm collections in a healthy, secure, and easily accessible form. •Increase crop genetic resource regeneration, and safeguard collection. •Develop crop production strategies to optimize crop genetic potential, mitigate losses due to biotic and abiotic stresses, and increase production efficiency.

2012 Actual	2013 Actual	2014 Actual	2015 Target	2016 Target
•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. •Developed more productive, disease free floricultural and nursery crops. •Applied a computer decision support system for crop and animal production that reduces production risks/losses. •Applied biocontrol technologies to crop plants to enhance disease resistance. •Developed plant varieties and ecologically-based soil/plant management strategies.	•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. •Developed more productive, disease free floricultural and nursery crops. •Applied a computer decision support system for crop and animal production that reduces production risks/losses. •Applied biocontrol technologies to crop plants to enhance disease resistance. •Developed plant varieties and ecologically-based soil/plant management strategies.	•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. •Researched maize, other cereals, and perennial grasses to provide better data analysis to accelerate crop yields, feed, and bioenergy. •Researched tree fruit vegetable, and food legume crops to provide enhanced data analysis to improve yield, nutrition, quality. •Improved sustainability of crop production systems. •Applied a computer decision support system for crop and animal production that reduces production risks/losses. •Applied biocontrol technologies to crop plants to enhance disease resistance.	•Increase crop genetic resource regeneration, and safeguard collection. •Develop crop production strategies to optimize crop genetic potential, mitigate losses due to biotic and abiotic stresses, and increase production efficiency. •Integrate crop cultivars, management strategies for abiotic and biotic stresses, and mechanization technologies into improved, productive, profitable, and environmentally acceptable crop production systems. •Distribute germplasm for research purposes. •Evaluate and characterize germplasm of wild relatives of crops to facilitate its use in crop breeding and research.	•Integrate crop cultivars, management strategies for abiotic and biotic stresses, and mechanization technologies into improved, productive, profitable, and environmentally acceptable crop production systems. •Enhance the health and productivity of farming systems. •Breed fruits and vegetables with enhanced nutritional value. •Breed crops and develop IPM for small scale farming operations. •Expand the National Plant Germplasm System. •Apply genetic/ genomic approaches to improve organic farming systems. •Identify and preserve native crop species. •Provide training/ information to Native Americans on traditionally and culturally important crops. •Develop best management practices to promote pollinator health and reduce/prevent

2012 Actual	2013 Actual	2014 Actual	2015 Target	2016 Target
		•Developed plant varieties and ecologically-based soil/plant management strategies.		Colony Collapse Disorder. •Improve agricultural sustainability. •Develop high value horticultural varieties that are adapted for growth in greenhouses that will extend the growing season and meet the needs of local food markets. •Provide new methods/technologies for insect/disease control during greenhouse production. •Host an Apprentice Farmer Program at BARC. •Establish the Transformational Breeding Initiative that includes new automated systems for high throughput crop analyses in the field; genetic analyses of genomic and genetic stocks/ germplasm; and bioinformatics and cyber- infrastructure.

Crop Production

Selected Past Accomplishments toward Achievement of the Key Outcome

- Released a new hybrid sweet orange with excellent tolerance to citrus greening, a disease that has reduced Florida citrus production by 50 percent.
- Determined how climate change could impact the nutritional qualities of wheat, rice, maize, sorghum, and soybean.

- Released a new apple rootstock with tolerance to apple replant disease, and resistant to fire blight and crown rot, two serious diseases that infect apple trees.
- Found new soybean genes which can increase crop yields.
- Invented an automated, variable rate, air assisted precision sprayer that minimizes human involvement in determining the amount of pesticide spray needed.
- Developed a trellis tension monitoring system that can be used to estimate grapevine yields.
- Demonstrated that honey bee protein supplements have less protein than pollen, and that bees fed protein supplements have a higher incidence of disease.
- Developed a rotating, cross arm trellis that allows blackberry vines to be rotated to the ground and covered with a protective, floating row cover to protect dormant vines from extreme temperatures.
- Determined that sugar and cane yields can be optimized with variable application rates of fertilizer, which could save sugarcane producers millions of dollars.

Selected Accomplishments Expected at the 2016 Proposed Resource Level

- Devise innovative approaches to crop genetic improvement and trait analysis.
- Expand crop genomic information resources and advanced bioinformatic capabilities.
- Expand fundamental knowledge of plant biological and molecular processes.
- Maintain and expand USDA germplasm collections in a healthy, secure, and easily accessible form.
- Increase crop genetic resource regeneration, and safeguard collection.
- Develop crop production strategies to optimize crop genetic potential, mitigate losses due to biotic and abiotic stresses, and increase production efficiency.
- Breed fruits and vegetables with enhanced nutritional value.
- Breed crops and develop IPM for small scale farming operations.
- Apply genetic/genomic approaches to improve organic farming systems.
- Identify and preserve native crop species.
- Provide training/information to Native Americans on traditionally and culturally important crops.
- Develop best management practices to promote pollinator health and reduce/prevent Colony Collapse Disorder.
- Improve agricultural sustainability.
- Develop high value horticultural varieties that are adapted for growth in greenhouses that will extend the growing season and meet the needs of local food markets.
- Provide new methods/technologies for insect/disease control during greenhouse production.
- Host an Apprentice Farmer Program at BARC.
- Establish the Transformational Breeding Initiative that includes new automated systems for high throughput crop analyses in the field; genetic analyses of genomic and genetic stocks/germplasm; and bioinformatics and cyber -infrastructure.

Key Performance Measures:

Provide scientific information to maximize the production efficiency of our food animal production systems. Develop new technologies and tools contributing to improve these systems to meet current and future food animal production needs of diversified consumers, while ensuring economic and environmental sustainability and animal well-being.

2012 Actual	2013 Actual	2014 Actual	2015 Target	2016 Target
•Continued to increase stored germplasm resources and use of National Animal Germplasm Program. •Increased the number of populations with adequate germplasm stores to enable reconstitution. •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.	•Continued to increase stored germplasm resources and use of National Animal Germplasm Program. •Increased the number of populations with adequate germplasm stores to enable reconstitution. •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	•Continued to increase stored germplasm resources and use of National Animal Germplasm Program. •Increased the number of populations with adequate germplasm stores to enable reconstitution. •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 SNP chips to target specific livestock breeds and a particular suite of traits. •Increased depth of sequence coverage in key genomic	•Continue to increase stored germplasm resources and use of National Animal Germplasm Program. •Increase the number of populations with adequate germplasm stores to enable reconstitution. •Develop improved semen extenders and artificial insemination methodologies. •Use the completed chicken, cattle, sheep, goat, poultry and swine genome sequences to identify genes impacting efficiency of nutrient utilization and adaptation to the production environment. •Develop specific genome array technologies to target specific livestock industry needs for a particular suite of traits.	•Continue to increase stored germplasm resources and use of National Animal Germplasm Program. •Increase the number of populations with adequate germplasm stores to enable reconstitution. •Develop improved semen extenders and artificial insemination methodologies. •Use the completed chicken, cattle, sheep, goat, poultry and swine genome sequences to identify genes impacting efficiency of nutrient utilization and adaptation to the production environment. •Develop specific genome array technologies to target robust livestock genetic variants for improved genetic evaluation systems.

2012 Actual	2013 Actual	2014 Actual	2015 Target	2016 Target
•Used metagenomics to identify microbial genes and microbial pathways affecting feed efficiency, animal health, and odor 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. •Developed integrated production systems that incorporate enhanced germplasm and pest/pathogen/water/ nutrient management strategies to optimize sustainable animal production. •Enhanced livestock production.	in key genomic regions to identify causative mutations. •Used metagenomics to identify microbial genes and microbial pathways affecting feed efficiency, animal health, and odor 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. •Developed integrated production systems that incorporate enhanced germplasm and pest/pathogen/water/ nutrient management strategies to optimize sustainable animal production. •Enhanced livestock production.	regions to identify causative mutations. •Used metagenomics to identify microbial genes and microbial pathways affecting feed efficiency, animal health, and odor 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. •Developed integrated production systems that incorporate enhanced germplasm and pest/pathogen/water/ nutrient management strategies to optimize sustainable animal production. •Used data to achieve improved feed efficiency and reduced antimicrobial resistance in livestock.	•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. •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 and develop technologies to achieve improved health, feed efficiency and reduced antimicrobial resistance in livestock.	•Use metagenomics to identify microbial genes and microbial pathways affecting feed utilization efficiency, animal health, and emissions in animal production. •Develop integrated production systems that incorporate enhanced germplasm and pest/pathogen/water/ nutrient management strategies to optimize sustainable animal production. •Develop technologies to achieve improved health, feed efficiency, and reduced antimicrobial resistance in livestock. •Improve the efficiency and productivity of ruminant grazing systems through nationally and regionally coordinated collaborative research initiatives. •Develop improved forage breeding and management systems to enhance the productivity and capacity of animal production systems.

2012 Actual	2013 Actual	2014 Actual	2015 Target	2016 Target
			•Improve the efficiency and productivity of ruminant grazing systems through nationally and regionally coordinated collaborative research initiatives. •Advance translational breeding including classical and genomics enabled breeding.	•Apply genetic/ genomic approaches to accelerate improvements of farm animals. •Apply genetic/ genomic approaches to accelerate improvement of shellfish for disease resistance, enhanced production capacity, and consumer quality attributes. •Determine how animal genotypes interact with environmental and management factors to optimize production and nutritional value. •Breed farm animals for small scale farming operations. •Establish the Transformational Breeding Initiative that includes new automated systems for high throughput animal analyses in the field; genomic and genetic analyses of genetic stocks/ germplasm; and bioinformatics and cyber-infrastructure. •Improve agricultural sustainability.

Animal Production

Selected Past Accomplishments toward Achievement of the Key Outcome

- Identified mutations in genes regulating skin formation, hair growth, and cooler body temperature that are inherited in heat tolerant breeds – important information to guide future breeding decisions and better understand the biological processes involved in adaptation to climate change.
- Identified genetic markers of Marek's disease (an extremely contagious viral disease capable of causing major losses to chicken) which could improve poultry selection for superior, genetic resistance.
- Developed a technology which enables sheep producers to selectively breed and generate flocks genetically less susceptible to ovine progressive pneumonia, one of the most costly sheep diseases.
- Demonstrated that monitoring of milk urea nitrogen on dairy farms can be used to optimize protein in dietary rations that reduce feed costs and nitrogen emissions.
- Developed a vaccine to protect catfish against enteric septicemia, the most devastating disease affecting the catfish industry.
- Commercialized a protein concentrate from barley that can be incorporated into aquaculture feeds which is highly digestible, supporting rapid fish growth, and reducing the need for more expensive ingredients such as fishmeal.

Selected Accomplishments Expected at the 2016 Proposed Resource Level

- Increase stored germplasm resources and the use of the National Animal Germplasm Program.
- Increase the number of populations with adequate germplasm stores to enable reconstitution.
- Develop improved semen extenders and artificial insemination methodologies.
- Use the completed chicken, cattle, sheep, goat, poultry, and swine genome sequences to identify genes impacting efficiency of nutrient utilization and adaptation to the production environment.
- Develop specific genome array technologies to target robust livestock genetic variants for improved genetic evaluation systems.
- Use metagenomics to identify microbial genes and microbial pathways affecting feed utilization efficiency, animal health, and emissions in animal production.
- Develop integrated production systems that incorporate enhanced germplasm and pest/pathogen/water/nutrient management strategies to optimize sustainable animal production.
- Develop technologies to achieve improved health, feed efficiency, and reduced antimicrobial resistance in livestock.
- Improve the efficiency and productivity of ruminant grazing systems through nationally and regionally coordinated collaborative research initiatives.
- Develop improved forage breeding and management systems to enhance the productivity and capacity of animal production systems.
- Apply genetic/genomic approaches to accelerate improvements of farm animals.
- Apply genetic/genomic approaches to accelerate improvement of shellfish for disease resistance, enhanced production capacity, and consumer quality attributes.
- Determine how animal genotypes interact with environmental and management factors to optimize production and nutritional value.
- Breed farm animals for small scale farming operations.
- Establish the Transformational Breeding Initiative that includes new automated systems for high throughput animal analyses in the field; genomic and genetic analyses of genetic stocks/germplasm; and bioinformatics and cyber-infrastructure.
- Improve agricultural sustainability.

<u>USDA Strategic Goal</u>: 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 Area 4: Animal Production and Protection	Objective 4.2: Prevent/ control pest and animal diseases that pose a threat to agriculture, public health, and the well-being of Americans.	Animal Health Veterinary, Medical, and Urban Entomology	Key Outcome 4.2: The knowledge the Nation needs for a secure agricultural production system and healthy food supply.

<u>USDA Strategic Objective</u>: Protect Agricultural Health by Minimizing Major Diseases and Pests to Ensure Access to Safe, Plentiful, and Nutritious Food. (Objective 4.4)

Key Performance Measures:

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

2012 Acutal	2013 Actual	2014 Actual	2015 Target	2016 Target
•Identified functional genes that convey specific disease-resistance traits. •Identified/charact-erized 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	•Identified functional genes that convey specific disease-resistance traits. •Identified/charact-erized 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	•Identified functional genes that convey specific disease-resistance traits. •Identified/charact-erized 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	•Identify/character-ize gene functions and mechanisms responsible for disease-resistance traits. •Discover genetic profiles that convey protective immunity against infectious diseases/ parasites. •Implement a technology driven vaccinology research program for control and eradication of biological threat agents. •Continue to investigate the biology and genomics of	•Identify/character-ize gene functions/ mechanisms for disease resistance traits. •Discover genetic profiles that convey protective immunity against infectious diseases/parasites. •Implement a technology driven research program for control and eradication of biological threat agents. Form new partnerships with industry, and universities to promote production and marketing of new methods for detection and identification of

2012 Acutal	2013 Actual	2014 Actual	2015 Target	2016 Target
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. •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.	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. •Developed alternatives to antibiotics to prevent/ treat pathogens affecting poultry health. •Selected vaccine candidates for prevention of cattle fever tick infestations. •Continued basic research on deer immunology to develop anti-tick vaccines. •Determined probable effects of climate change on distribution of livestock ticks. •Determined associations of soft tick vectors of African swine fever and feral hogs. •Performed tests to achieve FDA licensing of	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. •Selected vaccine candidates for prevention of cattle fever tick infestations. •Continued basic research on deer immunology to develop anti-tick vaccines. •Determined probable effects of climate change on distribution of livestock ticks. •Determined associations of soft tick vectors of African swine fever and feral hogs. •Performed tests to achieve FDA licensing of ivermectin medicated bait block for cattle, eliminating the need to dip infested cattle every two weeks.	important animal pathogens. •Continue to investigate the epidemiology and ecology of important animal pathogens. •Continue to form new partnerships and continue old partnerships with industry, universities and other government agencies to promote production and marketing of inventions that protect animals from pathogens. •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. •Develop control programs for invasive drug resistant nematodes, protozoa, and pests of livestock and poultry.	animal pathogens and arthropods that transmit pathogens, and arthropods that destroy property. •Develop integrated pest management strategies to control sea lice on salmon. •Determine the genetic correlation among disease resistance traits in rainbow trout and catfish. •Determine the genetic variation in responsiveness to vaccines in fish. •Breed for resistance to Dermo, MSX, and JOD in shellfish. •Continue to investigate the biology and genomics of important animal pathogens. •Develop alternatives in farm animals to prevent/control animal diseases, reduce antibiotic resistance, and enhance animal production. •Discover and develop new diagnostic platforms for priority animal diseases.

2012 Acutal	2013 Actual	2014 Actual	2015 Target	2016 Target
•Provided new information on host and pest/pathogen interaction to develop protective mechanisms. •Developed strategies to improve animal well-being.	ivermectin medicated bait block for cattle, eliminating the need to dip infected cattle every two weeks. •Developed an experimental bait block for deer. •Continued to transform lines of screwworm flies with DNA insertions intended to create lethal, female-linked genes that induce mortality. Evaluated nutritional requirements of screwworm flies to create diets with alternate ingredients. •Developed new and safer insecticides for treatment of livestock and public health pests. •Evaluated biological control of fire ants throughout the Southeastern U.S. •Developed tools for control of other invasive ants, including the Argentine ant and the Rasberry Crazy ant. •Determined specific physiology of vector-pathogen associations for	•Developed an experimental bait block for deer. •Continued to transform lines of screwworm flies with DNA insertions intended to create lethal, female-linked genes that induce mortality. Evaluated nutritional require-ments of screw-worm flies to create diets with alternate ingredients. •Developed new and safer insecticides for treatment of livestock and public health pests. •Evaluated biological control of fire ants throughout the Southeastern U.S. •Developed tools for control of other invasive ants, including the Argentine ant and the Rasberry Crazy ant. •Determined specific physiology of vector-pathogen associations for viruses that affect livestock. •Identified cryptic species or populations of mosquitoes that have different	•Develop alternatives to antibiotics to prevent/treat pathogens affecting poultry health. •Develop alternatives in farm animals to prevent/control animal diseases, reduce antibiotic resistance, and enhance livestock production. •Discover and develop new diagnostic platforms for priority animal diseases. •Improve integrated pest management of pests that affect the health and well-being of livestock, poultry, and humans. •Assess the risks associated with climate change as it affects pests that harm livestock, poultry, and humans.	•Evaluate the risk caused by climate change on the distribution and genetic makeup of arthropods significant to human and animal health. •Create new surveillance tools for pests of humans and animals. •Invent and adapt new pesticides for protection of human and animal health, creating more effective and safer tools for integrated pest management. •Make public databases available on the genetics and distribution of veterinary pests. •Develop biological control, targeted toxicants, and other methods for effective integrated pest management of invasive ant species. •Improve the efficiency of eradication programs against screwworm flies and cattle fever ticks. •Develop approaches to minimize pest damage at all stages of farm animal production including ticks that transmit animal pathogens.

2012 Acutal	2013 Actual	2014 Actual	2015 Target	2016 Target
	viruses that affect livestock. •Identified cryptic species or populations of mosquitoes that have different capabilities as vectors of pathogens. •Improved animal well-being, food safety, and animal health through development and use of IPM tools on house/stable/horn/ face flies. •Discovered and developed new diagnostic platforms for priority animal diseases. • Discovered and transferred new technologies for protection of animals and humans from biting arthropods. •Discovered and transferred new technologies for protection of animals from priority diseases. •Conducted research on countering biological threats.	capabilities as vectors of pathogens. •Improved animal well-being, food safety, and animal health through development of tools for IPM of house and stable flies. •Developed alternatives to antibiotics to prevent/treat pathogens affecting poultry health. •Developed a Veterinary Insect Genomics Information Center. •Developed alternatives in farm animals to prevent/control animal diseases, reduce antibiotic resistance, and enhance livestock production. •Discovered and developed new diagnostic platforms for priority animal diseases. • Discovered and transferred new technologies for protection of animals and humans from biting arthropods. •Discovered and transferred new technologies for		•Protect public health by preventing antimicrobial resistance. •Develop aquatic animal health strategies that do not rely on antibiotics. •Map the genome of the gut microbiome of at least one major food animal species to determine the function and ecology of gut micro-organisms and their genes including antibiotic resistance and virulence gene transfer. •Develop alternatives to antibiotics including improved management and husbandry practices; antimicrobial peptides; prebiotics, bacteriophage; modulators of innate and adaptive immunity; and immune modulators, including vaccines.

2012 Acutal	2013 Actual	2014 Actual	2015 Target	2016 Target
		protection of animals from priority diseases. •Conducted research on countering biological threats.		

Livestock Protection

Selected Past Accomplishments toward Achievement of the Key Outcome

- Found that cytokines (small proteins that are important in cell signaling) can be used as an alternative to antibiotics in preventing and combating infectious diseases in pigs.
- Found that amino acid changes in a viral protein determine the evolution of swine influenza A virus, an endemic and economically important pathogen in pigs with the potential of infecting other host species including humans.
- Developed a Rift Valley fever virus (transmitted by mosquitoes causing severe to fatal disease in ruminants and humans) challenge model to evaluate vaccines for sheep and goats.
- Evaluated the risk of indigenous ticks transmitting equine piroplasmosis to horses in the U.S.
- Improved protection of military personnel from mosquitoes by impregnating their uniforms with the insecticide permethrin.
- Found that white tailed deer can serve as hosts for cattle fever ticks – this information will be useful in maintaining tick eradication quarantine areas and disease free zones in the United States.
- Used genetic techniques to produce a more efficient, affordable method in the production of sterile male only screwworms. Maintaining an effective barrier against screwworms re-entering the United States, which had devastated the nation's livestock industry, is critically important.
- Evaluated species of mosquitoes commonly found in the United States for their ability to transmit the Rift Valley fever virus, and found some species have a greater ability to transmit the virus – useful information if the virus is ever found in the U.S.
- Demonstrated that a newly discovered ant virus only harms fire ants (which annually cause billions of dollars in damage), and does not have a negative impact on other ants that are considered non-target organisms.

Selected Accomplishments Expected at the 2016 Proposed Resource Level

- Identify gene functions/mechanisms for disease resistance traits.
- Discover genetic profiles that convey protective immunity against infectious diseases/parasites.
- Implement a technology driven research program for control and eradication of biological threat agents.
- Develop integrated pest management strategies to control sea lice on salmon.
- Determine the genetic correlation among disease resistance traits in rainbow trout and catfish.
- Determine the genetic variation in responsiveness to vaccines in fish.
- Breed for resistance to Dermo, MSX, and JOD in shellfish.
- Investigate the biology and genomics of important animal pathogens.
- Develop alternatives in farm animals to prevent/control animal diseases, reduce antibiotic resistance, and enhance animal production.
- Discover and develop new diagnostic platforms for priority animal diseases.
- Evaluate the risks caused by climate change on the distribution and genetic makeup of arthropods significant to human and animal health.

- Create new surveillance tools for pests of humans and animals.
- Invent and adapt new pesticides for protection of human and animal health.
- Make public databases available on the genetics and distribution of veterinary pests.
- Develop biological control, targeted toxicants, and other methods for effective integrated pest management of invasive ant species.
- Improve the efficiency of eradication programs against screwworm flies and cattle fever ticks.
- Develop approaches to minimize pest damage at all stages of farm animal production including ticks that transmit animal pathogens.
- Protect public health by preventing antimicrobial resistance.
- Develop aquatic animal health strategies that do not rely on antibiotics.
- Map the genome of the gut microbiome of at least one major food animal species.
- Develop alternatives to antibiotics including improved management and husbandry practices; antimicrobial peptides; prebiotics, bacteriophage; modulators of innate and adaptive immunity; and immune modulators, including vaccines.

Strategic Goal Funding Matrix
(Dollars in thousands)

Program / Program Items	2013 Actual	2014 Actual	2015 Enacted	Inc. or Dec.	2016 Estimate
Department Strategic Goal: Assist rural communities to create prosperity so they are self-sustaining, repopulating, and economically thriving					
Product Quality/Value Added	$93,102	$98,756	$100,156	+$1,459	$101,615
Staff Years	682	699	761	+2	763
Livestock Production	35,213	43,342	43,517	+2,936	46,453
Staff Years	188	222	242	+18	260
Crop Production	117,475	108,624	108,624	+9,769	118,393
Staff Years	827	657	716	+30	746
National Agricultural Library	20,691	23,791	23,791	+937	24,728
Staff Years	72	95	103	+3	106
Repair and Maintenance	18,614	20,144	20,144	+20,000	40,144
Staff Years	-	-	-	-	-
Decentralized GSA and DHS Security Payments	-	-	5,115	-	5,115
Staff Years	-	-	-	-	-
Total Costs, Strategic Goal	285,095	294,657	301,347	+35,101	336,448
Total Staff Years, Strategic Goal	1,769	1,673	1,822	+53	1,875
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	175,047	200,819	200,819	+5,333	206,152
Staff Years	1,254	1,299	1,414	+14	1,428
Total Costs, Strategic Goal	175,047	200,819	200,819	+5,333	206,152
Total Staff Years, Strategic Goal	1,254	1,299	1,414	+14	1,428
Department Strategic Goal: Help America promote agricultural production and biotechnology exports as America works to increase food security					
Livestock Production	35,213	43,342	43,342	+4,603	47,945
Staff Years	188	222	241	+18	259
Crop Production	93,304	106,542	106,542	+8,142	114,684
Staff Years	650	645	703	+30	733
Total Costs, Strategic Goal	128,517	149,884	149,884	12,745	162,629
Total Staff Years, Strategic Goal	838	867	944	48	992
Department Strategic Goal: Ensure that all of America's children have access to safe, nutritious, and balanced meals					
Food Safety	97,962	111,656	111,656	+4,505	116,161
Staff Years	783	659	718	+15	733
Human Nutrition	80,328	86,874	86,874	-1,678	85,196
Staff Years	279	235	256	-8	248
Livestock Protection	70,530	89,632	90,632	-101	90,531
Staff Years	411	459	500	-3	497
Crop Protection	179,469	188,960	191,413	+3,010	194,423
Staff Years	1,047	1,073	1,168	+6	1,174
Total Costs, Strategic Goal	428,289	477,122	480,575	+5,736	486,311
Total Staff Years, Strategic Goal	2,520	2,426	2,642	+10	2,652
Total Costs, All Strategic Goals	1,016,948	1,122,482	1,132,625	+58,915	1,191,540
Total FTEs, All Strategic Goals	6,381	6,265	6,822	+125	6,947

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 2013	FY 2014	FY 2015	FY 2016
	Direct Costs:				
	Research and Development	239,875	257,052	248,479	262,070
	Indirect Costs:				
	Program and Administrative/Financial Management	20,232	21,681	20,958	22,104
	USDA Central Charges	6,056	6,489	6,273	6,616
	Task Force, Advisory Committees, and Other Support Costs	365	391	378	399
	Total Indirect Costs	26,653	28,561	27,609	29,119
	Total Costs	**266,528**	**285,613**	**276,088**	**291,189**
	FTEs	1,769	1,673	1,822	1,875

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	17,762	20,104	20,144	40,144
Miscellaneous Fees	110	195	11,690	0
Decentralized GSA and Security Payments	0	0	5,115	5,115
FTEs	0	0	0	0
Total Costs for Department Strategic Goal 1 (program, direct, indirect)	**284,400**	**305,912**	**313,037**	**336,448**
FTEs	**1,769**	**1,673**	**1,822**	**1,875**

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 2013	FY 2014	FY 2015	FY 2016
	Direct Costs:				
	Research and Development	157,172	180,650	180,737	185,537
	Indirect Costs:				
	Program and Administrative/Financial Management	13,257	15,237	15,244	15,649
	USDA Central Charges	3,968	4,560	4,563	4,684
	Task Force, Advisory Committees, and Other Support Costs	239	275	275	282
	Total Indirect Costs	17,464	20,072	20,082	20,615
	Total Costs for Department Strategic Goal 2 (program, direct, indirect)	**174,636**	**200,722**	**200,819**	**206,152**
	FTEs	1,254	1,299	1,414	1,428

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 2013	FY 2014	FY 2015	FY 2016
	Direct Costs:				
	Research and Development	114,845	124,370	134,896	146,366
	Indirect Costs:				
	Program and Administrative/Financial Management	9,687	10,490	11,378	12,345
	USDA Central Charges	2,899	3,140	3,405	3,695
	Task Force, Advisory Committees, and Other Support Costs	175	189	205	223
	Total Indirect Costs	12,761	13,819	14,988	16,263
	Total Costs for Department Strategic Goal 3 (program, direct, indirect)	**127,606**	**138,189**	**149,884**	**162,629**
	FTEs	838	867	944	992

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 2013	FY 2014	FY 2015	FY 2016
	Direct Costs:				
	Research and Development	384,933	429,289	432,518	437,680
	Indirect Costs:				
	Program and Administrative/Financial Management	32,467	36,209	36,480	36,916
	USDA Central Charges	9,717	10,837	10,919	11,049
	Task Force, Advisory Committees, and Other Support Costs	586	653	658	666
	Total Indirect Costs	42,770	47,699	48,057	48,631
	Total Costs for Department Strategic Goal 4 (program, direct, indirect)	**427,703**	**476,988**	**480,575**	**486,311**
	FTEs	2,520	2,426	2,642	2,652

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)		**1,014,345**	**1,121,811**	**1,144,315**	**1,191,540**
	FTEs	6,381	6,265	6,822	6,947
Total Costs for Buildings and Facilities		**2,629**	**1,369**	**10,000**	**156,001**
	FTEs	0	0	0	0
Grand Total Costs for all Department Strategic Goals		**1,016,974**	**1,123,180**	**1,154,315**	**1,347,541**
	FTEs	**6,381**	**6,265**	**6,822**	**6,947**