2017 President's Budget
Agricultural Research Service

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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 Strategic Goals:

- 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, 2015, there were 5,409 permanent, full-time employees including 491 in the Headquarters offices and 4,918 in field offices.

OIG Audits - Completed

50024-0001-13, 3/13/2015, Review of the Department's U.S. Bank Purchase Card and Convenience Check Data.

50024-0004-13, 9/2/2015, Review of the Department's Fleet Charge Card Data.

50401-0007-11, 12/18/2014, Department of Agriculture's Consolidated Financial Statements for Fiscal Years 2014 and 2013.

50501-0006-12, 11/7/2014, Fiscal Year 2014 Federal Information Security Management Act.

OIG Audits - In Progress

02007-0001-31, Agricultural Research Service: U.S. Meat Animal Research Center.

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

50401-0009-11, Department of Agriculture's Consolidated Financial Statements for Fiscal Years 2015 and 2014.

50501-0008-12, Fiscal Year 2015 Federal Information Security Management Act.

50601-0001-12, Research, Education, and Economics' Compliance with Contractor Past Performance Reporting Requirements.

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

50601-0004-31, Department of Agriculture's Response to Antibiotic Resistance.

GAO Audits - Completed

GAO-14-755, 10/16/2014, Climate Change: USDA's Ongoing Efforts Can Be Enhanced with Better Metrics and More Relevant Information for Farmers.

GAO-15-35, 1/16/2015, Hazardous Waste: Agencies Should Take Steps to Improve Information on USDA's and Interior's Potentially Contaminated Sites.

GAO-15-80, 12/19/2014, Anthrax: Agency Approaches to Validation and Statistical Analyses Could Be Improved.

GAO-15-180, 12/18/2014, Federal Food Safety Oversight: Additional Actions Needed to Improve Planning and Collaboration.

GAO-15-495, 5/26/2015, Federal Veterinarians: Efforts Needed to Improve Workforce Planning.

GAO Audits - In Progress

100087, IT Spending on Investments in Operations and Maintenance and the Retirement of Legacy Systems.

100123, U.S.-China Clean Energy Cooperation—Goals, Funding, Benefits and Risks.

100180, Agencies Collecting and Reporting in the Foreign Assistance Dashboard.

100182, Advanced Biofuels Research and Development.

100267, Federal Actions to Monitor and Control Antibiotic Resistance in Animals.

100294, Department of Agriculture's Process for Determining the Safety of Imported Beef from Countries with a History of Foot and Mouth Disease.

100303, Review of Foreign Assistance Monitoring Policies.

100340, Federal Funding for Harmful Algal Blooms Research.

131349, Effectiveness and Coordination of Federal Programs Supporting U.S. Manufacturing.

291264, Biosafety and Biosecurity of Federal Laboratories that Handle Pathogens.

321036, Development Innovation Ventures at the U.S. Agency for International Development.

361569, Climate Change: HHS Could Take Further Steps to Enhance Understanding of Public Health Risks.

361589, Federal Regulation of Genetically-Engineered Crops.

361600, Risks to Commercial and Native Honey Bee Populations and Related Federal Actions.

361615, Federal Strategy for Addressing Emerging Swine Diseases, e.g., Porcine Epidemic Diarrhea Virus.

361617, Aquatic Invasive Species: Additional Steps Could Help Task Force Measure Federal Progress in Achieving Strategic Goals.

361628, Federal Agencies' Requirements for Conducting Federally Funded Research.

361642, EPA Management of Annual Renewable Fuel Standard Volume Mandates.

451159, Federal Agencies Use of Enterprise Risk Management Leading Practices.

460635, Technologies Available or in Development to Improve Efficiency of Municipal Drinking Water and Wastewater Processes.

460640, High Containment Laboratories: Inactivation and Attenuation Protocols.

542248, Federal Agencies Use of Independent Leasing Authority.

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

Item	2014 Actual		2015 Actual		2016 Enacted		2017 Estimate	
	Amount	SYs	Amount	SYs	Amount	SYs	Amount	SYs
Salaries and Expenses:								
Discretionary Appropriations	$1,122,482	6,265	$1,132,625	6,046	$1,143,825	6,062	$1,161,340	6,071
Buildings and Facilities:								
Discretionary Appropriations	-	-	45,000	-	212,101	-	94,500	-
Rescission	-	-	-1,530	-	-	-	-	-
Transfers In	102	-	102	-	-	-	-	-
Adjusted Appropriation	1,122,584	6,265	1,176,197	6,046	1,355,926	6,062	1,255,840	6,071
Balance Available, SOY	12,524	-	13,220	-	57,735	-	239,156	-
Other Adjustments (Net)	3,678	-	11,030	-	-	-	-	-
Total Available	1,138,786	6,265	1,200,447	6,046	1,413,661	6,062	1,494,996	6,071
Lapsing Balances	-2,386	-	-10,082	-	-	-	-	-
Balance Available, EOY	-13,220	-	-57,735	-	-239,156	-	-111,656	-
Obligations	1,123,180	6,265	1,132,630	6,046	1,174,505	6,062	1,383,340	6,071
Obligations under other USDA appropriations:								
Agricultural Marketing Service	102	1	-	-	-	-	-	-
Animal & Plant Health Inspection Service	17,483	64	16,471	55	16,471	55	16,471	55
Economic Research Service	3,440	12	3,161	10	3,161	10	3,161	10
Food, Nutrition & Consumer Services	1,849	7	468	2	468	2	468	2
Food Safety & Inspection Service	5,631	20	2,617	9	2,617	9	2,617	9
Foreign Agricultural Service	688	4	1,103	4	1,103	4	1,103	4
Forest Service	1,267	5	5,839	19	5,839	19	5,839	19
Hazardous Waste	2,550	9	-	-	-	-	-	-
National Agricultural Statistics Service	4,330	16	4,081	14	4,081	14	4,081	14
National Institute of Food and Agriculture	22,085	80	24,817	82	24,817	82	24,817	82
Natural Resources Conservation Service	4,865	18	3,988	13	3,988	13	3,988	13
Office of the Chief Financial Officer	545	4	989	3	989	3	989	3
Office of the Chief Economist	338	1	423	1	423	1	423	1
Misc., Other USDA Funds	338	1	305	1	305	1	305	1
Total, Other USDA	65,511	242	64,262	213	64,262	213	64,262	213
Total, Agriculture Appropriations	1,188,691	6,507	1,196,892	6,259	1,238,767	6,275	1,447,602	6,284
Other Federal Funds:								
Agency for International Development	7,344	27	6,802	23	6,802	23	6,802	23
Department of Commerce	816	3	-	0	-	0	-	0
Department of Defense	7,994	29	6,911	23	6,911	23	6,911	23
Department of Energy	1,159	4	886	3	886	3	886	3
Department of Health & Human Services	5,793	21	7,299	24	7,299	24	7,299	24
Department of Homeland Security	4,529	16	3,066	10	3,066	10	3,066	10

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

Item	2014 Actual		2015 Actual		2016 Enacted		2017 Estimate	
	Amount	SYs	Amount	SYs	Amount	SYs	Amount	SYs
Other Federal Funds: (continued)								
Department of State	1,134	4	2,482	8	2,482	8	2,482	8
Department of the Interior	3,108	11	3,160	11	3,160	11	3,160	11
Department of Treasury	-	-	136	1	136	1	136	1
Environmental Protection Agency	357	1	343	1	343	1	343	1
Federal Emergency Management Agency	277	1	273	1	273	1	273	1
National Aeronautics & Space Administration	1,665	6	1,865	6	1,865	6	1,865	6
Strategic Environmental Research Development Program (SERDP)	185	1	-	-	-	-	-	-
Misc., Other Federal Funds	-	-	4	-	4	-	4	-
Total, Other Federal	34,361	124	33,227	111	33,227	111	33,227	111
Non-Federal Funds:								
Agricultural Utilization Research Institute	-	-	100	-	100	-	100	-
Alabama, University of	191	1	247	1	247	1	247	1
Arkansas, University of	251	1	-	-	-	-	-	-
Binational Agricultural Research & Development (BARD)	492	3	333	1	333	1	333	1
Brigham Young University	-	-	119	-	119	-	119	-
California, State of	2,456	9	2,460	8	2,460	8	2,460	8
California, University of	2,296	8	2,003	7	2,003	7	2,003	7
Canada Council of Canada	-	-	103	-	103	-	103	-
Citrus Research and Development Foundation	2,610	9	1,974	7	1,974	7	1,974	7
Commodity Credit Corporation	-	-	150	-	150	-	150	-
Commonwealth Scientific and Industrial Research	112	1	-	-	-	-	-	-
Cornell University	1,186	4	1,092	4	1,092	4	1,092	4
Cotton Incorporated	1,211	4	1,023	3	1,023	3	1,023	3
Dade County Department of Environmental Resource Management	105	1	-	-	-	-	-	-
Danforth Plant Science Center	-	-	182	1	182	1	182	1
Delaware, University of	372	1	386	1	386	1	386	1
Drexel University	100	1	-	-	-	-	-	-
Florida Citrus Packers Association	250	1	-	-	-	-	-	-
Florida, State of	1,047	6	472	2	472	2	472	2
Florida, University of	429	3	217	1	217	1	217	1
Georgia, University of	540	4	523	2	523	2	523	2
Hispanic Serving Institutions National Program	2,071	8	-	-	-	-	-	-
Idaho, State of	104	1	114	-	114	-	114	-
Idaho State University	-	-	198	1	198	1	198	1
Idaho, University of	124	1	-	-	-	-	-	-
Illinois, University of	348	1	641	2	641	2	641	2
Iowa State University	2,151	8	1,176	4	1,176	4	1,176	4
Kansas State University	368	1	316	1	316	1	316	1

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

Item	2014 Actual		2015 Actual		2016 Enacted		2017 Estimate	
	Amount	SYs	Amount	SYs	Amount	SYs	Amount	SYs
Non-Federal Funds: (continued)								
Louisiana State University	229	1	215	1	215	1	215	1
Maryland, University of	213	1	149	-	149	-	149	-
Massachusetts General Hospital	159	1	-	-	-	-	-	-
Massachusetts, University of	143	1	156	1	156	1	156	1
Michigan State University	260	1	567	2	567	2	567	2
Minnesota, University of	383	2	240	1	240	1	240	1
Mississippi Soybean Promotion	-	-	230	1	230	1	230	1
Mississippi State University	-	-	199	1	199	1	199	1
Missouri, University of	319	1	-	-	-	-	-	-
National Peanut Foundation	277	1	-	-	-	-	-	-
National Pork Board	375	1	257	1	257	1	257	1
Nebraska, University of	629	4	594	2	594	2	594	2
Neon, Inc	-	-	1,516	5	1,516	5	1,516	5
New Hampshire, University of	-	-	127	-	127	-	127	-
North Carolina State University	314	1	255	1	255	1	255	1
North Dakota State University	242	1	112	-	112	-	112	-
Ohio State University	407	1	308	1	308	1	308	1
Oklahoma State University	842	5	151	-	151	-	151	-
Oregon State University	123	1	111	-	111	-	111	-
Pennsylvania State University	266	1	273	1	273	1	273	1
Perdue University	180	1	183	1	183	1	183	1
Qualisoy Inc	-	-	537	2	537	2	537	2
Revocable Permits & Easements	2,038	-	1,361	5	1,361	5	1,361	5
Rutgers University	201	1	169	1	169	1	169	1
Sale of Animals & Personal Property (Proceeds)	4,961	-	11,185	37	11,185	37	11,185	37
South Florida Water Management District	767	5	878	3	878	3	878	3
Southern Illinois University	118	1	102	-	102	-	102	-
Southern Regiona Aquaculture Center	-	-	126	-	126	-	126	-
Tennessee, University of	226	1	132	-	132	-	132	-
Tennessee A&M University	-	-	104	-	104	-	104	-
Texas Agrilife Research & Extension Center	696	4	164	1	164	1	164	1
Texas, State of	110	1	-	-	-	-	-	-
Travel and Miscellaneous Reimbursements	511	3	-	-	-	-	-	-
United Sorghum Checkoff Program	-	-	133	-	133	-	133	-
United Soybean Board	6,076	22	4,952	16	4,952	16	4,952	16
Washington State University	314	1	206	1	206	1	206	1
Washington Tree Fruit Research Commission	247	1	460	2	460	2	460	2
Washington University School of Medicine	106	1	148	-	148	-	148	-
Wisconsin University	438	3	357	1	357	1	357	1
Misc., Non-Federal Funds	3,381	12	3,353	11	3,353	11	3,353	11
Total, Non-Federal Funds	44,365	158	43,839	145	43,839	145	43,839	145
Miscellaneous Contributed Funds:	29,921	104	29,750	121	29,750	121	29,750	121
Total, ARS	1,297,338	6,893	1,303,708	6,636	1,345,583	6,652	1,554,418	6,661

Permanent Positions by Grade and Staff Year Summary

Item	2014 Actual			2015 Actual			2016 Enacted			2017 Estimate		
	D.C.	Field	Total	D.C.	Field	Total	D.C.	Field	Total	D.C.	Field	Total
SES.....	11	27	38	12	20	32	12	20	32	12	20	32
GS/GM-15.....	52	658	710	50	681	731	50	683	733	50	682	732
GS/GM-14.....	59	572	631	59	558	617	59	560	619	59	559	618
GS/GM-13.....	130	414	544	127	347	474	128	348	476	128	348	476
GS-12.....	128	255	383	108	263	371	109	264	373	108	263	371
GS-11.....	56	531	587	61	531	592	61	533	594	61	532	593
GS-10.....	1	3	4	1	3	4	1	3	4	1	3	4
GS-9.....	61	914	975	53	924	977	53	927	980	53	926	979
GS-8.....	18	333	351	14	305	319	14	306	320	14	306	320
GS-7.....	48	575	623	52	581	633	52	583	635	52	582	634
GS-6.....	17	213	230	13	199	212	13	199	212	13	199	212
GS-5.....	10	112	122	13	125	138	13	125	138	13	125	138
GS-4.....	6	32	38	6	25	31	6	25	31	6	25	31
GS-3.....	-	14	14			0			0			0
GS-2.....	-	10	10			0			0			0
GS-1.....	-	1	1			0			0			0
Other Graded Positions.....	4	-	4	4	-	4	4	-	4	4	-	4
Ungraded Positions.....	-	455	455	-	449	449	-	449	449	-	449	449
Total Perm. Positions.....	601	5,119	5,720	573	5,011	5,584	575	5,025	5,600	574	5,019	5,593
Unfilled EOY..	98	75	173	82	93	175	82	93	175	80	79	159
Total Perm. Full-Time Employment, EOY.....	503	5,044	5,547	491	4,918	5,409	493	4,932	5,425	494	4,940	5,434
Staff Year Est..	519	6,374	6,893	520	6,116	6,636	522	6,130	6,652	523	6,138	6,661

Size, Composition and Cost of Motor Vehicle Fleet

The 2017 Budget Estimates propose the replacement of 3 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 Vehicles	
		4X2	4X4						
****FY2014**	230	1,271	937	698	0	0	151	3,287	$5,839
***Change	-7	-53	-1	58	0	1	5	3	-103
FY2015	223	1,218	936	756	0	1	156	3,290	5,736
Change	0	0	0	0	0	0	0	0	342
FY2016	223	1,218	936	756	0	1	156	3,290	6,078
Change	0	0	0	0	0	0	0	0	362
FY2017	223	1,218	936	756	0	1	156	3,290	6,440

NOTES:

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

** 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.

***Change is due to SIN corrects

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, [$1,143,825,000] $1,161,340,000: *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] $500,000, except for headhouses or greenhouses which shall each be limited to [$1,200,000] $1,800,000, [and] except for 10 buildings to be constructed or improved at a cost not to exceed [$750,000] $1,100,000 each, and except for two buildings to be constructed at a cost not to exceed $3,000,000 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] $500,000, 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 of the appropriations hereunder, $57,192,000 may not be obligated until 30 days after the Secretary of Agriculture certifies in writing to the Committees on Appropriations of both Houses of Congress that the Agricultural Research Service has updated its animal care policies and that all Agricultural Research Service research facilities at which animal research is conducted have a fully functioning Institutional Animal Care and Use Committee, including all appropriate and necessary record keeping: *Provided further,* That such certification shall set forth in detail the factual basis for the certification and the Department's plan for ensuring these changes are maintained in the future: *Provided further,* That such certification shall be subject to prior consultation with the Committees on Appropriations of both Houses of Congress].

The first change in the language is for the purpose of amending the agency’s limitations on small buildings and to add a new small building authority limitation in the annual appropriations. The agency’s limitations on small buildings as authorized in the annual appropriations for Salaries and Expenses have not been increased since 2001. Over the past 14 years, construction and building costs have increased substantially. The current limitations are no longer sufficient. The new proposed small building authority limitation would provide the agency additional flexibility to replace worn out, decrepit facilities with new, more efficient same size/purpose facilities. This authority would be used only where repair of existing structures/systems does not make sense is not cost effective.

The second change in the language strikes the language as it is no longer applicable since the certification process will be completed in 2016.

Lead-Off Tabular Statement

Salaries and Expenses

Budget Estimate, 2017	$1,161,340,000
2016 Enacted	$1,143,825,000
Change in Appropriation	+17,515,000

Summary of Increases and Decreases
(Dollars in thousands)

	2014 Actual	2015 Change	2016 Change	2017 Change	2017 Estimate
Discretionary Appropriations:					
Product Quality/Value Added	$98,756	+$1,400	+$800	-$268	$100,688
Livestock Production	86,684	+175	-	+1,786	88,645
Crop Production	215,166	-	+2,542	-1,114	216,594
Food Safety	111,656	-	+134	+4,581	116,371
Livestock Protection	89,632	+1,000	+2,133	+12,756	105,521
Crop Protection	188,960	+2,453	+3,375	-3,182	191,606
Human Nutrition	86,874	-	-	-1,597	85,277
Environmental Stewardship	200,819	-	+2,216	+9,499	212,534
National Agricultural Library	23,791	-	-	+169	23,960
Repair and Maintenance	20,144	-	-	-	20,144
Decentralized GSA and DHS Security Payments	-	+5,115	-	-5,115	-
Total Discretionary Appropriations	1,122,482	+10,143	+11,200	+17,515	1,161,340

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

Program	2014 Actual		2015 Actual		2016 Enacted		Inc. or Dec.		2017 Estimate	
	Amount	SYs	Amount	SYs	Amount	SYs	Amount	SYs	Amount	SYs
Salaries and Expenses										
Discretionary Appropriations:										
Product Quality/Value Added	$98,756	699	$100,156	670	$100,956	671	-$268 (1)	-	$100,688	671
Livestock Production	86,684	444	86,859	425	86,859	425	+1,786 (2)	-	88,645	425
Crop Production	215,166	1,302	215,166	1,250	217,708	1,256	-1,114 (3)	-	216,594	1,256
Food Safety	111,656	659	111,656	659	111,790	659	+4,581 (4)	+1	116,371	660
Livestock Protection	89,632	459	90,632	440	92,765	444	+12,756 (5)	+6	105,521	450
Crop Protection	188,960	1,073	191,413	1,030	194,788	1,035	-3,182 (6)	-	191,606	1,035
Human Nutrition	86,874	235	86,874	235	86,874	235	-1,597 (7)	-	85,277	235
Environmental Stewardship	200,819	1,299	200,819	1,245	203,035	1,245	+9,499 (8)	+2	212,534	1,247
National Agricultural Library	23,791	95	23,791	92	23,791	92	+169 (9)	-	23,960	92
Repair and Maintenance	20,144	-	20,144	-	20,144	-	-	-	20,144	-
Decentralized GSA and DHS Security Payments	-	-	5,115	-	5,115	-	-5,115 (10)	-	-	-
Subtotal	1,122,482	6,265	1,132,625	6,046	1,143,825	6,062	+17,515	+9	1,161,340	6,071
Funds included for Homeland Security	[35,867]	-	[36,861]	-	[37,863]	-	-	-	[47,863]	-
Total Adjusted Approp	1,122,482	6,265	1,132,625	6,046	1,143,825	6,062	+17,515	+9	1,161,340	6,071
Transfers In:										
Cong. Relations	102	-	102	-	-	-	-	-	-	-
Total	102	-	102	-	-	-	-	-	-	-
Bal. Available, SOY	9,632	-	11,690	-	13,680	-	-13,680	-	-	-
Other Adjustments (Net)	3,671	-	10,937	-	-	-	-	-	-	-
Total Available	1,135,887	6,265	1,155,354	6,046	1,157,505	6,062	+3,835	+9	1,161,340	6,071
Lapsing Balances	-2,386	-	-10,082	-	-	-	-	-	-	-
Bal. Available, EOY	-11,690	-	-13,680	-	-	-	-	-	-	-
Total Obligations	1,121,811	6,265	1,131,592	6,046	1,157,505	6,062	+3,835	+9	1,161,340	6,071
Staff Years:										
Direct		6,265		6,046		6,062		+9		6,071
Other		628		590		590		-		590
Total, Staff Year Estimate		6,893		6,636		6,652		+9		6,661

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

Program	2014 Actual		2015 Actual		2016 Enacted		Inc. or Dec.		2017 Estimate	
	Amount	SYs	Amount	SYs	Amount	SYs	Amount	SYs	Amount	SYs
Salaries and Expenses										
Discretionary Obligations:										
Product Quality/Value Added…	$98,708	699	$99,958	670	$100,956	671	-$268 (1)	-	$100,688	671
Livestock Production……	86,642	444	86,688	425	86,859	425	+1,786 (2)	-	88,645	425
Crop Production……	215,608	1,302	214,741	1,250	217,708	1,256	-1,114 (3)	-	216,594	1,256
Food Safety……	111,656	659	111,656	659	111,790	659	+4,581 (4)	+1	116,371	660
Livestock Protection……	89,589	459	90,453	440	92,765	444	+12,756 (5)	+6	105,521	450
Crop Protection……	188,869	1,073	191,035	1,030	194,788	1,035	-3,182 (6)	-	191,606	1,035
Human Nutrition……	86,874	235	86,874	235	86,874	235	-1,597 (7)	-	85,277	235
Environmental Stewardship…..	200,722	1,299	200,423	1,245	203,035	1,245	+9,499 (8)	+2	212,534	1,247
National Agricultural Library…	22,844	95	23,441	92	23,791	92	+169 (9)	-	23,960	92
Repair and Maintenance……	20,104	-	20,144	-	20,144	-	-	-	20,144	-
Decentralized GSA and DHS Security Payments……	-	-	5,115	-	5,115	-	-5,115 (10)	-	-	-
Subtotal	1,121,616	6,265	1,130,528	6,046	1,143,825	6,062	+17,515	+9	1,161,340	6,071
Funds included for Homeland Security	[35,867]	-	[36,861]	-	[37,863]	-	-	-	[47,863]	-
Misc. Fees/Supplementals	195	-	1,064	-	13,680	-	-	-	-	-
Subtotal	195	-	1,064	-	13,680	-	-13,680	-	-	-
Total Obligations	1,121,811	6,265	1,131,592	6,046	1,157,505	6,062	+3,835	+9	1,161,340	6,071
Lapsing Balances	2,386	-	10,082	-	-	-	-	-	-	-
Bal. Available, EOY	11,690	-	13,680	-	-	-	-	-	-	-
Total Available	1,135,887	6,265	1,155,354	6,046	1,157,505	6,062	+3,835	+9	1,161,340	6,071
Transfers In	-102	-	-102	-	-	-	-	-	-	-
Bal. Available, SOY	-9,632	-	-11,690	-	-13,680	-	+13,680	-	-	-
Other Adjustments (Net)	-3,671	-	-10,937	-	-	-	-	-	-	-
Total Appropriation	1,122,482	6,265	1,132,625	6,046	1,143,825	6,062	+17,515	+9	1,161,340	6,071
Staff Years:										
Direct		6,265		6,046		6,062		+9		6,071
Other		628		590		590		-		590
Total, Staff Year Estimate		6,893		6,636		6,652		+9		6,661

Agricultural Research Service
Proposed 2017 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
2016 Base												
Salaries and Expenses	$100,956	$86,859	$217,708	$111,790	$92,765	$194,788	$86,874	$203,035	$23,791	$20,144	$5,115	$1,143,825
Reductions:												
Project Terminations	-4,572	-4,508	-10,889	-6,473	-7,800	-10,407	-2,017	-13,334	0	0	0	-60,000
Subtotal, Reductions	-4,572	-4,508	-10,889	-6,473	-7,800	-10,407	-2,017	-13,334	-	-	-	-60,000
Increases:												
Pay Cost	1,250	792	2,331	1,179	821	1,918	420	2,323	169	-	-	11,203
Decentralized GSA Rent/DHS Security Payments	579	502	1,244	-	523	1,107	-	1,160	-	-	(5,115)	-
Tools for Combatting Antimicrobial Resistance	-	3,800	-	8,000	8,512	-	-	2,000	-	-	-	22,312
Climate Change	1,100	700	4,200	-	700	3,200	-	9,100	-	-	-	19,000
Foreign Animal Diseases and Avian Influenza	-	-	-	-	10,000	-	-	-	-	-	-	10,000
Foreign Animal Diseases	-	-	-	-	(7,000)	-	-	-	-	-	-	(7,000)
Avian Influenza	-	-	-	-	(3,000)	-	-	-	-	-	-	(3,000)
Safe and Abundant Water Supplies to Support U.S. Agriculture	1,375	500	2,000	1,875	-	1,000	-	8,250	-	-	-	15,000
California Area Drought	-	-	(2,000)	-	-	-	-	(3,000)	-	-	-	(5,000)
Great Basin	-	-	-	-	-	(1,000)	-	(4,000)	-	-	-	(5,000)
Non-Traditional Waters	(1,375)	(500)	-	(1,875)	-	-	-	(1,250)	-	-	-	(5,000)
Subtotal, Increases	3,725	5,792	8,531	11,054	20,033	6,118	420	21,673	169	-	-	77,515
Total Changes, Salaries and Expenses	-268	1,786	-1,114	4,581	12,756	-3,182	-1,597	9,499	169	0	-5,115	17,515
Grand Total, 2017 Budget	100,688	88,645	216,594	116,371	105,521	191,606	85,277	212,534	23,960	20,144	0	1,161,340

Justification of Increases and Decreases

Salaries and Expenses

For fiscal year 2017, ARS is requesting $1,161,340,000 for its Salaries and Expenses account, $17,515,000 above the enacted 2016 Appropriations of $1,143,825,000. The 2017 Budget requests an increase of $66,312,000 for research priorities related to antimicrobial resistance, climate change, safe and abundant water supplies, foreign animal diseases, and avian influenza. An additional $11,203,000 for pay costs is also requested. Partially offsetting the proposed increases are decreases of $60 million (-5.2 percent) in proposed program redirections and lower priority project terminations.

Agriculture faces enormous, unprecedented challenges today, including ongoing issues such as soil erosion, the introduction of invasive species, and crop and yield losses due to changing climatic conditions; foreign animal diseases like Avian Influenza, swine flu, West Nile virus, and foot-and-mouth disease; plant diseases like soybean rust, karnal bunt, and plum pox; and foodborne diseases like E. coli, salmonella, listeria, and campylobacter. Agriculture also faces new and evolving challenges, like antimicrobial resistance (AMR) and unprecedented drought. Without immediate, long-term, sustainable action, challenges and threats like climate change, foreign animal diseases, AMR, and drought will endanger crop yields, wreak havoc on the environment, threaten our food supply, and have a deleterious ripple effect throughout the national and global economies.

Addressing these global challenges, both old and new, requires innovation and ingenuity. Agricultural research must be the "linchpin." As such, base funding for existing research must continue while funding for new research must increase, as it plays a leading and necessary role in addressing the many challenges and threats that will confront the world over the next several years and decades.

New Products/Product Quality/Value Added

(1) A decrease of $268,000 for New Products/Product Quality/Value Added research ($100,956,000 and 671 staff years available in 2016).

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, healthier 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.

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 2012 Action Plan goals.

The funding change is requested for the following items:

a) An increase of $1,250,000 for pay costs ($234,000 for annualization of the 2016 pay increase and $1,016,000 for the 2017 pay increase).

Funding for pay costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs and carrying out ARS' mission. Absorption of these costs reduces the number of scientists and support

personnel essential for conducting the agency's research programs. If pay costs are not fully funded, ARS will have to reduce spending for much needed laboratory equipment, supplies, and other materials.

b) An increase of $1,375,000 for Safe and Abundant Water Supplies to Support U.S. Agricultural Production.

This is a crosscutting, multidisciplinary initiative which supports the following programs: New Products/Product Quality/Value Added, Environmental Stewardship, Crop Production and Protection, and Food Safety. See page 18-39.

c) An increase of $1,100,000 for Resilient Crops which Respond and Adapt to Climate Change.

This is a crosscutting, multidisciplinary initiative which supports the following programs: New Products/Product Quality/Value Added, Environmental Stewardship, and Crop Production and Protection. See page 18-34.

d) An increase of $579,000 for General Services Administration (GSA) rent and Department of Homeland Security (DHS) security payments.

e) A decrease of $4,572,000 from ongoing research projects to support higher priority research initiatives.

The goal of ARS research programs is to make the most effective use of taxpayer dollars within available resources. In order to respond to priority national needs, it is often necessary to set priorities within the existing portfolio of projects, so that some projects do not qualify for continuing support. The 2017 Budget recommends 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 can no longer be funded because they are: 1) research that is mature, where the research objectives have been mainly accomplished; 2) research that is duplicative or can be accomplished more effectively elsewhere in ARS; 3) marginal or below threshold funding for program viability or sustainability; 4) research that is conducted in substandard or inadequate infrastructure and future costs are prohibitive; 5) research that is lacking a critical mass of scientists/support personnel for an effective program; or 6) research that is 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 2017 Budget, and will improve program and operational efficiencies.

IL, Peoria - Conversion of Polysaccharides and Other Bio-Based Materials to High-Value, Commercial Products (-$1,439,000)
MS, University - Discovery and Development of Natural Products for Pharmaceutical and Agrochemical Applications (-$2,684,000)
NY, Ithaca - Dissection of Maize Grain Quality Traits Using Biochemical Genetic and Genomic Approaches (-$449,000)

Livestock Production

(2) An increase of $1,786,000 for Livestock Production research ($86,859,000 and 425 staff years available in 2016).

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.

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 2012 Action Plan goals.

The funding change is requested for the following items:

a) An increase of $792,000 for pay costs ($148,000 for annualization of the 2016 pay increase and $644,000 for the 2017 pay increase).

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

b) An increase of $3,800,000 for Combatting Antimicrobial Resistance.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Livestock Production and Protection, Food Safety, and Environmental Stewardship. See page 18-32.

c) An increase of $700,000 for Assessing and Reducing Vulnerability of Agro-Ecosystems to Climate Change.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Livestock Production and Protection, Environmental Stewardship, and Crop Production and Protection. See page 18-36.

d) An increase of $500,000 for Safe and Abundant Water Supplies to Support U.S. Agricultural Production.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Livestock Production, Environmental Stewardship, Food Safety, New Products/Product Quality/Value Added, and Crop Production and Protection. See page 18-39.

e) An increase of $502,000 for General Services Administration (GSA) rent and Department of Homeland Security (DHS) security payments.

f) A decrease of $4,508,000 from ongoing research projects to support higher priority research initiatives.

The goal of ARS research programs is to make the most effective use of taxpayer dollars within available resources. In order to respond to priority national needs, it is often necessary to set priorities within the existing portfolio of projects, so that some projects do not qualify for continuing support. The 2017 Budget recommends 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 can no longer be funded because they are: 1) research that is mature, where the research objectives have been mainly accomplished;

2) research that is duplicative or can be accomplished more effectively elsewhere in ARS; 3) marginal or below threshold funding for program viability or sustainability; 4) research that is conducted in substandard or inadequate infrastructure and future costs are prohibitive; 5) research that is lacking a critical mass of scientists/support personnel for an effective program; or 6) research that is 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 2017 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 – Technology Development in Animal Research and Production Systems (-$699,000)
OK, El Reno – Improving the Efficiency and Sustainability of Diversified Forage-Based Livestock Production Systems (-$475,000)
OR, Corvallis - Determine Genetic Diversity and Develop Tools for Genetic Improvement of Oyster Stocks for the Pacific Northwest (-$364,000)
WV, Leetown - Integrated Research to Improve On-Farm Animal Health in Salmonid Aquaculture (-$468,000)
WI, Madison - Combating Viral Hemorrhagic Septicemia and Improving Yellow Perch Aquaculture for the Great Lakes Region (-$1,480,000)

Crop Production

(3) A decrease of $1,114,000 for Crop Production research ($217,708,000 and 1,256 staff years available in 2016).

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.

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 2012 Action Plan goals.

The funding change is requested for the following items:

a) An increase of $2,331,000 for pay costs ($436,000 for annualization of the 2016 pay increase and $1,895,000 for the 2017 pay increase).

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

b) An increase of $2,450,000 for Resilient Crops which Respond and Adapt to Climate Change.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Crop Production and Protection, Environmental Stewardship, and New Products/Product Quality/Value Added. See page 18-34.

c) An increase of $2,000,000 for Safe and Abundant Water Supplies to Support U.S. Agricultural Production.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Crop Production and Protection, Environmental Stewardship, Food Safety, and New Products/Product Quality/Value Added. See page 18-39.

d) An increase of $1,750,000 for Assessing and Reducing Vulnerability of Agro-Ecosystems to Climate Change.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Crop Production and Protection, Environmental Stewardship, and Livestock Production and Protection. See page 18-36.

e) An increase of $1,244,000 for General Services Administration (GSA) rent and Department of Homeland Security (DHS) security payments.

f) A decrease of $10,889,000 from ongoing research projects to support higher priority research initiatives.

The goal of ARS research programs is to make the most effective use of taxpayer dollars within available resources. In order to respond to priority national needs, it is often necessary to set priorities within the existing portfolio of projects, so that some projects do not qualify for continuing support. The 2017 Budget recommends 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 can no longer be funded because they are: 1) research that is mature, where the research objectives have been mainly accomplished; 2) research that is duplicative or can be accomplished more effectively elsewhere in ARS; 3) marginal or below threshold funding for program viability or sustainability; 4) research that is conducted in substandard or inadequate infrastructure and future costs are prohibitive; 5) research that is lacking a critical mass of scientists/support personnel for an effective program; or 6) research that is 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 2017 Budget, and will improve program and operational efficiencies.

CA, Davis - Improvement of Postharvest Performance of Ornamentals Using Molecular Genetic Approaches (-$289,000)
CA, Salinas - Strategies to Improve Soil and Pest Management in Organic Vegetable and Strawberry Production Systems (-$343,000)
CA, Salinas - Sugar Beet Germplasm Enhancement, Breeding, and Genetics (-$637,000)
CO, Ft. Collins - Modeling Soil and Soil-Plant Interaction Responses to Wind and Extreme Precipitation and Temperature Events under Different Management Strategies (-$1,126,000)
LA, Houma - Integrated Crop, Soil, and Water Management Systems for Sustainable Production of Sugarcane for Bioenergy Feedstock (-$298,000)
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)
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, Stoneville - Fitness and Virulence of Antimicrobial-Resistant Campylobacter in the Poultry Production Ecosystem (-$1,532,000)
MO, Columbia - Functional Genomics for Evaluating Genes and Gene Regulatory Networks of Soybean Quality Traits (-$313,000)
OR, Corvallis - Multi-Objective Optimization of a Profitable and Environmentally Sustainable Agriculture to Produce Food and Fiber in a Changing Climate (-$1,577,000)
WA, Pullman - Cultural Practices and Cropping Systems for Economically Viable and Environmentally Sound Oilseed Production in Dryland of Columbia Plateau (-$378,000)
WI, Madison - Agricultural Landscape, Pollinator Behavior, and Gene Flow Risk (-$460,000)

Food Safety

(4) An increase of $4,581,000 and 1 additional staff year for Food Safety research ($111,790,000 and 659 staff years available in 2016).

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.

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 2012 Action Plan goals.

The funding change is requested for the following items:

a) An increase of $1,179,000 for pay costs ($220,000 for annualization of the 2016 pay increase and $959,000 for the 2017 pay increase).

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

b) An increase of $8,000,000 for Combatting Antimicrobial Resistance.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Food Safety, Livestock Production and Protection, and Environmental Stewardship. See page 18-32.

c) An increase of $1,875,000 for Safe and Abundant Water Supplies to Support U.S. Agricultural Production.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Food Safety, Environmental Stewardship, Crop Production, and Protection, and New Products/Product Quality/Value Added. See page 18-39.

d) A decrease of $6,473,000 from ongoing research projects to support higher priority research initiatives.

The goal of ARS research programs is to make the most effective use of taxpayer dollars within available resources. In order to respond to priority national needs, it is often necessary to set priorities within the existing portfolio of projects, so that some projects do not qualify for continuing support. The 2017 Budget recommends 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 can no longer be funded because they are: 1) research that is mature, where the research objectives have been mainly accomplished; 2) research that is duplicative or can be accomplished more effectively elsewhere in ARS; 3) marginal or below threshold funding for program viability or sustainability; 4) research that is conducted in substandard or inadequate infrastructure and future costs are prohibitive; 5) research that is lacking a critical mass of scientists/support personnel for an effective program; or 6) research that is 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 2017 Budget, and will improve program and operational efficiencies.

AZ, Maricopa - Reuse of Treated Municipal Waste Water for Irrigation as a Means to Increase Alternative Water Supplies (-$289,000)
AR, Fayetteville – Alternative Intervention and Control Strategies for Foodborne Pathogens in Poultry and Poultry Products (-$947,000)
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 increase of $12,756,000 and 6 additional staff years for Livestock Protection research ($92,765,000 and 444 staff years available in 2016).

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.

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 2012 Action Plan goals.

The funding change is requested for the following items:

a) An increase of $821,000 for pay costs ($154,000 for annualization of the 2016 pay increase and $667,000 for the 2017 pay increase).

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

b) An increase of $8,512,000 for Combatting Antimicrobial Resistance.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Livestock Protection and Production, Food Safety, and Environmental Stewardship. See page 18-32.

c) An increase of $7,000,000 for Biodefense Research to Address Foreign Animal Diseases (base funding is $4,589,000).

Need for Change

To protect the long-term health and profitability of U.S. animal agriculture, incursions of foreign animal diseases must be prevented or rapidly controlled. Foreign animal diseases of concern include Foot-and-Mouth Disease (FMD), African swine fever (ASF), and emerging zoonotic diseases such as Ebola, MERS-CoV, and Nipah virus. In the United States, control usually means disease eradication. Disease eradication is accomplished by eliminating thousands of animals, resulting in animal welfare concerns, control costs, loss of income to the farm community, public opposition, and damage to the environment. In addition to control costs, one of the most immediate and severe consequences of a foreign animal disease occurrence is the loss of export markets.

Current methods for rapid response to disease outbreaks caused by a foreign animal diseases, such as the euthanasia of infected animals and carcass disposal, are not socially, environmentally, or economically acceptable. Control tools such as vaccines designed for the prevention and eradication of foreign animal diseases are inadequate or not available. Furthermore, our understanding of foreign animal disease epidemiology, pathogenesis, and transmission is insufficient to develop effective countermeasures to prevent, control, and eradicate foreign animal disease outbreaks. One important area of biodefense research is the need to advance the field of animal immunology, a fundamental gap in our research toolbox and at the core of some of the most pressing research priorities for

advancing the development of veterinary countermeasures. Comparative immunology provides opportunities for addressing a wide array of problems ranging from predicting to responding to the emergence and re-emergence of infectious diseases of veterinary and human importance. Emerging zoonotic diseases are threatening people and public health systems worldwide. Moreover, many zoonotic pathogens are also known as "select agents," which by definition could be used for bioterrorism. The construction of the National Bio- and Agro-Defense Facility (NBAF) in Manhattan, Kansas, will provide for the first time the opportunity for U.S. government scientists to work on Biosafety Level-4 agents, such as Ebola and Nipah virus. Addressing current scientific gaps in animal immunology is critical to the development of veterinary countermeasures and the future mission of NBAF.

Means to Achieve Change

- Foreign Animal Disease Research (+$7,000,000). ARS will:
  - -- Establish national networks to prioritize and develop immune tool kits for animal species of economic importance. Coordinate tool development so that priority reagents become available through public-private partnerships.
  - -- Identify critical components of innate immunity. Use acquired knowledge of innate immune pathways to develop new and novel immune interventions to treat and prevent infectious diseases.
  - -- Identify and characterize host genes that control important immunologic responses and determine mechanisms that drive poor versus good responses to vaccination.
  - -- Develop scientific information to establish on-farm practices that will maximize "biosecurity" to protect farms from naturally or intentionally introduced pathogens that threaten food security, farm productivity, and the trade and export of agricultural products.
  - -- Develop effective countermeasures to prevent and eliminate the threat of foreign animal diseases in agricultural and wildlife species.
  - -- Develop experimental animal disease models that will serve the veterinary and public health research communities to significantly shorten the timelines for developing veterinary countermeasures.

Outcomes

ARS is one of the leading animal health research institutions working in the discovery of animal vaccines and biotherapeutics, both of which are dependent on our knowledge of immunology. Recent successes include the development of a "leaderless" FMD vaccine that was specifically engineered for disease control and eradication and that can be safely manufactured on the U.S. mainland. Comparative immunology will provide the means to understand disease pathogenesis and mechanisms of transmission across species, which will contribute to our ability to intervene and prevent emerging foreign animal disease threats. Better understanding of host immune responses to infection, and adaptation across diverse species will strengthen our ability to develop veterinary countermeasures. Importantly, comparative immunology will lead to the development of countermeasures to better predict, prevent, and respond to emerging zoonotic infectious diseases.

Strategic Goals and Objectives

This initiative supports many of the Department's Strategic Goals, particularly: Ensure that All of America's Children Have Access to Safe, Nutritious, and Balanced Meals. Specifically, it supports the Department's Objective 4.4: Protect Agricultural Health by Minimizing Major Diseases and Pests to Ensure Access to Safe, Plentiful, and Nutritious Food. ARS' initiative also supports REE's Food Safety Goal and its Crop and Animal Health Subgoal.

The initiative also supports ARS' Strategic Plan Performance Measures:

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

-- 4.4.2: 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.

Collaborators

The goal of this initiative is to synthesize opportunities for a major interagency research effort between ARS and the National Institute of Food and Agriculture (NIFA) to establish a Comparative Immunology Consortium. This initiative is also critical to build capacity between the USDA and the Department of Homeland Security (DHS) for NBAF. This initiative will include international collaborations organized with the support of the Global FMD Research Alliance (GFRA), the Global African Swine Fever Research Alliance (GARA), and the Global Strategic Alliances for the Coordination of Research on the Major Infectious Diseases of Animals and Zoonoses (STAR-IDAZ).

d) An increase of $3,000,000 for Countermeasures to Combat Highly Pathogenic Avian Influenza (base funding is $2,550,000).

Need for Change

One of the most disconcerting emerging pathogens are avian influenza viruses with epizootic and/or pandemic potential. The highly pathogenic avian influenza (HPAI) outbreak in the United States in 2014-2015 is a recent example of the speed with which an emerging pathogen can spread and inflict damage, causing the death of over 49 million chickens and turkeys. Currently, no vaccines for HPAI are permitted in the United States. The use of HPAI vaccines is dependent on the ability to rapidly develop vaccines with good efficacy against the virus strains that are the cause of the disease outbreak. Multiple paths are available to rapidly develop new vaccines platforms in the research pipeline. However, each has technical, legal, regulatory, or financial hurdles and the use of vaccines for control and eradication requires highly effective vaccines that can prevent viral shedding and ideally allow the differentiation of infected from vaccinated animals.

Emerging zoonotic diseases, such as animal influenza viruses, represent a significant portion of the emerging or re-emerging infectious diseases that are threatening people and public health systems worldwide. The response to detecting and characterizing emerging avian influenza viruses has been greatly improved with the development of low cost genomic sequencing, but we need to greatly improve how we detect, prevent, and control disease outbreaks. Understanding the host response to infectious agents, and how pathogens evade the host immune system, host range specificity, and the host response to different vaccines across a number of different species can provide insight into the many biological mechanisms that can be exploited to better control disease. Improved low cost vaccines that can be used early in the hatchery to prevent the virus amplification are needed to limit the spread and reduce the threat from avian influenza viruses.

Means to Achieve Change

- Avian Influenza Research (+$3,000,000). ARS will:
  -- Develop vaccine platforms that optimize interventions during embryogenesis, birth, neonatal/young animals, weaning, or prior to stress (i.e., shipping, comingling, and slaughter).

Outcomes

Successful completion of this research will result in the development of vaccines specifically designed to respond to disease outbreaks caused by emerging highly pathogenic avian influenza. Outbreaks of avian influenza pose a tremendous threat to people and public health systems. Preventing and controlling avian influenza at the source is the most efficient and cost-effective means of protecting poultry farmers and people. In a world where trade is a fundamental component of everyday life, having countermeasures for rapid control and eradication of diseases that limit or prevent animal and animal product trade is extremely relevant to poultry producers and Federal agencies responsible for emergency management and preparedness.

Strategic Goals and Objectives

This initiative supports many of the Department's Strategic Goals, particularly: Ensure that All of America's Children Have Access to Safe, Nutritious, and Balanced Meals. Specifically, it supports the Department's Objective 4.4: Protect Agricultural Health by Minimizing Major Diseases and Pests to Ensure Access to Safe, Plentiful, and Nutritious Food. ARS' initiative also supports REE's Food Safety Goal and its Crop and Animal Health Subgoal.

The initiative also supports ARS' Strategic Plan Performance Measures:
-- 1.4.1: Provide scientific information to maximize the production efficiency of our food animal production systems. Develop new technologies and tools contributing to improve those systems to meet current and future food animal production needs of diversified consumers, while ensuring economic and environmental sustainability and animal well-being.
-- 4.4.2: 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.

Collaborators

The goal of this initiative is to effectively respond to future highly pathogenic avian influenza disease outbreaks. Establishing public-private partnerships to enable the development of next generation avian influenza vaccines will be critical. Collaborations with Veterinary Services, Animal and Plant Health Inspection Service (APHIS) to implement the effective use of avian influenza vaccines in response to future disease outbreaks will be established.

e) An increase of $700,000 for Assessing and Reducing Vulnerability of Agro-Ecosystems to Climate Change.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Livestock Protection and Production, Environmental Stewardship, and New Products/Product Quality/Value Added. See page 18-36.

f) An increase of $523,000 for General Services Administration (GSA) rent and Department of Homeland Security (DHS) security payments.

g) A decrease of $7,800,000 from ongoing research projects to support higher priority research initiatives.

The goal of ARS research programs is to make the most effective use of taxpayer dollars within available resources. In order to respond to priority national needs, it is often necessary to set priorities within the existing portfolio of projects, so that some projects do not qualify for continuing support. The 2017 Budget recommends 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 can no longer be funded because they are: 1) research that is mature, where the research objectives have been mainly accomplished; 2) research that is duplicative or can be accomplished more effectively elsewhere in ARS; 3) marginal or below threshold funding for program viability or sustainability; 4) research that is conducted in substandard or inadequate infrastructure and future costs are prohibitive; 5) research that is lacking a critical mass of scientists/support personnel for an effective program; or 6) research that is 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 2017 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)
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)

MS, Stoneville - Products for Invasive Ant Control (-$2,708,000)
MS, University Mississippi - Green Biopesticides: Identification (-$333,000)
NE, Lincoln - Integrated Management of Stable Flies (-$815,000)

Crop Protection

(6) A decrease of $3,182,000 for Crop Protection research ($194,788,000 and 1,034 staff years available in 2016).

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.

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: Ensure that All of America's Children Have Access to Safe, Nutritious, and Balanced Meals. The research also directly supports many of the REE 2012 Action Plan goals.

The funding change is requested for the following items:

a) An increase of $1,918,000 for pay costs ($358,000 for annualization of the 2016 pay increase and $1,560,000 for the 2017 pay increase).

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

b) An increase of $2,050,000 for Resilient Crops which Respond and Adapt to Climate Change.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Crop Protection and Production, Environmental Stewardship, and New Products/Product Quality/Value Added. See page 18-34.

c) An increase of $1,150,000 for Assessing and Reducing Vulnerability of Agro-Ecosystems to Climate Change.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Crop Protection and Production, Environmental Stewardship, and Livestock Production and Protection. See page 18-36.

d) An increase of $1,000,000 for Safe and Abundant Water Supplies to Support U.S. Agricultural Production.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Crop Protection and Production, Environmental Stewardship, Food Safety, and New Products/Product Quality/Value Added. See page 18-39.

e) An increase of $1,107,000 for General Services Administration (GSA) rent and Department of Homeland Security (DHS) security payments.

f) A decrease of $10,407,000 from ongoing research projects to support higher priority research initiatives.

The goal of ARS research programs is to make the most effective use of taxpayer dollars within available resources. In order to respond to priority national needs, it is often necessary to set priorities within the existing portfolio of projects, so that some projects do not qualify for continuing support. The 2017 Budget recommends 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 can no longer be funded because they are: 1) research that is mature, where the research objectives have been mainly accomplished; 2) research that is duplicative or can be accomplished more effectively elsewhere in ARS; 3) marginal or below threshold funding for program viability or sustainability; 4) research that is conducted in substandard or inadequate infrastructure and future costs are prohibitive; 5) research that is lacking a critical mass of scientists/support personnel for an effective program; or 6) research that is 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 2017 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 – Electron and Confocal Microscopy Applications to Pests and Plant Processes Impacting Agricultural Productivity (-$624,000)
MD, Beltsville - Methods for Rapid Identification and Functional Analysis of Fungi Causing Postharvest Decay of Pome Fruit (-$782,000)
MD, Beltsville - Potato and Tomato Disease Management Through Understanding of Host Resistance and Pathogen Variability (-$1,212,000)
MI, Stoneville - Improvement of Bioherbicide Strategies for Invasive Weeds in Southern Cropping Systems (-$335,000)
MO, Columbia - Insect Biotechnology Products for Pest Control and Emerging Needs in Agriculture (-$1,735,000)
MO, Columbia - Plant Resistance, Artificial Diets, Biology, and Resistance Management of Western Corn Rootworm and Other Maize Pests (-$265,000)
MT, Sidney - Ecology and Management of Grasshoppers and Other Range Land and Crop Insects in the Great Plains (-$1,312,000)
ND, Fargo - Insect Cryopreservation, Dormancy, Genetics and Biochemistry (-$1,977,000)

Human Nutrition

(7) A decrease of $1,597,000 for Human Nutrition research ($86,874,000 and 235 staff years available in 2016).

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 studies essential nutrients and nonessential, health-promoting components in foods. 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.

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 2012 Action Plan goals.

The funding change is requested for the following items:

a) An increase of $420,000 for pay costs ($78,000 for annualization of the 2016 pay increase and $342,000 for the 2017 pay increase).

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

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

The goal of ARS research programs is to make the most effective use of taxpayer dollars within available resources. In order to respond to priority national needs, it is often necessary to set priorities within the existing portfolio of projects, so that some projects do not qualify for continuing support. The 2017 Budget recommends 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 can no longer be funded because they are: 1) research that is mature, where the research objectives have been mainly accomplished; 2) research that is duplicative or can be accomplished more effectively elsewhere in ARS; 3) marginal or below threshold funding for program viability or sustainability; 4) research that is conducted in substandard or inadequate infrastructure and future costs are prohibitive; 5) research that is lacking a critical mass of scientists/support personnel for an effective program; or 6) research that is 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 2017 Budget, and will improve program and operational efficiencies.

MA, Boston - Rural Aging Study (-$186,000)
MD, Beltsville - Effect of Elevated Atmospheric Co_2, 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)

Environmental Stewardship

(8) An increase of $9,499,000 and 2 additional staff years for Environmental Stewardship research ($203,035,000 and 1,245 staff years available in 2016).

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.

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 2012 Action Plan goals.

The funding change is requested for the following items:

a) An increase of $2,323,000 for pay costs ($435,000 for annualization of the 2016 pay increase and $1,888,000 for the 2017 pay increase).

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

b) An increase of $8,250,000 for Safe and Abundant Water Supplies to Support U.S. Agricultural Production.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Environmental Stewardship, Crop Production and Protection, Food Safety, and New Products/Product Quality/Value Added. See page 18-39.

c) An increase of $5,400,000 for Resilient Crops which Respond and Adapt to Climate Change.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Environmental Stewardship, Crop Production and Protection, and New Products/Product Quality/Value Added. See page 18-34.

d) An increase of $3,700,000 for Assessing and Reducing Vulnerability of Agro-Ecosystems to Climate Change.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Environmental Stewardship, Crop Production and Protection, and Livestock Production and Protection. See page 18-36.

e) An increase of $2,000,000 for Combatting Antimicrobial Resistance.

This is a crosscutting, multidisciplinary initiative which supports the following programs: Environmental Stewardship, Livestock Production and Protection, and Food Safety. See page 18-32.

f) An increase of $1,160,000 for General Services Administration (GSA) rent and Department of Homeland Security (DHS) security payments.

g) A decrease of $13,334,000 from ongoing research projects to support higher priority research initiatives.

The goal of ARS research programs is to make the most effective use of taxpayer dollars within available resources. In order to respond to priority national needs, it is often necessary to set priorities within the existing portfolio of projects, so that some projects do not qualify for continuing support. The 2017 Budget recommends 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 can no longer be funded because they are: 1) research that is mature, where the research objectives have been mainly accomplished; 2) research that is duplicative or can be accomplished more effectively elsewhere in ARS; 3) marginal or below threshold funding for program viability or sustainability; 4) research that is conducted in substandard or inadequate infrastructure and future costs are prohibitive; 5) research that is lacking a critical mass of scientists/support personnel for an effective program; or 6) research that is 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 2017 Budget, and will improve program and operational efficiencies.

AZ, Maricopa - Reuse of Treated Municipal Waste Water for Irrigation as a Means to Increase Alternative Water Supplies (-$433,000)
CO, Akron - Sustainable Dryland Cropping System for the Central Great Plains (-$2,201,000)
LA, Houma - Integrated Crop, Soil, and Water Management Systems for Sustainable Production of Sugarcane for Bioenergy Feedstock (-$696,000)
MD, Beltsville - Developing Analytical and Management Strategies to Improve Crop Utilization and Reduce Losses to the Environment (-$1,646,000)
MD, Beltsville - Enhanced Alfalfa and Forage Productivity through Molecular Detection and Characterization of Plant Nematodes (-$393,000)
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, 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 - Improvement of Biotic and Abiotic Stress Tolerance in Cool Season Grasses (-$1,105,000)
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 (-$1,109,000)

Library and Information Services

(9) An increase of $169,000 for Library and Information Services ($23,791,000 and 92 staff years available in 2016).

The National Agricultural Library (NAL) provides services directly to the staff of USDA and to the public, primarily via its web site, http://www.nal.usda.gov. NAL was created with the USDA in 1862 and was named in 1962 as one of four national libraries by Congress. NAL is the primary agricultural information resource of the U.S., and is responsible 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.

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; and extending partnerships with USDA and other Federal agencies to develop targeted information services.

The funding change is requested for the following item:

a) An increase of $169,000 for pay costs ($32,000 for annualization of the 2016 pay increase and $137,000 for the 2017 pay increase).

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

(10) *Decentralized GSA and DHS Security Payments*

A decrease of $5,115,000 for GSA and DHS Security Payments (Funding is spread among selected program clusters).

Funding was appropriated in FY 2015 for decentralized GSA and DHS Security Payments. This funding is now part of the agency's base and is spread among the program clusters.

Priority Initiatives Crosscutting Two or More Program Areas

(1) New Tools for Combatting Antimicrobial Resistance.

ARS is requesting an increase of $22,312,000 for this crosscutting, multidisciplinary initiative (base funding is $30,056,000). Funding increases for this initiative are located under the Food Safety, Livestock Protection and Production, and Environmental Stewardship sections of this document.

Need for Change

Antibiotics are one of the most important medical discoveries of the 20th century and will remain an essential tool for treating animal and human diseases in the 21st century. However, antimicrobial resistance among bacterial pathogens and concerns over the prudent use of antibiotics in animals has garnered global attention. The potential transfer of antimicrobial resistance from animal to human pathogens resulting in the loss of medically important antibiotics has resulted in the development of national strategies by the global public health communities to combat antimicrobial resistant bacteria. Importantly, the availability of effective medical interventions to prevent and control animal diseases on the farm is likely to impact global food security. Accordingly, more attention needs to be given to understanding the drivers of antimicrobial resistance in farm animals and the discovery of novel technologies that can provide alternatives to antibiotics.

Developing novel alternatives to antibiotics will be challenging since alternatives with narrow spectrum efficacy are needed to replace the broad-based efficacy of antibiotics, which contribute to the selection of antimicrobial resistant bacteria. Research addressing microbial ecology to better understand the relationships between microbes and livestock, the environment, and human health are needed to improve safe animal production and the preservation of medically important antibiotics. This "Combatting Antibiotic Resistant Bacteria" initiative addresses the 2014 Executive Order 13676, and the Secretary's priority: Reducing the use of antimicrobials and the development and presence of resistant bacteria in food producing animals. The proposed research builds upon the agency's strong animal health and food safety research programs to reduce the development of antibiotic resistant bacteria and reduce the use of antibiotics in animal production.

Means to Achieve Change

- Antimicrobial Resistance (+$10,312,000). ARS will:
  - -- Develop highly effective vaccines that will reduce the use of antibiotics in animal agriculture.
  - -- Identify specific nutrients with beneficial immune modulating properties that optimize immune function. Define specific nutrient requirements for effective and appropriate vaccination and immunological memory, and for amelioration of periods of immune deficiency, such as during pregnancy, parturition, pediatric development, aging, and stress.
  - -- Define probiotic microbial populations in the gut microbiome that affect immune development and functional resistance at mucosal surfaces and on the efficacy of systemic immunity, and the diets (prebiotics) and dietary supplements that support appropriate resident or ingested microbial populations.

- Protect Public Health by Preventing Antimicrobial Resistance (+$7,500,000). ARS will:
  - -- 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 animal health, 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 animal and foodborne pathogens, such as clostridia, E. coli, 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.

- Protect Public Health by Working with the Food and Drug Administration, Centers for Disease Control and Prevention, and National Institutes of Health to Understand How Antimicrobial Resistance Occurs in Animals and the Environment (+ $4,500,000). ARS will:
  -- 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 animal health, such as control and mitigation of pathogenicity, reduction of antibiotic use, and minimization of 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 immune status, health, and productivity.

Outcomes

The research will lead to the development of strategies to minimize the level of antimicrobial resistance in production animals and will inform the development of alternatives to antibiotics to prevent or treat respiratory and enteric diseases of livestock and poultry. The research will 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. Success will be achieved by implementing effective technology transfer strategies, resulting in the development and availability of new technologies to combat antimicrobial resistant bacteria.

Strategic Goals and Objectives

This initiative supports many of the Department's Strategic Goals, particularly: Ensure that All of America's Children Have Access to Safe, Nutritious, and Balanced Meals. Specifically, it supports the Department's Objective 4.4: Protect Agricultural Health by Minimizing Major Diseases and Pests to Ensure Access to Safe, Plentiful, and Nutritious Food. ARS' initiative also supports REE's Food Safety Goal and its Crop and Animal Health Subgoal.

The initiative also supports ARS' Strategic Plan Performance Measures:
-- 1.4.1: Provide scientific information to maximize the production efficiency of our food animal production systems. Develop new technologies and tools contributing to improve those systems to meet current and future food animal production needs of diversified consumers, while ensuring economic and environmental sustainability and animal well-being.
-- 4.1.2: Develop new technologies that assist ARS customers in detecting, identifying, and controlling foodborne diseases associated with the consumption of animal products that affect human health.
-- 4.4.2: 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.

Collaborators

As part of the President's National Strategy for Combatting Antibiotic Resistant Bacteria, USDA is charged with the development of practical mitigation strategies to limit or reduce the prevalence of Antimicrobial Resistance. To achieve this goal, ARS, APHIS, Economic Research Service (ERS), Food Safety and Inspection Service (FSIS), National Agricultural Statistics Service (NASS), and National Institute of Food and Agriculture (NIFA) jointly

developed a USDA Antimicrobial Resistance Action Plan (Plan), which calls for these agencies to make combatting antibiotic resistance a programmatic budgetary priority.

While the FY 2017 agencies' budget requests focus on their specific work related to antimicrobial resistance, the programs and funding are inextricably linked, allowing USDA to maximize efforts, reduce duplication, and leverage the resources across the agencies in the areas of surveillance, research, education, and extension/outreach. The proposed activities of each agency are dependent upon the partnering agencies fulfilling their proposed activities. This integrated approached allows the most timely and effective response to the antimicrobial resistance issue.

Consistent with the Plan, the agencies propose the following for FY 2017. NASS and APHIS will continue to collect cross-sectional longitudinal data on farm practices and animal health. This information will be combined with information from characterization of biologic samples collected by APHIS and FSIS to evaluate and identify changes in antibiotic usage, production practices, and disease status, and to determine if current and future efforts to impact the use of antibiotics result in reduced prevalence of antibiotic resistance in animal food production and the environment. Building upon this, intramural research conducted by ARS, and competitive extramurally-funded research activities funded by NIFA will lead to better understanding and characterization of effective mitigation strategies for antimicrobial resistance throughout the agro-ecosystem. Data generated from ARS research, and from NIFA-funded research, education, and extension/outreach activities, will be used to inform antimicrobial stewardship efforts conducted both within and external to government. Information from these agencies will support ongoing analysis by ERS of the effects of alternative policy scenarios on farm production, profits, and market outcomes.

(2) Resilient Crops which Respond and Adapt to Climate Change.

ARS is requesting an increase of $11,000,000 for this crosscutting, multidisciplinary initiative (base funding is $14,251,000). Funding increases for this initiative are located under the Environmental Stewardship, Crop Production and 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 advances. 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 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 responses based on environmental cues while other species (including most pests) have very elastic responses leading to situations where the entire population does not respond uniformly. The genetic elasticity 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, i.e., the modification of the chromosome structure and gene activity due to environmental factors) 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).

Three fundamental research challenges will be addressed as a first step in a major, new coordinated research initiative on crop adaptation to climate change that integrates crop breeding, crop production, and crop pest management: (1) Develop new breeding strategies and crop genetic resources (germplasm) to sustain continuous gains in crop yield, nutritional quality, and resilience to pressures from climate change; (2) Develop new innovations in crop production practices that maximize yield and nutritional quality and resilience; and (3) Determine the impacts of climate change on crop pests and beneficial insects so that solutions can be developed.

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). ARS will:
  - -- 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 Management Practices that Maximize the Genetic Potential to Achieve Optimal Yield and Quality with Climate Change (+$3,500,000). ARS will:
  - -- Identify response-based options for crop variety management strategy combinations that synergistically boost agricultural resilience to climate change.

- Advance Understanding of the Effects of Climate Change on Pests and Beneficial Insects (+$3,000,000). ARS will:
  - -- 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). ARS will:
  - -- 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.

Strategic Goals and Objectives

This initiative supports many of the Department's Strategic Plan 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. Specifically, it supports the Department's Objective 2.2: Lead Efforts to Mitigate and Adapt to Climate Change, Drought, and Extreme Weather in Agriculture and Forestry. ARS' initiative also supports REE's Subgoal 2A: Responding to Climate Variability.

The initiative also supports ARS' Strategic Plan Performance Measures:
-- 1.2.6: Develop integrated solutions to solve challenges related to agricultural system productivity, profitability, energy efficiency, and natural resource stewardship.
-- 1.3.1: 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 diverse consumers, while ensuring economic and environmental sustainability and production efficiency, health, and value of our nation's crops.
-- 2.2.5: Develop and transfer economically viable and environmentally sustainable production and conservation practices, technologies, plant materials and integrated management strategies, based on fundamental knowledge of ecological processes, that conserve and enhance the Nation's diverse natural resources found on its range, pasture, hay and turf lands.
-- 4.3.2: Provide scientific information to increase our knowledge of plant genes, genomes and biological and molecular processes to protect crops and cropping systems from the negative effects of pests and infectious diseases. Develop sustainable control strategies for crop pests and pathogens based on fundamental and applied research that are effective and affordable, while maintaining food safety and environmental quality.

Collaborators

To accomplish these outcomes, ARS scientists will collaborate with university researchers, USDA sister agencies, such as APHIS and NIFA, Federal agencies, such as the Department of Interior and the National Oceanic and Atmospheric Administration (NOAA), industry partners, and the broader data and modeling community. Specifically, ARS will collaborate with: APHIS on pest and disease impacts on yield; NIFA and university scientists through efforts such as Free-Air CO_2 Enrichment (FACE), Long-Term Ecological Research (LTER), and Long-Term Agro-ecosystem Research (LTAR) on greenhouse gases and yield; the NIFA Cropping Systems Coordinated Agricultural Project (CAP) on corn and wheat; on data efforts, such as GEOGLAM and Global Open Data for Agriculture and Nutrition (GODAN); and on international research and outreach efforts, such as AgMIP, Global Research Alliance on Agricultural Greenhouse Gases (GRA), and Global Alliance for Climate-Smart Agriculture (GACSA). Building on priorities laid out in the President's Climate Action Plan, ARS scientists will also collaborate across ARS locations, with other USDA agencies, other Federal departments, and key stakeholders through the network of Regional Climate Hubs.

(3) Assessing and Reducing Vulnerability of Agro-Ecosystems to Climate Change.

ARS is requesting an increase of $8,000,000 for this crosscutting, multidisciplinary initiative (base funding is $9,501,000). Funding increases for this initiative are located under the Environmental Stewardship, Crop Production and Protection, and Livestock Protection and 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 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 enable 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). ARS will:
  - -- 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). ARS will:
  - -- 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). ARS will:
  - -- 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 the 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). ARS will:
  - -- Identify 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.

Strategic Goals and Objectives

This initiative supports many of the Department's Strategic Plan 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. Specifically, it supports the Department's Objective 2.2: Lead Efforts to Mitigate and Adapt to Climate Change, Drought, and Extreme Weather in Agriculture and Forestry. ARS' initiative also supports REE's Subgoal 2A: Responding to Climate Variability.

The initiative also supports ARS' Strategic Plan Performance Measures:

- -- 1.2.6: Develop integrated solutions to solve challenges related to agricultural system productivity, profitability, energy efficiency, and natural resource stewardship.
- -- 1.3.1: 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 diverse consumers, while ensuring economic and environmental sustainability and production efficiency, health, and value of our nation's crops.
- -- 1.4.1: Provide scientific information to maximize the production efficiency of our food animal production systems. Develop new technologies and tools contributing to improve those systems to meet current and future food animal production needs of diversified consumers, while ensuring economic and environmental sustainability and animal well-being.
- -- 2.2.1: Develop technology and practices to promote improvement of integrated, effective and safe water resource management.
- -- 4.3.2: Provide scientific information to increase our knowledge of plant genes, genomes and biological and molecular processes to protect crops and cropping systems from the negative effects of pests and infectious diseases. Develop sustainable control strategies for crop pests and pathogens based on fundamental and applied research that are effective and affordable, while maintaining food safety and environmental quality.

Collaborators

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

(4) Safe and Abundant Water Supplies to Support U.S. Agricultural Production.

ARS is requesting an increase of $15,000,000 for this crosscutting, multidisciplinary initiative (base funding is $11,981,000). Funding increases for this initiative are located under the Environmental Stewardship, Crop Production and Protection, Food Safety, New Products/Product Quality/Value Added, and Livestock Production sections of this document.

Need for Change

Agriculture is the largest consumer of freshwater in the U.S. Given recent climatic trends (e.g., record droughts, declining snow packs, climatic variability, and extreme events) providing enough water to meet human, agricultural, and other needs is a key 21st century challenge that threatens our food security, food safety, and human nutrition. Unprecedented population growth (i.e., 8.7 billion by 2025; 9.7 billion by 2050) and the expansion of urban/suburban populations into rural agricultural landscapes, has increased the competition for water once used mainly for food production. Even in the absence of drought, agriculture must continue to seek new ways to use water more efficiently, including the safe use of non-traditional waters (e.g., agricultural return flows; salty waters; and treated wastewaters), and tailoring genetic selection and crop choice to enhance water use efficiency.

Non-traditional waters vary in composition based on both source and treatment. Rain water is generally low in salinity and mineral content, but due to evaporation and transpiration associated with irrigation, this is not always true for surface or ground waters. As water demands increase in drought prone areas and elsewhere, degraded waters are being increasingly treated to remove contaminants that threaten food safety and human health (e.g., salts, heavy metals, pharmaceuticals, pesticides, and enteric bacteria) and then used for irrigation. Reintroducing key minerals (e.g., magnesium, and calcium) can both increase agricultural productivity and benefit human health (e.g., reducing cardiovascular disease). Simply stated, using the highest quality waters where they are most needed, and relying on non-traditional water sources when there is no risk to human health just makes good sense for agriculture.

In California, persistent record droughts have affected a wide range of specialty crops that comprise a significant portion of the State's economic productivity, while nonsustainable water use is causing groundwater salinization and subsidence. In addition, the spread of invasive plants to key aquatic environments (e.g., the San Joaquin Delta, and the San Francisco Bay) has increased water loss by evapotranspiration, while physically clogging irrigation gates and channels. The Great Basin, a large region in the arid western U.S. (includes portions of the hot Mojave and Colorado deserts to the south, and the cold Great Basin and Oregon high deserts of the north.) It has suffered from declines in annual water availability that are reducing the availability of animal forages critical for feeding beef cattle in a region that has 20,000 to 25,000 ranches. The resulting dry conditions have facilitated the invasion of exotic grasses, increasing fire frequency and range land degradation. And while the nonsustainable use of water in the Ogallala aquifer is well known, farmers and ranchers in other parts of the country (e.g., Lower Mississippi River Basin, and the southeastern U.S.) must now provide supplemental irrigation to maintain crop productivity and profitability, causing declines in key aquifers in these regions as well.

At the heart of these regional water issues lies the key question: How can we improve our management of agricultural water supplies to maintain or enhance productivity and profitability for American farmers and ranchers while also meeting human and other needs? The goals of this initiative are to: 1) Provide the research and technology development to significantly increase the sustainability of agricultural water use in the U.S.; 2) quantify and characterize the current and potential future use of non-traditional waters for U.S. agriculture, providing research to expedite the development and deployment of non-traditional water use technologies; and 3) develop crops that are more drought- and salt-tolerant.

We need a water management approach that coordinates agricultural water use and reuse across scales ranging from the genetic composition of commodities (animal and plant) and their efficiency of water use, to alternative cropping systems that use less water than current ones, to improved irrigation management that uses new technologies to maximize water use efficiency at the field scale including new technologies to reuse agricultural processing waste streams, to improved basin scale (e.g., watershed, and landscape) management strategies for both surface and ground water resources including control of aquatic weeds. While we may currently be addressing each of these components in isolated investigations, what is needed is a coordinated effort across both regions and scales, from

genetic modifications to cropping practices to basin-wide water management. Moreover, achieving our objectives will require enhanced investments over current funding levels. For example, ARS currently supports an areawide pest management project in the San Joaquin Delta addressing invasive aquatic weed control, but the funding is temporary and does not provide the capacity to address new or emerging issues in other U.S. agricultural regions.

In some parts of the U.S. (e.g., Monterey County, California), farmers are already using non-traditional waters (e.g., treated wastewaters) to safely and efficiently support agricultural production. Expanding current usage to a much larger proportion of the agriculture community is essential to reducing agriculture's water footprint while saving higher quality freshwater supplies for human needs and valuable ecosystem services. With any agricultural use of non-traditional waters the human health risks from potential contaminants must be fully identified and eliminated.

Advances have been made in developing lettuce, spinach, bean, and soybean germplasm that tolerate higher temperatures, low water availability (i.e., drought), and nutrient poor soils. ARS scientists in Salinas, California, are also breeding lettuce, spinach, and other crops for resistance to human pathogens and the mechanisms of infection or infestation, working with surrogate bacterial strains provided by ARS scientists at Albany, California. These types of efforts need to be expanded to other crops and to the diversity of climates present in California and elsewhere, including programs like the "Feed the Future Pulse Productivity" program in Africa.

One of the key aspects of this initiative would be a new Water Availability and Watershed Management Research Unit for California. This unit would organize efforts statewide to address critical water resource issues including: 1) mitigating/adapting to drought, i.e., improved irrigation management/efficiency; increased use of non-traditional waters to support irrigation by exploiting new agricultural return flow sources (e.g., from raisin processing); and new or improved germplasm and/or cultivars that use water more efficiently without loss of productivity, profitability, or food nutritional quality; 2) groundwater salinization and depletion; 3) improved management of water resources at the landscape scale including improved estimation and allocation of waters derived from snow melt in mountain regions; and 4) management of invasive aquatic weeds. This new research unit would serve as a lead or co-lead for a new LTAR site for California. As such, the proposed initiative would build on prior LTAR investments, by filling a key gap in the network that currently includes no sites in California. There is already strong interest in this effort from a variety of potential partners including the University of California-Davis/Russell Ranch, the nine University of California Research and Education Centers (each with its own NEON like observatory infrastructure), and E&J Gallo.

Current ARS research activities address many of these components, but in many cases the efforts are modest at best and generally not coordinated. The use of non-traditional waters is a key example—three ARS laboratories (Maricopa, Parlier, and Riverside) working on isolated efforts with modest resources. The proposed initiative would represent a truly integrative approach addressing key agricultural water resource issues across the U.S. (i.e., increasing water use efficiency; improving basin-wide water management; improving the sustainability of key groundwater resources; and significantly enhancing the development of new non-traditional water sources to support agricultural irrigation.) Research efforts would be integrated across scales ranging from genetic modifications, to field scale production systems, to watershed and landscape scale water management, as well as across key U.S. agricultural production regions (e.g., California, the Great Basin, the Ogallala Aquifer Region, the Lower Mississippi River Basin, and the southeastern U.S.).

Means to Achieve Change

- California Area Drought (+$5,000,000). ARS will:
  - -- Maintain agricultural productivity and profitability despite droughts and variable or declining water supplies.
  - -- Improve knowledge of the hydrologic cycle and how it may be changing as a function of climate change to improve water availability management in light of drought and/or increased competition for water resources.
  - -- Ensure invasive weeds no longer have significant negative effects on important waterways and associated water supplies.

  - -- Stabilize and enable key groundwater resources to recharge without negative effects on agricultural productivity or profitability, helping to stabilize land elevation (i.e., reduce subsidence) and improving aquifer water quality (e.g., reducing salinization).

- Non-Traditional Waters (+$5,000,000). ARS will:
  - -- Provide a more "water efficient" agriculture, with increased productivity and enhanced water availability for other important users (e.g., human and industrial needs).
  - -- Safely reduce agriculture's water footprint in terms of the use of high quality freshwaters, resulting in more high quality freshwaters available for human and ecosystem needs.
  - -- Develop safe, affordable, and tractable technologies to support non-traditional water use.
  - -- Provide more efficient and effective water treatment technologies that reduce the discharge of contaminated waste streams to receiving aquatic ecosystems (i.e., streams, rivers, estuaries) thereby improving water quality and human nutrition while reducing food safety concerns.
  - -- Ensure rural economies remain viable because the availability of alternate water sources keeps farmers and ranchers in business despite variable or declining freshwater supplies.

- Great Basin (+$5,000,000). ARS will:
  - -- Identify genotypes of native, perennial grasses that are productive as forage crops in the Great Basin that can establish under the typical, xeric (especially in summer) high elevation conditions of this region.
  - -- Develop reseeding technologies that improve the establishment of productive native grasses and forbs during range land restoration, including methods for pollinator friendly plants identified in the President's Memorandum for pollinators, and restoration techniques to help native plants compete against invasive weeds.
  - -- Increase adaptive capacities of cow/calf, stocker, and feedlot operations through the utilization of drought tolerant feed and forages, drought-based grazing management strategies, and site specific livestock management systems.

Outcomes

A water management system with the broadest series of outcomes would coordinate the allocation of different types of waters for different uses, reaping maximum benefits while minimizing risks to human and ecosystem health. Such a water management system would combine new or improved germplasm/cultivars with complementary management strategies at a variety of scales. To achieve these goals, ARS researchers will develop: 1) new germplasm/cultivars that improve water use efficiency that are matched to more arid environments that conserve water from rainfall, and that tolerate different non-traditional water sources; 2) improved rootstock/scion combinations for fruit, nut, ornamental tree, and vegetable crops that help plants thrive under conditions of low water availability; 3) improved and affordable field scale water management technologies, including new/improved production systems and crop rotations that improve water use efficiency, and decision support tools that help farmers/ranchers make production/management decisions based on predicted water availability for the upcoming growing season; 4) improved region-wide control systems for weeds invading both western range lands and irrigation systems; 5) new/improved treatment technologies for non-traditional water sources (e.g., fish farm, food processing, and tannery effluents) that effectively remove contaminants with potential human health risks from non-traditional water sources, infrastructure to support these technologies, and decision support systems/tools to help manage non-traditional water use safely and effectively for diverse needs; 6) new/improved animal feeds that reduce waste products in fish farm effluents and other return flows from animal production systems; and 7) improved understanding of the hydrologic cycle at a variety of scales, coupled with new/improved models/decision support systems to more efficiently and effectively manage water availability for agriculture and other uses.

The proposed initiative would expand key water resource activities to provide a broad-based and coordinated program of water management options for different U.S. agricultural production regions. It would include new and/or improved germplasm/cultivars, field scale water management practices, and watershed/landscape scale water management approaches to provide U.S. farmers and ranchers with the means to maintain or enhance productivity, profitability, and ecosystem services despite increased competition for water resources against the background of variable and/or declining water availability.

Strategic Goals and Objectives

This initiative supports 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. Specifically, it supports the Department's Objective 2.3: Contribute to Clean and Abundant Water by Protecting and Enhancing Water Resources on National Forests and Working Lands. ARS' initiative also supports REE Goal 3: Sustainable Use of Natural Resources.

The initiative also supports ARS' Strategic Plan Performance Measures:

-- 1.1.3: Develop methods and technologies to better define, measure, preserve or enhance quality and improve utilization of food crops, animals and agricultural fibers, as well as non-food, non-fuel biobased products and sustainable technologies/processes.
-- 2.2.1: Develop technology and practices to promote improvement of integrated, effective and safe water resource management.
-- 2.2.5: Develop and transfer economically viable and environmentally sustainable production and conservation practices, technologies, plant materials and integrated management strategies, based on fundamental knowledge of ecological processes that conserve and enhance the Nation's diverse natural resources found on its range, pasture, hay, and turf lands.
-- 4.3.2: Provide scientific information to increase our knowledge of plant genes, genomes and biological and molecular processes to protect crops and cropping systems from the negative effects of pests and infectious diseases. Develop sustainable control strategies for crop pests and pathogens based on fundamental and applied research that are effective and affordable, while maintaining food safety and environmental quality.

Collaborators

Working on this initiative will be ARS scientists from many of its laboratories (i.e., Albany and Parlier, California; Bushland and Lubbock, Texas; Burns, Oregon; Columbia, Missouri; Florence, South Carolina; Ft. Collins, Colorado; Maricopa, Arizona; New Orleans, Louisiana; Stoneville, Mississippi; Stuttgart, Arkansas; and Wyndmoor, Pennsylvania). ARS will collaborate with scientists from other Federal agencies, from the Forest Service (FS), NCRS, Bureau of Land Management, USGS, Fish and Wildlife Service, Bureau of Reclamation, Environmental Protection Agency, and NASA's Ames Research Center. State agencies which will be involved include: Colorado, Nevada, Utah, Arizona, Oregon, Mississippi, and Idaho. State universities include California, Cornell, Nevada, Colorado, Florida, North Carolina, Clemson, Mississippi, Texas, and Wisconsin. Private Organizations include the National Leather Board; National Dairy Council; California Wine Grape and Raisin Board; Colorado Salinity Forum; The Nature Conservancy; Soybean Research Board; Cotton Inc.; Mississippi Delta Council; and E&J Gallo.

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

	2014 Actual		2015 Actual		2016 Enacted		2017 Estimate	
Location	Amount	SY	Amount	SY	Amount	SY	Amount	SY
ALABAMA, Auburn	$6,104	42	$5,605	39	$6,442	41	$6,712	41
ARIZONA								
Maricopa	9,593	65	9,742	70	9,801	70	10,051	70
Tucson	6,264	47	6,373	46	6,320	46	6,995	46
Total	15,857	112	16,115	116	16,121	116	17,046	116
ARKANSAS								
Booneville	3,736	15	4,163	16	3,929	16	3,929	16
Fayetteville	1,928	12	1,929	11	1,862	11	445	11
Jonesboro	- -	- -	1,220	3	1,424	3	1,784	3
Little Rock	7,770	2	7,728	- -	7,759	- -	7,759	- -
Stuttgart	7,547	63	7,749	62	7,888	62	8,293	62
Total	21,865	92	22,788	92	22,862	92	22,210	92
CALIFORNIA								
Albany	38,621	217	39,056	206	38,062	206	38,962	206
Davis	12,133	86	11,715	82	11,673	82	12,043	82
Parlier	10,943	97	10,835	85	11,319	85	15,369	86
Riverside	5,151	36	5,129	35	5,164	35	5,974	35
Salinas	5,075	43	5,887	43	8,352	48	7,291	48
Total	71,923	479	72,622	451	74,571	456	79,640	457
COLORADO								
Akron	1,915	20	1,900	19	1,981	19	1,665	19
Fort Collins	14,258	111	14,657	118	14,718	118	13,705	118
Total	16,173	131	16,557	137	16,699	137	15,370	137
DELAWARE								
Newark	2,767	15	2,467	14	2,000	14	2,000	14
DISTRICT OF COLUMBI								
National Arboretum	12,146	71	10,926	68	11,978	68	11,978	68
Headquarters Federal Administration	97,551	519	112,863	520	88,115	522	88,115	523
Total	109,697	590	123,789	588	100,092	590	100,092	591
FLORIDA								
Canal Point	2,839	31	2,697	26	2,936	26	2,936	26
Fort Lauderdale	2,565	27	2,286	26	2,446	26	2,446	26
Fort Pierce	13,841	131	13,929	121	13,373	121	13,598	121
Gainesville	12,140	106	11,342	97	11,863	97	12,178	97
Miami	5,447	31	4,412	34	4,578	34	4,578	34
Total	36,832	326	34,666	304	35,194	304	35,734	304
GEORGIA								
Athens	24,497	148	23,026	132	23,410	134	26,298	134
Byron	3,555	28	5,189	30	3,559	30	3,559	30
Dawson	3,698	32	3,555	33	3,714	33	3,714	33
Griffin	2,568	19	2,420	19	2,410	19	2,410	19
Tifton	10,385	86	10,330	80	10,161	80	10,161	80
Total	44,703	313	44,519	294	43,254	296	46,142	296
HAWAII, Hilo	9,490	57	9,714	60	9,360	60	9,990	60

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

	2014 Actual		2015 Actual		2016 Enacted		2017 Estimate	
Location	Amount	SY	Amount	SY	Amount	SY	Amount	SY
IDAHO								
Aberdeen	6,467	46	6,267	44	6,094	44	6,094	44
Boise	2,110	18	2,546	21	1,978	21	2,968	21
Dubois	1,791	16	1,978	13	2,141	13	2,141	13
Kimberly	4,246	35	4,056	36	4,270	36	4,270	36
Total	14,614	115	14,846	114	14,483	114	15,473	114
ILLINOIS								
Peoria	31,497	207	31,781	202	32,471	202	30,761	202
Urbana	5,771	41	5,770	42	5,562	42	5,562	42
Total	37,268	248	37,551	244	38,033	244	36,323	244
INDIANA, W. Lafayette	7,252	60	7,049	53	7,537	53	7,897	53
IOWA, Ames	52,652	388	53,189	360	54,245	360	59,049	362
KANSAS, Manhattan	13,585	101	13,183	85	14,396	87	15,296	87
KENTUCKY								
Bowling Green	2,554	13	2,609	13	2,621	13	2,621	13
Lexington	2,591	13	2,567	13	2,705	13	2,705	13
Total	5,145	26	5,176	26	5,326	26	5,326	26
LOUISIANA								
Baton Rouge	3,013	25	2,831	22	2,987	22	2,987	22
Houma	4,421	46	3,871	43	3,957	43	3,063	43
New Orleans	20,856	143	20,542	135	20,781	135	21,681	135
Total	28,290	214	27,245	200	27,725	200	27,731	200
MAINE, Orono	2,579	14	2,249	14	2,260	14	1,332	14
MARYLAND								
Beltsville	115,264	692	119,147	651	118,472	651	113,096	651
National Ag Library	22,844	95	23,441	92	23,197	92	23,197	92
Frederick	5,878	35	5,866	39	6,096	39	6,096	39
Total	143,986	822	148,454	782	147,765	782	142,389	782
MASSACHUSETTS, Bost	16,662	8	15,177	8	14,993	8	14,826	8
MICHIGAN, East Lansing	4,945	32	4,990	32	5,007	32	5,457	32
MINNESOTA								
Morris	2,655	27	2,743	25	2,530	25	2,530	25
St. Paul	6,927	51	7,022	50	6,677	50	6,677	50
Total	9,582	78	9,765	75	9,207	75	9,207	75
MISSISSIPPI								
Mississippi State	9,305	71	9,026	71	9,252	71	5,974	71
Oxford	14,564	86	13,974	82	14,005	82	9,754	84
Poplarville	5,716	33	5,676	29	5,497	29	5,497	29
Stoneville	37,747	251	38,163	242	40,201	245	34,702	245
Total	67,332	441	66,837	424	68,955	427	55,927	429
MISSOURI, Columbia	9,226	69	9,077	71	9,323	71	7,646	71
MONTANA								
Miles City	3,677	21	3,487	22	3,755	22	4,070	22
Sidney	4,731	41	4,802	41	4,821	41	4,720	41
Total	8,408	62	8,289	63	8,576	63	8,790	63

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

	2014 Actual		2015 Actual		2016 Enacted		2017 Estimate	
Location	Amount	SY	Amount	SY	Amount	SY	Amount	SY
NEBRASKA								
Clay Center	23,648	118	23,825	117	22,752	117	25,677	117
Lincoln	5,768	58	5,818	55	5,612	55	6,948	55
Total	29,416	176	29,643	172	28,363	172	32,624	172
NEVADA								
Reno	2,347	15	2,463	16	2,274	16	3,849	16
NEW MEXICO								
Las Cruces	6,867	47	7,048	50	7,044	50	7,044	50
NEW YORK								
Geneva	4,306	34	4,118	33	3,894	33	3,894	33
Greenport	4,031	29	4,014	27	4,130	27	9,530	30
Ithaca	11,854	53	11,762	52	11,480	52	11,166	52
Total	20,191	116	19,894	112	19,504	112	24,590	115
NORTH CAROLINA								
Raleigh	9,443	70	9,921	64	9,377	64	11,861	64
NORTH DAKOTA								
Fargo	15,178	107	15,431	103	15,624	103	14,781	103
Grand Forks	8,950	42	9,636	43	9,273	43	9,273	43
Mandan	4,018	32	3,720	29	4,166	29	4,346	29
Total	28,146	181	28,787	175	29,064	175	28,401	175
OHIO								
Columbus	1,487	15	1,781	16	1,454	16	1,454	16
Wooster	5,680	44	5,552	45	4,836	45	4,836	45
Total	7,167	59	7,333	61	6,290	61	6,290	61
OKLAHOMA								
El Reno	6,626	41	6,721	38	6,876	38	6,448	38
Stillwater	3,965	29	3,604	30	3,649	30	3,649	30
Woodward	2,178	15	2,177	15	2,219	15	2,219	15
Total	12,769	85	12,502	83	12,743	83	12,315	83
OREGON								
Burns	2,642	23	2,472	23	2,607	23	3,282	23
Corvallis	12,812	99	12,937	95	11,823	95	9,621	95
Pendleton	1,947	19	1,967	19	1,900	19	999	19
Total	17,401	141	17,376	137	16,330	137	13,902	137
PENNSYLVANIA								
University Park	5,464	39	5,833	40	5,857	40	5,857	40
Wyndmoor	32,987	184	31,269	171	31,525	171	31,885	171
Total	38,451	223	37,102	211	37,382	211	37,742	211
SOUTH CAROLINA								
Charleston	4,576	38	4,436	37	4,589	37	4,589	37
Florence	4,855	27	3,858	25	3,919	25	4,279	25
Total	9,431	65	8,294	62	8,508	62	8,868	62
SOUTH DAKOTA								
Brookings	2,956	34	2,984	31	2,824	31	3,634	31

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

	2014 Actual		2015 Actual		2016 Enacted		2017 Estimate	
Location	Amount	SY	Amount	SY	Amount	SY	Amount	SY
TEXAS								
Bushland	6,429	39	6,315	40	6,847	40	6,847	40
College Station	14,754	106	13,193	92	13,125	92	14,506	92
Houston	15,774	7	15,970	7	13,524	7	13,524	7
Kerrville	6,213	41	5,950	38	6,218	38	6,668	38
Lubbock	8,884	88	9,016	86	8,275	86	8,371	86
Temple	3,352	29	3,646	32	3,760	32	3,760	32
Total	55,406	310	54,088	295	51,749	295	53,676	295
UTAH, Logan	9,454	75	9,138	75	9,271	75	9,946	75
WASHINGTON								
Prosser	3,775	25	- -	- -	- -	- -	- -	- -
Pullman	17,973	105	20,521	117	19,452	117	19,472	117
Wapato	4,625	50	6,234	52	5,885	52	5,885	52
Wenatchee	2,745	20	2,023	17	2,035	17	2,035	17
Total	29,118	200	28,778	186	27,373	186	27,393	186
WEST VIRGINIA								
Kearneysville	7,716	61	9,855	62	7,082	62	7,082	62
Leetown	7,829	35	7,468	35	7,589	35	7,798	35
Total	15,545	96	17,323	97	14,671	97	14,880	97
WISCONSIN, Madison	17,401	104	17,069	101	17,683	101	15,937	101
WYOMING, Cheyenne	3,116	23	3,175	22	3,612	22	3,612	22
PUERTO RICO								
Mayaguez	3,198	37	3,403	38	3,159	38	3,159	38
OTHER COUNTRIES								
France, Montpellier	3,673	1	3,650	2	3,201	2	3,201	2
Extramural and Funds Administered from Headquarters-Held Funds	23,274	- -	19,553	- -	58,831	- -	70,665	- -
Repair & Maintenance of Facilities	20,104	- -	20,144	- -	20,144	- -	20,144	- -
Obligations	1,121,811	6,893	1,131,592	6,636	1,143,825	6,652	1,161,340	6,661
Lapsing Balances	2,386	- -	2,413	- -	- -	- -	- -	- -
Bal. Available, EOY	11,690	- -	13,680	- -	- -	- -	- -	- -
Total Available	1,135,887	6,893	1,147,685	6,636	1,143,825	6,652	1,161,340	6,661

Salaries and Expenses

Classification by Objects
(Dollars in thousands)

		2014 Actual	2015 Actual	2016 Enacted	2017 Estimate
Personnel Compensation:					
Washington D.C.		$43,664	$43,071	$43,537	$44,581
Field		445,448	439,640	444,393	455,048
11	Total personnel compensation	489,112	482,711	487,930	499,629
12	Personal benefits	159,161	161,281	163,577	167,499
13.0	Benefits for former personnel	1,152	547	-	-
	Total, personnel comp. and benefits	649,425	644,539	651,507	667,128
Other Objects:					
21.0	Travel and transportation of persons	10,365	10,790	10,855	10,949
22.0	Transportation of things	295	288	291	292
23.1	Rental payments to GSA	300	4,982	5,115	5,115
23.2	Rental payments to others	12	527	533	535
23.3	Communications, utilities, and misc. charges	45,192	49,162	49,693	49,904
24.0	Printing and reproduction	319	388	392	394
25.1	Advisory and assistance services	829	1,180	1,193	1,197
25.2	Other services from non-Federal sources	8,945	11,732	12,319	11,905
25.3	Other purchases of goods and services from Federal sources	348	4,221	4,267	4,283
25.4	Operation and maintenance of facilities	44,967	42,440	42,918	43,064
25.5	Research and development contracts	177,634	187,558	197,706	195,309
25.6	Medical care	322	245	247	248
25.7	Operation and maintenance of equipment	15,814	22,032	17,216	17,283
25.8	Subsistence and support of persons	8	2	2	2
26.0	Supplies and materials	95,630	73,222	84,121	74,298
31.0	Equipment	52,375	53,594	54,173	54,381
32.0	Land and structures	5,579	8,192	8,281	8,313
41.0	Grants, subsidies, and contributions	13,452	16,498	16,676	16,740
	Total, Other Objects	472,386	487,053	505,998	494,212
99.9	Total, new obligations	1,121,811	1,131,592	1,157,505	1,161,340
DHS Building Security payments (included in 25.3)		-	$137	$139	$142
Position Data:					
Average Salary (dollars), ES Position		$127,724	$129,430	$130,515	$133,464
Average Salary (dollars), GS Position		$66,608	$68,170	$68,741	$70,294
Average Grade, GS Position		10.6	10.7	10.7	10.7

Salaries and Expenses

Shared Funding Projects
(Dollars in thousands)

	2014 Actual	2015 Actual	2016 Enacted	2017 Estimate
Working Capital Fund:				
Administration:				
HR Enterprise System Management	-	-	$130	$130
Integrated Procurement Systems	$1,161	$1,374	1,608	1,609
Mail and Reproduction Services	1,826	1,368	1,560	1,516
Material Management Service Center	132	139	182	174
Procurement Operations Division	5	644	30	28
Subtotal	3,124	3,525	3,510	3,457
Communications:				
Creative Media and Broadcast Center	224	172	400	301
Finance and Management:				
Financial Management Systems	2,001	4,909	5,080	5,127
Controller Operations	2,554	-	-	-
Internal Control Support Services	136	113	150	159
National Finance Center	2,269	2,221	2,209	2,115
Subtotal	6,960	7,243	7,439	7,401
Information Technology:				
Client Technology Service	-	613	819	824
International Technology Services	3	-	-	-
National Information Technology Center	1,034	997	930	1,177
Telecommunications Services	1,846	1,099	1,234	1,271
Subtotal	2,883	2,709	2,983	3,272
Correspondence Management	98	70	106	133
Total, Working Capital Fund	13,289	13,719	14,438	14,564
Departmental Shared Cost Programs:				
1890 USDA Initiatives	210	201	243	243
Advisory Committee Liaison Services	3	3	4	4
Classified National Security Information	-	73	47	47
Continuity of Operations Planning	145	153	150	150
Emergency Operations Center	166	163	169	169
Facility and Infrastructure Review and Assessment	32	32	32	32
Faith-Based and Neighborhood Partnerships	16	28	29	29
Federal Biobased Products Preferred Procurement Program	25	-	-	-
FITARA Administration and Operations	-	-	93	128
Hispanic-Serving Institutions National Program	143	131	165	165
Honor Awards	5	6	5	5
Human Resources Transformation (inc. Diversity Council)	123	124	106	106
Identity and Access Management (HSPD-12)	484	488	483	483
Medical Services	18	42	53	53
People's Garden	41	52	47	47
Personnel Security Branch	83	71	68	68
Pre-authorizing Funding	260	274	295	295
Retirement Processor Web Application	41	43	43	43

Salaries and Expenses

Shared Funding Projects
(Dollars in thousands)

	2014 Actual	2015 Actual	2016 Enacted	2017 Estimate
Sign Language Interpreter Services	42	-	-	-
TARGET Center	66	101	104	104
USDA 1994 Program	54	52	94	94
Virtual University	140	143	142	142
Visitor Information Center	17	-	-	-
Total, Departmental Shared Cost Programs	2,114	2,180	2,372	2,407
E-Gov:				
Budget Formulation and Execution Line of Business	7	7	7	7
Enterprise Human Resources Integration	161	152	139	139
E-Rulemaking	74	58	-	-
E-Training	200	201	178	-
Financial Management Line of Business	13	12	9	5
Grants.gov	45	39	-	-
Human Resources Line of Business	20	20	20	20
Integrated Acquisition Environment - Loans and Grants	136	137	-	-
Integrated Acquisition Environment	48	48	154	190
Total, E-Gov	704	674	507	361
Agency Total	16,107	16,573	17,317	17,332

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 2015 and current research activities, including the National Agricultural Library, are detailed below.

Program Evaluations: In 2015, ARS conducted retrospective reviews of its Food Safety; Climate Change, Soils, and Emissions; and Plant Diseases 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 Research, Education, and Economics (REE) Action Plan goals.

Selected Examples of Recent Progress:

Innovative, rapid nondestructive detection of fungi contaminated wheat seeds. Selecting intact wheat seeds naturally free of fungal pathogens and toxins like fusarium head-blight – the casual organism of vomitoxin (DON) which the Food & Drug Administration regulates to levels of no more than 1 part per million DON in flour-based food products – would advance the development of lines resistant to DON. ARS scientists in Manhattan, Kansas, developed an automated, nondestructive, near-infrared light scanning scope that can detect the fungi causing DON, not only on the surface but within individual seeds. Because contamination free seeds are intact, breeders for the first time can use them to develop DON resistant wheat cultivars. As a result of this new technology, advances in the fusarium head-blight resistant wheat and barley initiative are being made.

LED, portable egg candling system and online data management software. Current commercial egg candling grading lights are no longer available and are based on obsolete incandescent bulbs. The Agricultural Marketing Service (AMS) has requested their grading units be upgraded to new high intensity LED candling lights. ARS scientists in Athens, Georgia, have designed and developed both portable and stationary LED light grading systems, and engineered a computerized software system designed to specifically meet the needs of AMS for egg cracking detection. The software system was developed to monitor, collect, and process the egg cracking data, replacing current paper data forms, in real time suitable for statistical and trend analysis. An ARS certification process is under development to ensure security of the web server application software system. The LED egg candling device was demonstrated to AMS graders and administrators, with favorable responses including immediate deployment for field tests. An industry manufactured LED, egg candling system is under development.

Napier grass beats corn in bioethanol production. Napier grass is a warm season grass that has low water and nutrient requirements, can be grown in marginal or uncultivated lands, does not compete with food crops for growing space, and is being developed as a bioenergy crop for production in the southeastern U.S. ARS scientists in Peoria, Illinois, and Tifton, Georgia, converted Napier grass into ethanol with an estimated yield of 10,300 liters per hectare (ha). By comparison, a corn field that typically yields 444 bushels/ha could produce only 4,640 liters per ha.

Napier grass can be grown alongside corn as a "pull" crop, attracting insects away from corn while improving soil fertility and preventing erosion, and can be grown as a high yielding, non-food feedstock to produce ethanol. This research furthers the feasibility of producing bioenergy crops in the southeastern U.S as a feedstock for production of liquid biofuels.

"Oily" yeast lowers the cost of biodiesel fuel. Nearly 1.3 billion tons of plant biomass (lignocellulose) could be harvested each year in the U.S. in the form of energy crops and forest and agricultural residues, but current biofuel conversion is inefficient. This biomass could potentially be converted into 30 billion gallons of biodiesel/year (62 percent of current U.S. diesel consumption) using microorganisms called "oily" yeasts. ARS scientists in Peoria, Illinois, screened numerous yeast strains from ARS' Culture Collection at Peoria, Illinois, capable of producing high lipid concentrations. Applying an advanced two stage process to manage sugar and nitrogen supplies, the top yeast strains were able to rapidly accumulate 50-65 percent of cell biomass as lipid, which corresponded to economically harvestable concentrations of lipid up to 30 grams of oily yeast per liter even under typical industrial acidic pH conditions. This new technology is expected to advance the economic feasibility of high quality biodiesel and jet fuels from renewable biomass.

Guayule yields tire rubber and is an excellent source of biofuels. Guayule, a woody desert shrub cultivated in the southwestern United States, will soon be commercialized as a source of natural rubber, organic resins, and possibly a high energy biofuel feedstock. ARS researchers at Wyndmoor, Pennsylvania, used guayule bagasse, the residue left after rubber extraction, as feedstock in a pyrolysis process that employs a reactive gas environment to formulate a special intermediate bio-oil product that can be used as a hydrocarbon (drop-in) fuel. This novel guayule bagasse conversion has been completed without the use of catalysts, producing a bio-oil with much less oxygen than catalyst generated bio-oils, producing a high energy. This breakthrough has resulted in a patent application filed with the U.S. Patent and Trademark Office entitled, "Bio-oils and Methods of Producing Bio-oils from Guayule Bagasse and/or Leaves."

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:

Lysozyme is an alternative antimicrobial for swine production. Sub-therapeutic levels of antibiotics are used in swine feeds to promote growth, improve feed efficiency, and reduce susceptibility to bacterial infections. As a result, the use of antibiotics improves profitability. However, swine producers are currently under pressure to eliminate sub-therapeutic antibiotic use throughout the production cycle. Finding safe and effective alternatives to traditional antibiotics will give producers viable options in the event that the removal of traditional antibiotics is required. ARS researchers at Clay Center, Nebraska, determined that feeding an antimicrobial enzyme, lysozyme,

to nursery pigs was as effective as traditional antibiotics in increasing growth performance, including growth, nutrient accretion, and feed efficiency.

Selection to reduce ovine progressive pneumonia. Ovine progressive pneumonia (OPP) is one of the most costly sheep diseases in North America due to loss of weight, labored breathing, poor milk production, lameness, and premature removal of sheep from breeding flocks. A gene that affects susceptibility to OPP infection was identified by ARS researchers at Clay Center, Nebraska. The infection rate at 39 months for sheep with either one or two copies of an unfavorable form of the gene was 89 percent compared to 10 percent for other sheep. Sheep producers are using this DNA technology to make their flocks genetically less susceptible to this disease.

Response to vaccination for Marek's disease. Marek's disease (MD) is an avian tumor virus induced disease and is primarily controlled by host genetics. Since the introduction of MD vaccines in the 1970s, the influence of host genetics on vaccine protective efficacy has been overlooked by the vaccine and poultry industries. ARS scientists at East Lansing, Michigan, demonstrated that host genetics contributes up to 83 percent of MD vaccine protective efficacy. This will directly benefit the poultry industry by significantly reducing economic losses due to disease, improve animal welfare, and provide consumers with safe poultry products.

New feed additive offers protection against columnaris disease. *Flavobacterium columnare*, the causative agent of columnaris disease, is among the most prevalent of all freshwater diseases causing bacteria in aquaculture systems. ARS scientists in Stuttgart, Arkansas, collaborated with investigators from Auburn University and demonstrated that the feeding of prepared diets (36 percent protein, 8 percent lipid) formulated with a yeast-based additive offered protection against columnaris disease when compared to the basal ration. These feed formulations offer producers a new means by which to combat costly columnaris outbreaks on farms.

A DNA marker for selective breeding in Atlantic salmon. Contemporary Atlantic salmon breeding programs in the United States have not employed genetic markers for improving important aquaculture production traits. This approach could be especially useful for traits that are difficult or expensive to measure and/or require sacrificing fish. One such trait is the infestations of sea lice, which negatively impact fish health and product quality. ARS scientists in Franklin, Maine, and their collaborators developed a panel of genetic markers that will be used in a commercial breeding program to increase the efficiency of selective breeding for sea lice resistance in Atlantic salmon.

A potent peptide to induce ovulation in catfish. Hybrid catfish produced by manual mating of channel catfish females with blue catfish males demonstrates superior production in ponds compared to purebred channel catfish. Induced spawning of channel catfish is the only reliable method for producing hybrid catfish embryos in hatcheries, however, the type and dose of peptides used to induce ovulation in catfish must be optimized. ARS scientists in Stoneville, Mississippi, evaluated the efficacy of salmon gonadotropin releasing hormone analog (sGnRHa) to induce ovulation in channel catfish. The results which were validated in five commercial hatcheries demonstrated that 10 micrograms sGnRHa per kilogram of body weight was the minimum effective dose to induce ovulation in channel catfish. This dose is ten times lower than the widely used mammalian peptide currently used in catfish hatcheries, significantly reducing the cost of hybrid embryo production.

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:

Downy mildew disease promotes the colonization of lettuce leaves by human enteric pathogens. ARS researchers in Salinas and Albany, California, demonstrated that the plant pathogen that causes downy mildew disease of lettuce changes the plant environment so that human enteric pathogens have higher survival and multiplication rates on lettuce leaves. This finding shows for the first time a significant interaction between downy mildew infection and survival of human enteric pathogens on lettuce. Therefore, development of lettuce breeding lines with high resistance to downy mildew is extremely important for both the quality of the final product (less blemishes on lettuce leaves) and the product safety (less likely survival of human pathogens). This highlights the value of ongoing ARS research on downy mildew resistant lettuce cultivars to provide a continuous and safe supply of commercial lettuce varieties.

New cotton germplasm resistant to cotton leaf curl virus, one of the most dangerous threats to U.S. agriculture. Although cotton leaf curl virus (CLCuV) disease has not yet been reported in the United States, the USDA has ranked it among the top 20 potential threats to U.S. agriculture. USDA and other U.S. government agencies funded a multinational project to proactively develop resistant cotton varieties, not for immediate cultivation, but to be prepared before the disease reaches the United States. Cotton germplasm was screened for resistance to CLCuV in Pakistan, where the disease is endemic and causes losses of a million or more bales of cotton each year. An ARS scientist in Stoneville, Mississippi, developed cotton lines for this purpose and screened them for resistance to CLCuV for two years in Pakistan, identified two resistant germplasm lines, and made them available to breeders for developing CLCuV resistant varieties.

The one day rice genome. Knowledge of the sequence and structure of crop genomes is critical for accelerating progress in crop research and genetic improvement. Such information is particularly important for exploiting the wild relatives of crops for their rich source of genes for increasing yield, enhancing disease resistance, and accelerating adaptation to weather extremes. But the process of assembling individual pieces of genomic data into a coherent picture of crop genomic structure has been slow and expensive, primarily because of the volume of data and the computationally intensive data analyses involved. ARS scientists in Ithaca, New York, and university cooperators at the iPlant Collaborative, a national project to facilitate access to high performance computing, software, and DNA sequence analysis tools, developed a computational "pipeline" that for the first time will enable a researcher to assemble a rice genome sequence and characterize all of its genes – all in the same day – through the computational resources at iPlant. This new capacity could substantially accelerate genetic improvement initially in rice and later in other crops.

Optimizing tree shape for improved crop productivity and sustainability. The large size and spreading growth habit of trees are limiting factors for orchard planting density and crop yield. Genetically improving tree shapes to enable high density orchard production and limit chemical inputs is hampered by lack of knowledge about the underlying genetic controls of tree architecture. ARS researchers in Kearneysville, West Virginia, applied a new technology that combines knowledge from conventional plant breeding with new DNA sequencing information to identify several genes responsible for naturally occurring architectural traits in peach trees including dwarf, weeping, and pillar (columnar) growth forms. Molecular markers were developed to facilitate breeding these novel tree forms. The genes functioned similarly in diverse plant species, therefore, the technology has potentially broad applications to optimizing plant form in a wide range of tree crops, forest species, and woody ornamentals.

Improved understanding of honey bees and other bee pollinator's immunity through genomics allows targeting of sensitive immune proteins. Through collaborative work with an international consortium from 30 plus institutions**,** ARS researchers in Beltsville, Maryland, sequenced the full genome of two Asian honey bee species, the North American bumble bee species used most for commercial pollination, *Bombus impatiens*, and the Alfalfa leaf cutting

bee. This helped identify the behavioral and disease related traits of these species, and gave insights into social behavior and key biology traits. Researchers can now target immune proteins that are especially responsive to disease agents. This information can be used for the management of pollinator species in croplands and help honey bee breeders.

Sugarcane yield monitor increases harvest efficiency and profitability. A commercially acceptable yield monitoring system is not currently available for sugarcane harvesters. ARS scientists in Houma, Louisiana, with Louisiana State University cooperators, developed and tested a new optical yield monitor for use on a billet type sugarcane harvester. The system uses three lasers mounted on the top of the harvester elevator and measures the cane yield directly in the field. A calibration equation that was developed with data from the monitor indicated that the amount of cane on the elevator, harvested distance, harvester speed, and direction of cut were all significantly correlated with weight. On larger truck loads (over 60 metric tons), the system predicted loads with errors below two percent. The system is currently under commercial testing at several sugarcane farms throughout Louisiana. The yield monitoring system will help sugarcane growers better manage their fields and ultimately increase profits.

Improved diagnostic reliability for detection of the presumed causal agent of citrus greening. Reliable detection and quantification of *Candidatus* Liberibacter asiaticus (CLas, presumed agent of citrus greening) is crucial for regulatory management strategies to prevent epidemics. Sensitivity of the standard assay protocol (quantitative polymerase chain reaction or qPCR) is constantly challenged, but without data to support the challenges. ARS scientists in Fort Pierce, Florida, conducted experiments to test the effects of various assay parameters on qPCR detection of CLas. The results demonstrated that the test used and validated by APHIS to detect citrus greening was accurate enough to detect as few as one bacterial cell, whether from citrus or the Asian citrus psyllid vector. However, the scientists improved the parameters of the assay test based on their research to reduce the chance of false negatives, thus improving the reliability of the test. Considering the immediate threat of citrus greening to the California citrus industry, and the danger posed by false negative diagnoses of Liberibacter, these results have considerable significance. Based on ARS' research, APHIS has incorporated these changes into their test protocols for Liberibacter.

Outdoor display educates the public on the importance and benefits of turfgrass. To educate and inform the public about turfgrass, ARS scientists at the U.S. National Arboretum in Washington, D.C., developed "Grass Roots," a 1.3 acre outdoor exhibit that opened at the Arboretum in 2014. Grass Roots provides fundamental turfgrass information, its value as a landscape element, and scientific efforts to improve turfgrass. The exhibit and associated web site have been visited by tens of thousands of visitors who have learned about the importance of turfgrass to the U.S. economy and environment. Grass Roots is the result of a collaboration between USDA and its turfgrass industry partners.

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 REE agencies, as well as with the Food Safety and Inspection Service (FSIS), 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:

Residue detection. Ensuring that surfaces are effectively cleaned and sanitized is critically important for the food industry. Handheld imaging devices are required as aids for the detection of food residues on processing surfaces since cross contamination from surfaces by pathogenic bacteria can lead to foodborne illnesses. A handheld fluorescence imaging device developed by ARS scientists at Beltsville, Maryland, was assessed and validated for detection of three types of food residues (spinach leaf, milk, and bovine red meat) that have been associated with foodborne illness outbreaks. Two common processing surfaces (high density polyethylene and food grade stainless steel) were evaluated. Interchangeable optical filters were selected to optimize the contrast between food residues and processing surfaces as detected using hyperspectral fluorescence imaging. The fluorescence imaging plus image analysis differentiated food residues from the processing surfaces more clearly than did human visual inspection in ambient lighting. This cost effective optical sensing device can be used over relatively large or complex surfaces of processing equipment to detect food residues, and has potential for use in the food industry as an aid for detection of specific (targeted) food residues.

EPA registration of a new ARS aflatoxin biocontrol product. The use of biopesticide strains that do not produce a toxin (atoxigenic) to prevent aflatoxin contamination has expanded in the United States to include cotton, corn, peanut, fig, and pistachio acreage. This expansion has resulted in the need for additional capacity to produce these biological control agents. To meet the demand, ARS researchers in Tucson, Arizona, developed novel biocontrol formulations that permit high production while reducing capital input, lowering energy costs, and using less expensive materials. With the Arizona Cotton Research and Protection Council (ACRPC) and the IR-4 project, ARS submitted multi-year field efficacy, safety, stability, quality, and manufacturing performance data to EPA as part of a request for registration for a biopesticide identified by ACRPC and named *Aspergillus flavus,* AF36 Prevail. Based on that data, EPA granted an unconditional registration for the new biopesticide in June 2015. This unconditional approval will allow cost effective increases in the use of atoxigenic strain-based biopesticides to reduce aflatoxin contamination in the United States.

Antimicrobial resistant (AMR) *Escherichia coli* and *Salmonella* in cattle. Concerns have been raised that AMR *Escherichia coli* and AMR *Salmonella enterica* may be present in cattle production environments (feedlots), persist through beef processing, and contaminate final products. In addition, it has been theorized that meat products, including beef products, are a source of extraintestinal pathogenic *E. coli* (ExPEC) that cause human urinary tract infections. ARS scientists in Clay Center, Nebraska, tracked the occurrences of AMR *E. coli*, AMR *Salmonella*, and ExPEC in cattle from feedlots through processing. AMR *E. coli* were present on 100 percent of hides at feedlots, on 100 percent of hides when cattle began processing, on 1 percent of final carcasses, and on 0 percent of final products. AMR *Salmonella* were identified on 11 percent of hides at feedlots and on 8 percent of hides when cattle began processing but not on carcasses or final products. ExPEC were rarely detected (0.4 percent) in feedlot and pre-intervention processing, and ExPEC were never detected from post-intervention processing and final products. These results, conveyed to industry and regulatory agencies, indicate that sanitizing interventions currently employed at beef processing plants effectively eliminates AMR bacteria and ExPEC from final products.

Vaccine to control pathogenic bacteria in poultry. The poultry and animal industries continue to combat the spread of foodborne pathogens in food products, and have spent millions of dollars attempting to control *Salmonella* and *Campylobacter* with minimal results. Poultry companies have ruled out many intervention strategies because of costs. New interventions must be cost effective and easily integrated into normal production practices. ARS researchers at College Station, Texas, demonstrated that the normal Marek's disease vaccine can increase the *Salmonella* load in birds if given incorrectly. However, by vaccinating the chick embryo on day 18 of incubation instead of day-of-hatch, *Salmonella* can be reduced 10-fold in the chick. This is a significant effect; the results have attracted interest from several U.S. vaccine companies. Additional studies have been conducted with the infectious bronchitis vaccine.

Salmonella serotyping. Serotyping *Salmonella* can be an expensive and time consuming effort. However, serotyping is a fundamental method that identifies those strains with most risk to the food supply. It is also problematic since there are over 2600 serotypes of *Salmonella*, but only 30 are considered to be recurring causes of foodborne illness. While DNA-based serotyping has been in the research laboratory for some time, no one technique has made it to the point where the producer could have access at an affordable cost. ARS research in

Athens, Georgia, "democratized" *Salmonella* serotyping. Democratized assays refer to those that have major impact on improving public health and should thus be developed to have low cost and wide availability. ARS obtained approval to release a DNA database for assigning serotype to *Salmonella enterica* in the USDA Open Data Catalog. To facilitate open use by industry, regulatory agencies, and food safety monitoring services, ARS also provided a set of 96 key isolates to Neogen for development of a streamlined service for serotyping, (http://www.neogen.com/Corporate/PR2015/2015-07-27.html). The impact is that an innovative and rapid serotyping method will be available that will alleviate many of the current typing problems.

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:

USDA speeds development of bird flu vaccine. ARS scientists developed, in record time, an effective vaccine against the highly pathogenic avian influenza (HPAI) virus strains that caused the death of over 49 million chickens and turkeys in the United States, from December 2014 to May 2015. Although these HPAI viruses were not the cause of any human deaths, concerns remain that these viruses could mutate and become more harmful. Vaccines constitute a critical veterinary medical countermeasure to respond to biological threats such as avian influenza viruses. Currently, no vaccines for HPAI are licensed or permitted in the United States. The use of HPAI vaccines is dependent on our ability to rapidly develop vaccines with good efficacy against the virus strains that are the cause of the disease outbreak. In response to the first detections of new HPAI viruses (H5N8 and H5N2) in wild waterfowl and captive raptors in the United States in December 2014, ARS refocused its entire team of scientists working on avian influenza research to the most imminent research needs to address the U.S. outbreak, including the rapid development of a vaccine for emergency use. Within weeks, scientists at the ARS Southeast Poultry Research Laboratory in Athens, Georgia, rapidly engineered a vaccine (rg-H5 vaccine) using reverse genetics technology that matches the H5N2 and H5N8 HPAI viruses that was the cause of the disease outbreak. The power of the reverse genetics technology is twofold. First, it allows the manipulation of the genes to change the hemagglutinin (HA) gene from its typical amino acids to having a sequence similar to other Low Pathogenic Avian Influenza (LPAI) viruses. This allows the change of a HPAI virus into a LPAI virus for safe production without affecting the efficacy of the vaccine virus. The second factor is that it allows the creation of a unique vaccine virus by swapping the HA gene with the one that matches the HA genes causing the disease outbreak. ARS, with the support of their Office of Technology Transfer and APHIS, developed and implemented in record time a technology transfer plan that enabled the transfer of the rg-H5 vaccine to a commercial partner for development and production.

African swine fever virus experimental vaccine confers protection against a virulent virus challenge. African swine fever virus (ASFV) is the etiological agent of a contagious and often lethal disease of domestic pigs that has significant economic consequences for the swine industry. The control of African Swine Fever has been hampered by the unavailability of vaccines. ASFV is one of the largest viruses known, and the function of most of the viral genes are unknown. Experimental vaccines have been developed using genetically modified live attenuated ASFV where viral genes were removed from the genome. However, to date, none of these viruses have proven to be fully attenuated or effective. ARS scientists at the Foreign Animal Disease Research Unit, Plum Island Animal Disease Center (Orient Point, New York), have engineered a recombinant virus by specifically deleting six genes thought to be associated with virulence. Studies conducted in pigs showed that when this recombinant virus was inoculated in pigs, the virus was completely attenuated and did not cause disease. Importantly, when these animals were subsequently exposed to highly virulent ASFV strain, no signs of the disease were observed. This is the first report demonstrating the role of these genes acting as independent determinants of ASFV virulence. Additionally, this is the first experimental vaccine reported to induce protection when challenged against this very virulent strain.

Understanding the mechanisms that drive persistent infections in FMD infected cattle. Tissues obtained post-mortem from cattle persistently infected with foot-and-mouth disease virus (FMDV) were analyzed by ARS scientists in Orient Point, New York, to characterize the tissue specific localization of FMDV and assess the expression of genes associated with the host immune response. Analysis of 28 distinct anatomic sites from 21 steers infected with FMDV had the highest prevalence of overall viral detection in the dorsal nasopharynx and dorsal soft palate. FMDV was less frequently detected in laryngeal mucosal tissues, oropharyngealmucosal sites, and lymph nodes draining the pharynx. Within persistently infected mucosal tissues, FMDV antigens were rarely detectable within few epithelial cells in regions of mucosa associated lymphoid tissue. Assessment of the genes associated with the host immune response of persistently infected pharyngeal tissues indicated a general trend of decreased gene expression for 14 genes compared to uninfected control animals. Overall, this study demonstrated that during the FMDV carrier state in cattle, viral persistence is associated with epithelial cells of the nasopharynx in the upper respiratory tract and decreased levels of expression of several genes associated with the immune response in the infected tissues.

Next generation arthropod repellent military and civilian clothing. Diseases are a major cause of casualties during military operations, greatly outnumbering injuries and death from battle injuries. ARS scientists in Gainesville, Florida, conducted a Good Laboratory Practice study that generated data on etofenprox treatment for U.S. military clothing. The data were reported to the EPA in July, 2015. Registration of this product which protects the wearer from the diseases received by arthropods that bite humans and animals, is expected in July, 2016. This product use can be extended to civilian clothing and is a safer alternative to the permethrin, the only currently available arthropod repellent for clothing. Additionally, this will be the only treatment available for use on undergarments and clothing made of multiple fabric types. The protocol used for this study will become an EPA guideline for the future registration of repellent treated clothing.

Sequencing the genome of the horn fly. The genome of an organism is a master template that guides its development, metabolism, and responses to environmental perturbations, and determines the organism's success within its ecosystem. ARS scientists in Kerrville, Texas, in collaboration with researchers at the National Center for Genome Resources in Santa Fe, New Mexico, completed the sequencing of the horn fly genome. The genome sequence will be computationally assembled and annotated to identify the full complement of genes that make up the horn fly. Knowing the gene sequences of the horn fly will facilitate the development of new fly control technologies by enabling the identification of specific gene products that can be targets for new insect specific pesticides and anti-fly vaccines.

Improved insecticide treated barrier for the U.S. military. Protection of U.S. military personnel from bites of disease carrying arthropods is important to the success of military operations. ARS researchers in Gainesville, Florida, demonstrated that a reduction in adult mosquitoes could be achieved by aerial applied insecticide treatment of U.S. military blast walls containing geotextile material and radar scattering camouflage netting. There was a significant improvement in adult mosquito death from the release of pesticides (pallethrin and sumithrin) at times of the day when adult mosquitoes were present in highest numbers. This study also provided additional evidence that existing models of spray deposition used to guide aerial applications of pesticide in the United States do not adequately represent actual spray deposition, and may be improved to reduce pesticide use and better track the fate of sprayed

pesticide droplets. These findings will be integrated into future versions of the Mobile Pesticide App, (http://www.ars.usda.gov/Business/docs.htm?docid=24908).

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:

Canine disease detection for citrus greening. Fifteen years of canine disease detection research has culminated in training 10 dogs to detect Huanglongbing, and three dogs to detect citrus canker all at greater than 99.97 percent reliability. Dogs will be deployed over the next two years to various affected States, and commercialization plans are in progress with dog training companies. This is currently the only method to quickly detect citrus greening in trees prior to symptom development. Early detection will aid in management of the disease.

Detection of new races of stem rust in Africa. Wheat stem rust is a fungal disease of wheat that can significantly impact crop yield. A strain of the wheat stem rust fungus, known as Ug99, threatens global wheat production due to its ability to infect nearly all wheat varieties. Inadvertent introduction of this pathogen to the United States would severely impact our wheat production. A stem rust race belonging to the Ug99 race group, TTKSK, was detected for the first time in Egypt, by ARS scientists in St. Paul, Minnesota. Two new races, (TTKTK and TTKTT), in this group were identified from samples collected in Kenya. These new races overcame wheat with the resistance gene SrTmp, an important stem rust resistance gene carried by several newly released cultivars in eastern Africa. These new virulence races explained continued stem rust epidemics in Kenya on newly released Ug99 resistant cultivars, and pose an unrelenting threat to wheat production. Constant vigilance by ARS scientists is necessary to assure continued development of resistant wheat varieties for growers in the United States.

Development of successful bactericide therapy for citrus greening disease. New methods are urgently needed to maintain the productivity of citrus trees infected with the citrus greening disease. This plant disease is caused by bacteria (*Candidatus* Liberibacter asiaticus) that reside in the tree phloem, just beneath the bark. ARS researchers in Fort Pierce, Florida, developed bactericidal formulations that are applied in topical sprays, which then penetrate through the citrus bark to the phloem. In field trials, titers of the causal disease organism were reduced, tree vigor improved, and no non-target effects were detectable to beneficial insects or honey bees.

Adaptive management tools for areawide water hyacinth control. Water hyacinth is considered among the worst floating, aquatic weeds on earth which has become especially problematic in Florida and the Sacramento-San Joaquin River Delta in California, impeding navigation and mosquito abatement, and hindering the use of scarce water resources in a time of severe drought. ARS scientists and collaborators have developed two important new tools to improve the control of this weed on an areawide basis. First, an accurate mapping application was developed that utilizes LANDSAT multispectral satellite images and automated image processing to detect water hyacinth among other species of floating plants. The application tracks seasonal development of water hyacinth

populations allowing pest control operators not only to track their success but also to target nursery populations. Nursery populations occur upstream and are often small early in the year but serve as sources for downstream infestations that become severe outbreaks later in the year. Second, a new biological control agent, the planthopper *Megamelus scutellaris*, has been identified, and is now being produced and released to control this weed. Nearly 400,000 of these plant hoppers have been released throughout Florida and a robust population has been established in the Sacramento River watershed serving as the first new agent released against water hyacinth in California in over 30 years. Damage inflicted by biological control agents make the plant more susceptible to other control methods. These new tools help make possible successful, adaptive, and integrated management of water hyacinth and other aquatic weeds.

RNA interference technology for control of aphid pests of crops. Cereal aphids, such as greenbugs and Russian wheat aphids, are the primary pests of wheat, and infestations can require yearly applications of insecticides. The development of aphid resistant wheat lines has been the most economical solution for control. However, aphid biotypes have developed in both greenbug and Russian wheat aphids that overcome wheat resistance. Therefore, new technologies are needed that are not specific to any given aphid biotype. Double stranded RNA (dsRNA) constructs that are complementary to a specific aphid genes can prevent those genes from functioning and kill the insect. ARS scientists developed two dsRNA constructs that have proven to be highly effective in causing Russian wheat aphid mortality in laboratory tests. These constructs targeted two different genes in the pest. This novel technology offers a new approach in creating wheat plants with highly specific resistance to aphids. A U.S. patent has been filed on these two constructs.

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:

Infant feeding options do not affect reproductive organs at five years of age. There has been long term controversy about the relative safety of feeding infant formula whether it contains cow's milk or soy protein. One of the claims has been that soy contains very high levels of plant estrogens that may affect normal development. ARS funded researchers in Little Rock, Arkansas, studied children that were breastfed or given cow's milk or soy formula exclusively for the first four to six months and then studied with ultrasound at five years of age to measure the volumes of reproductive organs including breast buds, uterus, ovary, prostate, and testes. No differences in volume or structural characteristics were found. While continued follow-up through puberty is planned, these data provide reassurance that soy formula has no measurable adverse effect on reproductive organs.

Quality and cost of school lunches beats those brought from home. The quality and cost of lunches brought from home had not been studied in the school food environment. Nevertheless, some have suggested they are better choices than USDA approved school lunch programs. ARS funded researchers in Houston, Texas, studied about 350 elementary and intermediate school students who brought lunches from home. Lunches brought from home had more sodium, and less fruit, vegetables, whole grains, and milk than national school lunch program guidelines. Most lunches from home contained desserts, snack chips, and sweetened beverages, which are not permitted in

reimbursable school meals. These results point to the need to make parents aware of the nutritional quality of average lunches brought from home.

Chronic mental or emotional stress may predispose individuals to obesity. Exposure to stress may alter brain pathways in ways that lead to stronger reactions to highly rewarding (typically high in calories) foods. ARS researchers in Davis, California, conducted a brain imaging study using functional magnetic resonance imaging to examine how chronic stress affects activity in the brain when viewing pictures of high calorie foods. The study showed that women reporting higher chronic stress and viewing pictures of high calorie foods had exaggerated activity in brain regions linked to reward and emotional based food intake, and reduced activity in regions that mediate self-control and decision-making. In these women, higher chronic stress was associated with eating more high fat/sweet foods from a voluntary snack food buffet. This neurophysiological and behavioral evidence supports a biological basis for poor food choice, dysfunctional eating habits, and obesity risk in persons experiencing chronic stress.

Postnatal nutrition and nerve development. Postnatal nutrition influences neurodevelopment, but it is not known whether the development of individual differences in physiologic measures is related to variations in early infant diet. Vagal tone is a well-studied marker that has been associated with individual differences in cognitive function and social emotional behavior in infants, children, and adults. ARS funded researchers in Little Rock, Arkansas, studied the stability of vagal tone during infancy and again at two years of age in 146 breast fed, 143 milk formula fed, and 137 soy formula fed infants. Breast fed infants had more stability of vagal tone than formula fed infants, although gender affected stability in some groups. These findings indicate that infant diet and gender are important modulators of the early development of vagal tone and that such variation may have an important influence on neurobehavioral and cognitive functioning.

Weight of young children increases disproportionately during summer. Annual checkups miss seasonal patterns of weight gain in children. Researchers supported by ARS funded researchers in Houston, Texas, recently tracked over 7,500 ethnically diverse children's weight change during elementary school and found that children who were overweight and obese or Hispanic gained more weight each summer than during the school years. Children of other ethnicities or with healthy body weight did not show this pattern. While the causes were not assessed, this points to the need for strategies outside of school to help children maintain healthy growth.

Development and application of a new marker of vitamin B-12 status. Vitamin B12 deficiency is a serious problem in many areas of the world. Markers of vitamin status are important for the accurate determination of deficiencies. Traditional methods of assessing B12 status often result in inconsistent classification of individuals or populations as being vitamin B12 deficient. ARS researchers in Davis, California, in collaboration with Aarhus University, Aarhus, Denmark, developed a new biomarker, cB12, which combines multiple traditional biomarkers, and have demonstrated its improved performance for detecting metabolomic and neurological responses to vitamin B12 interventions. This research has produced a new marker of vitamin B12 status which is likely to be used widely in clinical practice, epidemiological status, and nutrition research.

Honey and high fructose corn syrup cause similar blood sugar responses. It is commonly believed that honey has different effects than other sugars. ARS supported scientists in Grand Forks, North Dakota, conducted a clinical trial and demonstrated equivalent glycemic response to chronic intake of honey, high fructose corn syrup, and sucrose in humans. Blood glucose and insulin responses were not different among the different sweeteners. Serum triglyceride levels were elevated after daily intake of 50 grams of all sugars for two weeks in all participants indicating that this level of intake has detrimental effects no matter what the sugar source. These results add important knowledge regarding the metabolism of sugars in glucose tolerant and glucose intolerant individuals which may impact dietary guidance regarding sugar intake.

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:

Development of the National Aeronautics and Space Administration (NASA) Soil Moisture Active/Passive (SMAP) satellite mission. On January 31, 2015, the NASA SMAP mission was successfully launched and deployed into Earth orbit. Due to its particular combination of resolution, accuracy, global coverage, and repeat time characteristics, SMAP is the best satellite soil moisture sensor ever deployed. A large portion of the scientific and technical basis for the mission was based on over 30 years of microwave remote sensing research by ARS researchers in Beltsville, Maryland, and Tucson, Arizona. Prior to the launch of the mission, these ARS scientists also led efforts to engage potential SMAP data users. The result has been an unprecedented pre-launch preparation for SMAP applications and critical feedback to improve the mission, providing direction for all upcoming NASA Earth observation missions and setting the context for the future of Earth observation. SMAP will provide global measurements of soil moisture for weather prediction, drought and flood forecasting, agricultural management, and national security. The potential value of these measurements for agricultural applications is underscored by a recent five year NASA/USDA agreement signed by USDA's Deputy Secretary and NASA's Deputy Administrator "to improve agricultural and Earth science research, technology, agricultural management, and the application of science data, models, and technology in agricultural decision-making."

Significant enhancement of the world's leading watershed simulation model, the Soil and Water Assessment Tool (SWAT). SWAT is the world's leading simulation model for assessing the watershed scale environmental effects of crop, forest, and range land management. Developed by ARS scientists in Temple, Texas, SWAT is a critical component of the Conservation Effects Assessment Project (CEAP), through which USDA evaluates the regional and national effects of conservation practices. In collaboration with Natural Resources Conservation Service (NRCS) scientists, ARS scientists at Temple, Texas, have improved SWAT by: 1) modernizing its data structures and modules; 2) developing a web-based interface with an output analyzer and scenario analysis tools; 3) improving floodplain, riparian zone, and gully erosion routines; and 4) improving representation of critical agricultural production regions. These enhancements maintain SWAT as the state-of-the art scientific tool relied upon by Congress, USDA, and international decision-makers to support natural resource management and conservation decisions. Because of these enhancements to SWAT, the NRCS/ARS national CEAP modeling team can provide

scientifically sound information on regional and national conservation effects, including identification of conservation successes and remaining concerns. In addition, analyses with SWAT and field scale models developed by ARS at Temple support agricultural policy formulation and implementation through the Farm Bill and other regional and national programs.

A national conservation practice standard for surface application of gypsum products. ARS scientists from University Park, Pennsylvania; Auburn, Alabama; and Beltsville, Maryland, led the development of a National Conservation Practice Standard for the surface application of gypsum products involving more than 70 scientists from the international community. A draft standard that was delivered to the NRCS was officially adopted in July, 2015. The practice standard sets forth criteria for gypsum purity for agricultural use, allowing utilization of flue gas desulfurization gypsum, millions of tons of which are produced annually and sent to landfills. Surface application of gypsum can reduce dissolved phosphorus losses, improve soil physical characteristics, ameliorate subsoil acidity, and/or reduce pathogen losses from biosolids or manure amended soils.

Award winning soil test helps producers optimize fertilizer application rates. Fertilizer application protocols must be carefully chosen, taking into consideration all sources of plant available nutrients to ensure that the fertilizer is applied at the right place, at the right time, in the right amount, in the right manner, and in the right form to achieve goals for yield, environmental stewardship, and economic return. Recent high profile nutrient related incidents, such as the situation in Lake Erie which affected the City of Toledo's drinking water supply, have increased pressure on farmers and ranchers to further optimize nutrient application and management. ARS scientists at Temple, Texas have developed the "Haney Test," an award winning soil test based on enhanced methodology that is quickly being adopted by major soil testing laboratories to determine optimal fertilization application rates. During field evaluations in Texas, fertilizer recommendations based on the Haney Test reduced nutrient losses, increased profit potential, and decreased input cost and production risk. Use of the Haney Test has resulted in reduced fertilizer application rates, minimizing negative impact to air and water resources, and reducing fertilizer costs by 20-40 percent. This procedure is a revolutionary advancement for fertilizer management, proving important information to agricultural producers seeking to increase profitability and sustainability, and to laboratories, consultants, and land management agencies needing sound, scientifically-based metrics to support natural resource conservation decisions.

First bacterial bioherbicide registered by the EPA. Downy brome (cheatgrass), medusahead rye, and jointed goatgrass are invasive annual grass species that greatly increase conditions conducive to wildfires, reduce cereal yields, compete with native plant species, and reduce habitat for wildlife. ARS scientists at Pullman, Washington, have isolated naturally occurring soil bacteria that reduce these three grass weeds to near zero in five years, reduce the weed seed bank when used in an integrated program, and do not harm crops or desirable native species. The EPA has registered one of these bacteria as an herbicide and is considering a second. These are the first bacterial bioherbicides to ever be registered. Bacterial bioherbicides provide a new tool to growers and land managers in their struggle to limit these invasive grass weeds, while reducing the need for more traditional tillage practices and herbicides used for weed control that have some environmental concerns.

Improved techniques for analyzing soil microbial community structure and function. Identification and quantification of microbes and pathogens by traditional methods, such as culturing, is estimated to catalog as little as 1 percent of the microbial diversity in the soil, and is semi-quantitative at best. Due to the complexity of these microbial communities, traditional ecological indices may over estimate diversity (i.e., pseudo-diversity) as a result of incomplete community sampling. ARS scientists in Fort Collins, Colorado, utilized molecular biology techniques to quantify microbial community structure and function from a variety of natural environments. The scientists conducted the first known application of pyrosequencing (a DNA analysis technique) to investigate root endophytes in an agricultural crop leading to the discovery of a wide variety of previously unknown microbial species residing within the roots of crop plants. These analyses have led to the development a new diversity index and statistical software that can be used to avoid pseudo–diversity, providing more accurate estimates of the true variation within microbial communities across various scales. This improved understanding of the soil microbial communities opens up new opportunities to better understand and eventually manage soil microbial communities for improved soil health and expanded crop production.

Evaluation of inexpensive anaerobic digesters for small dairy farms. Anaerobic digesters are used on about 300 U.S. dairies for treatment of manure prior to storage and land application. But roughly 90 percent of U.S. dairies have less than 200 cows, making large commercial digesters impractical. ARS researchers from Beltsville, Maryland and the University of Maryland, designed and constructed six pilot scale plug flow digesters using simple proven designs from developing countries modified to function in temperate climates. Results showed that biogas production and solids removal values of the simple pilot scale digesters were comparable to values from a traditional larger, farm scale vertical tank digester. Results from this research demonstrate the feasibility of smaller, anaerobic digesters for the majority of U.S. dairy and livestock producers. If made available and adopted, these systems will enable significantly greater reductions of fossil fuel use and greenhouse gas emissions by industry.

Fluoroquinolone antibiotics can stimulate antibiotic resistance gene transfer from multi-drug resistant *Salmonella*. *Salmonella* often lives in the intestinal tract of food producing animals and are a leading cause of bacterial foodborne disease and food-related deaths in the U.S. The development of antibiotic resistance in *Salmonella* is considered a serious concern by the U.S. Centers for Disease Control and Prevention. Bacterial viruses (prophage) are frequently found in the chromosome of *Salmonella* and, when activated, can transfer genetic material from the original strain to another *Salmonella* recipient. ARS researchers in Ames, Iowa, demonstrated in laboratory experiments that multi-drug resistant *Salmonella* exposed to fluoroquinolone antibiotics, which are used in both human and veterinary medicine, can stimulate prophage to transfer genetic material, including antibiotic resistance genes, to another *Salmonella* strain. The fluoroquinolones are an important group of antibiotics used to treat a broad range of bacterial illnesses. Although antibiotics are beneficial for treating bacterial disease in both people and animals, the use of antibiotics may have unintended consequences. This research provides physicians, veterinarians, animal producers, and the public with information to encourage the cautious use of antimicrobials in order to prevent the transfer of antibiotic resistance genes that reduce the effectiveness of certain antibiotics used to treat bacterial diseases in the future.

Enhanced recovery of ammonia from swine manure through gas membranes. Ammonia emissions from animal husbandry operations in the U.S. were estimated at 2.4 million tons/year during 2010, while the cost of fertilizers has rapidly increased in recent years, especially nitrogen fertilizer such as anhydrous ammonia which is made from natural gas. ARS researchers at Florence, South Carolina, have developed a new technology to recover concentrated ammonia from liquid manures, thus leading to reduced ammonia emissions, and providing an alternative source of crop fertilizer. The new technology has worked well for recovery of ammonium from liquid manure. Ammonium concentration in raw swine manure declined from 2,270 milligram ammonium nitrate per liter pre-treatment to 20 milligram ammonium nitrate per liter post-treatment, demonstrating an overall capture of 98 percent of the ammonia in the manure. Because the system does not rely on chemicals, the operational cost of ammonia recovery was further reduced by 57 percent. This new system offers livestock producers a better way to manage ammonia in manure for a beneficial use.

Molecular diagnostics of seed gall nematodes. Certain species of seed gall nematodes are regulated as quarantine pests by many countries because they attack wheat and other grasses. They can carry bacteria toxic to livestock. Growers and regulatory officials face an enormous problem in that the existing molecular methods for distinguishing these nematodes are time consuming and occasionally inaccurate. Scientists from ARS and APHIS in Beltsville, Maryland, designed a new molecular diagnostic test that can rapidly detect and distinguish four different seed gall nematodes of wheat and grasses. This research is significant because the new assay is species specific, highly sensitive, and faster to perform than existing molecular methods. This test will be useful for Federal and State diagnostic laboratories, domestic and international research scientists, regulatory personnel, and extension agencies for identifying and preventing further damage caused by seed gall nematodes.

Reducing the carbon footprint of cellulosic ethanol. After producing ethanol from crop residues such as corn stover and straw, a slowly decomposing byproduct remains which is typically burned for energy recovery, but harvesting crop residues can result in decreased crop yields and soil carbon levels. ARS scientists in University Park, Pennsylvania, in collaboration with university scientists, compared the current practice of burning this residue versus applying it back to the land. They found that although most prior studies recommend burning this material to generate electricity for the biorefinery, applying it to the land instead resulted in ethanol production systems with the lowest greenhouse gas (GHG) footprint, highest levels of soil carbon, and the greatest offset of GHG emissions.

This finding could help the industry evaluate the different markets for byproducts produced at the biorefinery, considering both the economic and environmental impacts.

Improving the digestibility of forage grasses through cell wall modification. Grasses frequently have a lower digestibility compared to other forages, such as alfalfa, due to a strong cross linked structure in grass cell walls. A major component of the cross linking in grass cell walls is a phenolic compound called “ferulic acid” which produces ferulates. Ferulates in the cell wall become attached to lignin, creating a cross linked network that reduces grass digestibility in dairy cows and other ruminants. ARS scientists in Madison, Wisconsin, found a way to change the composition of the cell wall components in grasses, resulting in decreased ferulate attachments, fewer cross linkages, and improved digestibility. Using modern genetic engineering tools, forage grasses can be modified to increase digestibility without inhibiting yield. Such increased digestibility has both economic and environmental benefits to U.S. dairy producers with the potential to save $350 million in feed costs and reduce the amount of manure produced by 2.8 million tons.

An improved cover crop selection tool. Producers grow cover crops for benefits, such as improved soil health, soil nutrient management, and soil erosion control. However, selecting a cover crop to meet specific producer needs has been challenging because of the many options available. ARS researchers in Mandan, North Dakota, developed an updated Cover Crop Chart (CCC) to help producers select cover crops that will meet specific production and natural resource goals. The chart categorizes 57 cover crops based on the plant type and general growth characteristics, and provides basic descriptive information. The CCC is internet accessible and is being used by producers and conservation agencies to help assess and select cover crops that will meet producer needs. Cover crop use is expected to increase and to be more effective at meeting producer goals because of the greater ease of decision-making with the CCC.

Canola yield estimates using remote sensing. Above ground biomass is an important parameter used to estimate crop yield from remote sensing data. However, the reflectance from bright yellow canola flowers creates errors when estimating canola biomass. ARS scientists in Pendleton, Oregon, have developed a novel spectral index that is strongly related to canola flower density. Using the new index to correct for the effects of yellow flower reflectance, reliable estimates of canola plant biomass and yield were achieved. The new spectral index also performed well as an estimator of oilseed yield based on the premise that yield is directly proportional to flower and seed pod numbers. The index makes reliable estimates of canola yield possible using remote sensing and thus provides a means for private firms and government agencies to monitor crop conditions and estimate crop yields at county and State levels. Crushing plants could also use the method to more efficiently find and procure oilseed, minimizing storage and transportation costs.

Library and Information Services

Current Activities:

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

Selected Examples of Recent Progress:

PubAg. NAL launched a preliminary version of PubAg, a portal for literature searches and full text access of more than 43,000 scientific journal articles written by USDA researchers, mostly from 1997 to 2015. PubAg also provides access to 991,000 peer reviewed, agriculture-related scientific articles, published primarily between 2002 and 2015. Each article citation in PubAg includes NAL Thesaurus subject terms, and a link to the article if available

from internal NAL repository, PubMed Central, and the publisher. The second phase of PubAg includes an additional 600,000 highly relevant, high quality literature from the four million bibliographic citations in the AGRICOLA Index database which was used to establish PubAg. PubAg can be found at http://PubAg.nal.usda.gov.

Automated indexing. NAL is continuously improving full scale production of the 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 2015, NAL used the system to index 332,680 articles, an increase of 147,674 articles over FY 2014 production.

i5K Workspace at NAL. NAL continued to build and enhance the i5K (insect 5,000 genome) Workspace (https://i5k.nal.usda.gov/) to meet the initiative needs for genome hosting and other bioinformatics services. The Workspace currently hosts 42 genomes with several more in the pipeline. Approximately 400 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.

Ag Data Commons. NAL soft launched the Ag Data Commons (https://data.nal.usda.gov). The Commons serves as a catalog for agricultural research datasets. The records link to the data no matter where the data reside. The Commons also serves as a repository for data not otherwise hosted. The Ag Data Commons currently has almost 170 records for ARS and USDA funded research results.

Long Term Agro-ecosystem Research Data Portal. NAL launched the Long Term Agro-ecosystem Research (LTAR) Data Portal. The Portal serves as the primary data repository for the 18 sites comprising the LTAR network. The FY 2015 release involved near real-time meteorological data from five sites and data from four additional sites, posting more than 30,000 observations. The Portal also links to 21 Phenocams located at seven LTAR sites. More than 100 datasets associated with LTAR publications are posted in the Ag Data Commons.

Life Cycle Assessment (LCA) Commons. NAL released an updated web site (https://www.lcacommons.gov). The new site brings an up-to-date look and feel to the LCA Commons and brings three important U.S. Federal Life Cycle Assessment projects under one domain: the USDA LCA Commons crop production dataset, the Ag Data Commons LCA Collection, and the Federal LCA Commons. The new lcacommons.gov also features highlighted LCA resources and an agricultural LCA bibliography.

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 2015, NAL successfully digitized and created citation information for 31,180 items (1,306,940 pages). Until all publications are available via NAL web services, they are publically accessible at https://archive.org/details/usdanationalagriculturallibrary.

NAL Digital Collections. As of the end of FY 2015, NAL's digital repository of full text content comprises ten collections, including nearly 50,000 peer reviewed journal articles authored by USDA researchers, and more than 30,000 historical documents and reports. Citizens downloaded 9,014,569 full text items during the year.

DigiTop. NAL obtained contributions from across USDA to purchase nearly $5.2 million in licensed full text and databases to support research and scientific discovery. A key DigiTop component called Navigator, enables cross searching of multiple bibliographic databases. This system includes AGRICOLA, AGRIS, BIOSIS, CAB Abstracts, EBSCO Environment Complete, Food Science and Technology Abstracts, GEOBASE, GeoRef, MEDLINE, Web of Science, Scopus, and Zoological Record. The Navigator service allows researchers to access nearly 96 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 the 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, [$212,101,000] $94,500,000 to remain available until expended.

Lead-Off Tabular Statement

Current Law

Buildings and Facilities

Budget Estimate, 2017	$94,500,000
2016 Enacted	212,101,000
Change in Appropriation	-117,601,000

Summary of Increases and Decreases
(Dollars in thousands)

	2014 Actual	2015 Change	2016 Change	2017 Change	2017 Estimate
Discretionary Appropriations:					
Athens, GA, Biocontainment Lab and Poultry Research Facility	-	+$45,000	+$68,701	-$113,701	-
Tucson, AZ, Southwest Watershed Research Center	-	-	+12,400	-12,400	-
Ames, IA, National Lab for Agriculture and the Environment	-	-	+13,500	-13,500	-
Beltsville, MD, Agricultural Research Center, Building 307	-	-	+37,100	-37,100	-
Houston, TX, Children's Nutrition Research Center	-	-	+29,200	-29,200	-
Fort Detrick, MD, Foreign Disease-Weed Science Research Lab	-	-	+4,900	+59,400	$64,300
Salinas, CA, U.S. Agricultural Research Station	-	-	+1,300	+28,900	30,200
Total	-	+45,000	+167,101	-117,601	94,500

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

Program	2014 Actual		2015 Actual		2016 Enacted		Inc. or Dec.		2017 Estimate	
	Amount	SYs	Amount	SYs	Amount	SYs	Amount	SYs	Amount	SYs
Buildings and Facilities										
Discretionary Appropriations:										
Athens, GA, Biocontainment Lab and Poultry Research Facility.	-	-	$45,000	-	$113,701	-	-$113,701	-	-	-
Tucson, AZ, Southwest Watershed Research Center.....	-	-	-	-	12,400	-	-12,400	-	-	-
Ames, IA, National Lab for Agriculture and the Environment...	-	-	-	-	13,500	-	-13,500	-	-	-
Beltsville, MD, Beltsville Agricultural Research Center, Building 307.....	-	-	-	-	37,100	-	-37,100	-	-	-
Houston, TX, Children's Nutrition Research Center.....	-	-	-	-	29,200	-	-29,200	-	-	-
Fort Detrick, MD, Foreign Disease-Weed Science Research Laboratory…….....	-	-	-	-	4,900	-	+59,400	-	$64,300	-
Salinas, CA, U.S. Agricultural Research Station.....	-	-	-	-	1,300	-	+28,900	-	30,200	-
Subtotal.....	-	-	45,000	-	212,101	-	-117,601	-	94,500	-
Total Appropriation.....	-	-	45,000	-	212,101	-	-117,601	-	94,500	-
Rescission.....	-	-	-1,530	-	-	-	-	-	-	-
Bal. Available, SOY.....	$2,892	-	1,530	-	44,055	-	+195,101	-	239,156	-
Recoveries, Other (Net).....	7		94		-	-	-	-	-	-
Total Available.....	2,899	-	45,094	-	256,156	-	77,500	-	333,656	-
Bal. Available, EOY.....	-1,530	-	-44,055	-	-239,156	-	127,500	-	-111,656	-
Total Obligations.....	1,369	-	1,039	-	17,000	-	205,000	-	222,000	-

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

Program	2014 Actual		2015 Actual		2016 Enacted		Inc. or Dec		2017 Estimate	
	Amount	SYs	Amount	SYs	Amount	SYs	Amount	SYs	Amount	SYs
Buildings and Facilities										
Discretionary Obligations:										
Athens, GA, Biocontainment Lab and Poultry Research Facility...	-	-	$1,039	-	$6,500	-	+$137,500	-	$144,000	-
Tucson, AZ, Southwest Watershed Research Center.....	-	-	-	-	1,000	-	+9,000	-	10,000	-
Ames, IA, National Lab for Agriculture and the Environment.....	-	-	-	-	1,200	-	+9,600	-	10,800	-
Ames, IA, Demo Building 1 and 2.....	$1,362	-	-	-	-	-	-	-	-	-
Beltsville, MD, Beltsville Agricultural Research Center, Building 307.....	-	-	-	-	1,200	-	+31,100	-	32,300	-
Houston, TX, Children's Nutrition Research Center.....	-	-	-	-	2,500	-	+21,100	-	23,600	-
Fort Detrick, MD, Foreign Disease-Weed Science Research Laboratory.....	-	-	-	-	3,600	-	-2,600	-	1,000	-
Salinas, CA, U.S. Agricultural Research Station.....	-	-	-	-	1,000	-	-700	-	300	-
Albany, CA, Western Regional Research Center.....	3	-	-	-	-	-	-	-	-	-
Houma, LA, Sugarcane Research Lab.....	4	-	-	-	-	-	-	-	-	-
Total Obligations.....	1,369	-	1,039	-	17,000	-	+205,000	-	222,000	-
Bal. Available, EOY.....	1,530	-	44,055	-	239,156	-	-127,500	-	111,656	-
Total Available.....	2,899	-	45,094	-	256,156	-	+77,500	-	333,656	-
Rescission.....	-	-	1,530	-		-	-	-	-	-
Bal. Available, SOY.....	-2,892	-	-1,530	-	-44,055	-	-195,101	-	-239,156	-
Recoveries, Other (Net).....	-7	-	-94	-	-	-	-	-	-	-
Total Appropriation.....	-	-	45,000	-	212,101	-	-117,601	-	94,500	-

Justification of Increases and Decreases

Buildings and Facilities

In 2012, at the request of the Secretary and Congress, ARS completed an extensive review of the agency's laboratory portfolio and developed a plan for future capital investments. 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.

In its FY 2017 Budget, ARS requests $94.5 million for modernization of two of its laboratories: Foreign Disease-Weed Science Research Laboratory in Frederick, Maryland; and the Agricultural Research Technology Center in Salinas, California. These two laboratories are among the agency's highest priorities based on criteria developed (i.e., research program importance and facility condition) in the CIS report.

ARS' Salinas laboratory stands on the frontline in California for crop production and improvement against catastrophic losses due to drought, disease and insect pests, and weeds. The CIS report described the Salinas laboratory as in "relatively least adequate condition and in greatest need of repair and renovation/modernization." The Frederick laboratory is a critical national resource, protecting U.S. crops from increasing threats from foreign crop diseases. The CIS report identified the Frederick laboratory as 'most critical and urgent for ARS replacement given the priority of its research and the relative low condition of current facilities." In FY 2016, these two laboratories received funding for their design which will be completed in FY 2017.

(1) An increase of $94,500,000 for Buildings and Facilities

The funding change is requested for the following items:

a) An increase of $30,200,000 for the Construction of Phase 1 of the Agricultural Research Technology Center, Salinas, California.

The Agricultural Research Technology Center (ARTC) has a strong and expanding research program dedicated to crop improvement and protection. The research program determines the basic biology of viral, fungal, bacterial, and nematode diseases affecting crops, and develops alternatives to methyl bromide as a soil fumigant for control of soilborne pests. The research also develops scientifically-based organic crop production practices, and methods for weed, insect, and disease control.

There is growing public concern about the environmental impacts of agriculture, and the need to find alternatives to chemicals such as methyl bromide. Research at a new ARTC would strengthen organic farming and sustainable agricultural practices to preserve agricultural production systems, and develop management practices that would protect the sensitive marine ecosystems in the Monterey Bay. The expanded areas of research would advance sustainable agriculture and improve the ability of ARS to deal with the biotic factors limiting crop production. The ARTC would be the center for technology transfer and practical applications for producers and consumers in the Monterey Bay area. The ARTC would serve virtually as a Center of Excellence attracting national and international scientists for collaborative research as well as training and technology transfer.

ARTC's existing facilities are inadequate for addressing its expanding research program. The 70 year old, four wood framed laboratory/office buildings, are deficient in meeting current seismic, safety, engineering, mechanical, electrical, and building code standards. The 19 existing greenhouses (36,900 gsf), mostly built in the 1940s and 1960s, lack irrigation systems, temperature controls, and artificial lighting to enhance plant growth, and are sited inefficiently causing experimental variability. The proposed new facility would meet the long-term needs of ARTC.

The 2017 budget is requesting $30.2 million to fund the construction of Phase 1, West Wing Laboratory/Office Building. Construction of Phases 2 (East Wing Laboratory/Office Building), and Phase 3 (Headhouse/Greenhouse) is estimated at $67.8 million.

b) An increase of $64,300,000 for the Construction of the Foreign Disease – Weed Science Research Laboratory, Frederick, Maryland.

The U.S. Army Garrison (Ft. Detrick) in Frederick, Maryland conducts biomedical and infectious disease research. The Fort supports the Departments of Defense, Veterans Affairs, Homeland Security, Health and Human Services, and Agriculture.

USDA's/ARS' Foreign Disease -- Weed Science Research Laboratory is located at Ft. Detrick. At the laboratory, ARS' scientists research foreign plant pathogens that pose a potential threat to American agriculture, which are not yet established in the United States and which must be kept under containment.

A facility condition study in 2002 of ARS' facilities at Ft. Detrick identified a number of deficiencies in the Biosecurity Level-3 (BSL-3) containment facility (Building 374), the greenhouse complex, and other ARS laboratories and offices. The facility study proposed enlarging the capacity of the BSL-3 containment facility to accommodate ARS' biosecurity research needs. The new, enlarged containment replacement facility would be built in compliance with security requirements and Ft. Detrick's facility master plan.

In FY 2017, ARS is requesting $64.3 million to fully fund the construction of the Laboratory.

Buildings and Facilities

Classification by Objects
(Dollars in thousands)

		2014 Actual	2015 Actual	2016 Enacted	2017 Estimate
Other Objects:					
32.0	Land and structures	$1,369	$1,039	$17,000	$222,000
99.9	Total, new obligations	1,369	1,039	17,000	222,000

Status of Construction Projects as of January 2016

Status of research facilities authorized or funded in prior years and reported as uncompleted in the 2016 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
Arizona, Tucson Southwest Watershed Research Center	2016 Design and Construction	$12,400,000	Design will be awarded in the 4th Quarter of FY 2016 and completed in the 2nd Quarter of FY 2017. Construction will be awarded in the 4th Quarter of FY 2017 and completed in the 2nd Quarter of FY 2019.
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 was 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)	
	2016 Design	$1,300,000	A design update will be awarded in the 1st Quarter of FY 2017 and completed in the 4th Quarter of FY 2017.
	Total	$5,116,375	
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	

Location and Purpose	Year	Amount of Funds Provided	Description
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	
Florida, Canal Point	2008 Planning and Design	$521,325	POR completed 2nd Quarter 2011. Land purchases complete. Historic preservation consultation needs to be completed before building demolition can occur.
Agricultural Research Service Lab	2009 Planning and Design	1,096,000	
	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 POR was awarded in the 3rd Quarter of 2015 and completed in the 4th Quarter of 2015. Design was awarded in the 4th Quarter of 2015 and in the 3rd Quarter of 2016. Construction of all 3 phases will be awarded in the 2nd Quarter of 2017 and completed as follows: Phase 1A in the 2nd Quarter of 2019, Phase 1B in the 1st Qarter of FY 2020, Phase 1C in the 2nd Quarter of FY 2020, Phase 2 in the 2nd Quarter of FY 2022, and Phase 3 in the 2nd Quarter of FY 2023.
Southeast Poultry Research	1993 Construction	677,000	
Laboratory	2008 Planning and Design	2,780,400	
	2009 Planning and Design	2,427,000	
	2011 Rescission	($5,832,898)	
	2015 Planning,Design,Const.	45,000,000	
	2016 Construction	113,701,000	
	Total	159,152,502	
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. Construction contract for Phase 2 awarded 4th Quarter 2010 and completed 1st Quarter 2012.
U.S. Pacific Basin	2000 Construction	4,500,000	
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	

Location and Purpose	Year	Amount of Funds Provided	Description
Illinois, Peoria	2000 Construction Design	$1,800,000	The modernization of the Chemical Wing was completed in 3 segments. The construction of phases
National Center for	2002 Construction	6,500,000	1 and 2 is complete. Construction for all remaining phases of the Central Wing awarded 2nd
Agricultural	2004 Construction	2,684,070	Quarter 2010 using ARRA funding and completed 3rd Quarter 2012.
Utilization Research	2005 Construction	2,976,000	
(Central Wing)	2006 Construction	3,588,750	
	2008 Construction	1,869,819	
	2009 Construction	2,192,000	
	2009 ARRA	16,237,165	
	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 2017, as site restoration work was added to the scope.
Iowa, Ames	2016 Design and Construction	$13,500,000	Design will be awarded in the 4th Quarter of FY 2016 and completed in the 2nd Quarter of
National Laboratory for Agricultural and the Environment			FY 2017. Construction will be awarded in the 4th Quarter of FY 2017 and completed in the 2nd Quarter of FY 2019.
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	

Location and Purpose	Year	Amount of Funds Provided	Description
Louisiana, Houma	2004 Planning and Design	$1,342,035	Design (100%) completed 4th Quarter 2007. Repackaging of design to allow for construction of some elements within the available funding was completed 2nd Quarter 2008. Phase 1A construction was completed 4th Quarter 2010. Phase 1b construction awarded 2nd Quarter 2011 and completed in the 3rd Quarter 2013.
Sugarcane Research	2005 Construction	2,976,000	
	2006 Construction	3,588,750	
	2008 Construction	1,869,819	
	2009 Construction	2,505,000	
	2010 Construction	3,654,000	
	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 Restoration (LTR) of facilities damaged by Hurricane Katrina. Design (100%) for the LTR of facilities was completed 4th Quarter 2008. Construction of the LTR was awarded 3rd Quarter 2009 and completed 3rd Quarter 2011.
Southern Regional	1999 Modernization	6,000,000	
Research Center	2000 Modernization	5,500,000	
(Industrial Wing)	2006 Supplemental (design)	4,900,000	
	2006 Supplemental (construction)	20,000,000	
	Total	37,500,000	
Maine, Orono/Franklin	2001 Planning and Design	$2,494,500	Construction of all facilities at Franklin (Pump House, Storage Tanks, Lab/Office/Tank Bldg.) is complete. Program for the laboratory facility located at the University Campus in Orono, ME needs to be developed.
National Cold Water Marine	2002 Construction	3,000,000	
Aquaculture Center	2003 Construction	9,090,525	
	2004 Design & Construction	2,684,070	
	2005 Design & Construction	2,976,000	
	2006 Design & Construction	2,475,000	
	2011 Rescission	($2,012,504)	
	Total	20,707,591	
Maryland, Beltsville	1988 Design & Construction	$5,750,000	Study to evaluate boiler plants, steam lines, and electrical distribution was completed 4th Quarter 2009. Construction contract for repairs to boiler plants and portions of the steam distribution system was awarded 4th Quarter 2010 with ARRA funding and were completed 2nd Quarter 2012. Design-Build contract for major renovations to Building 306 was awarded 4th Quarter 2010 with ARRA funding and was completed 4th Quarter 2012.
Beltsville Agricultural Research	1989 Design & Construction	6,100,000	
Center, (BARC)	1990 Design & Construction	9,860,000	
	1991 Design & Construction	15,999,792	
	1992 Design & Construction	16,000,000	
	1993 Design & Construction	13,547,000	
	1994 Design & Construction	19,700,000	A design update for Building 307 will be awarded in the 4th Quarter of FY 2016 and completed in completed in the 2nd Quarter of FY 2017. Construction will be awarded in the 4th Quarter of FY 2017 and completed in the 2nd Quarter of FY 2019.
	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	

Location and Purpose	Year	Amount of Funds Provided	Description
	2010 Construction	3,000,000	
	2011 Rescission	($9,831,954)	
Renovate Building 307	2016 Design and Construction	37,100,000	
	Total	205,762,274	
Maryland, Beltsville	1998 Design & Construction	$2,500,000	Renovation of the NAL building continues. Completed projects include: replacement of the computer room HVAC and fire suppression systems; completion of chiller replacement and brick repairs of three building elevations; and 14th floor window replacements. Construction for the deteriorated building envelope, repair of brick facade, and replacement of the plumbing system was awarded 1st Quarter 2010 using ARRA funding and was completed 3rd Quarter 2012.
National Agricultural	1999 Design & Construction	1,200,000	
Library	2001 Design & Construction	1,766,106	
	2002 Construction	1,800,000	
	2003 Design & Construction	1,490,250	
	2004 Design & Construction	894,690	
	2009 ARRA	6,357,422	
	2011 Rescission	($115,175)	
	Total	15,893,293	
Maryland, Frederick (Fort Detrick)	2016 Design	$4,900,000	
Foreign Disease-Weed Science Research Laboratory			Design will be awarded in the 1st Quarter of FY 2017 and completed in the 1st Quarter of FY 2018.
Michigan, East Lansing	1992 Planning	$250,000	Design (100%) for this multi-phased facility modernization is complete.
Avian Disease and	1993 Planning	212,000	
Oncology Laboratory	1998 Planning and Design	1,800,000	
	2011 Rescission	($63,193)	
	Total	2,198,807	
Mississippi, Lorman	2006 Planning and Design	$1,980,000	A lease agreement with Alcorn State University for the new facility was completed 4th Quarter 2009. POR was completed 3rd Quarter 2008.
Biotechnology Laboratory	2008 Planning and Design	1,390,200	
Alcorn State University	2009 Construction	1,176,000	
	2010 Construction	1,500,000	
	2011 Rescission	($5,798,055)	
	Total	248,145	
Mississippi, Poplarville	2002 Design	$800,000	Construction of the Headhouse/Greenhouse was awarded 4th Quarter 2007 and completed 1st Quarter 2008.
Thad Cochran Southern	2003 Construction	9,140,200	
Horticultural Laboratory	2006 Supplemental	4,300,000	
	2011 Rescission	($9,178)	
	Total	14,231,022	
Mississippi, Starkville	2005 Planning and Design	$2,976,000	Lease agreement is in place. Design (100%) was completed 1st Quarter 2008.
Poultry Science	2006 Construction	4,950,000	
Research Facility	2008 Construction	1,390,200	
	2009 Construction	3,177,000	
	2011 Rescission	($10,345,645)	
	Total	2,147,555	

Location and Purpose	Year	Amount of Funds Provided	Description
Mississippi, Stoneville	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 2nd Quarter 2016.
Jamie Whitten Delta	2005 Construction	2,976,000	
States Research Center	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	
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 Lab) was completed 4th Quarter 2008.
Northern Plains Agricultural	1999 Construction	7,300,000	
Research Laboratory	2004 Design and Construction	2,505,132	
	2011 Rescission	($29,505)	
	Total	10,381,627	
Nebraska, Lincoln	2008 Planning and Design	$1,390,200	POR was completed 3rd Quarter 2011.
Systems Biology Research Facility	2009 Planning and Design	1,088,000	
	2010 Construction	3,760,000	
	2011 Rescission	($5,782,528)	
	Total	455,672	
New York, Geneva	2004 Planning and Design	$2,415,663	Design (100%) was completed 4th Quarter 2007.
Grape Genetics	2005 Construction	2,976,000	
	2006 Construction	3,588,750	
	2008 Construction	1,869,819	
	2009 Construction	2,192,000	
	2010 Construction	3,654,000	
	2011 Rescission	($14,806,870)	
	Total	1,889,362	

Location and Purpose	Year	Amount of Funds Provided	Description
New York, Ithaca	2004 Planning and Design	$3,847,167	Design (100%) was completed 2nd Quarter 2008.
Crop-based Health Genomics	2005 Construction	2,976,000	
	2006 Construction	3,588,750	
	2011 Rescission	($7,314,491)	
	Total	3,097,426	
Ohio, Toledo	2005 Planning and Design	$1,984,000	Design (100%) completed 1st Quarter 2010. Lease agreement is in place.
University of Toledo	2006 Construction	1,584,000	
	2008 Construction	1,869,819	
	2009 Construction	2,192,000	
	2010 Construction	3,654,000	
	2011 Rescission	($9,356,845)	
	Total	1,926,974	
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

Location and Purpose	Year	Amount of Funds Provided	Description
Texas, Houston Children's Nutrition Research Center	2016 Design and Construction	$29,200,000	Design will be awarded in the 4th Quarter of FY 2016 and completed in the 3rd Quarter of FY 2017. Construction will be awarded in the 4th Quarter of FY 2017 and completed in the 2nd Quarter of FY 2019.
Texas, Kerrville	2008 Planning and Design	$1,390,200	POR was completed 2nd Quarter 2010.
Knipling Bushland Lab	2009 Planning and Design	1,957,000	
	2011 Rescission	($2,768,214)	
	Total	578,986	
Utah, Logan	2008 Planning and Design	$5,560,800	Lease completed 3rd Quarter 2010. POR completed 4th Quarter 2010.
Agricultural Research Center	2009 Design and Construction	4,351,000	
	2010 Construction	4,527,000	
	2011 Rescission	($13,839,929)	
	Total	598,871	
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	

Location and Purpose	Year	Amount of Funds Provided	Description
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' Strategic Goals and Objectives, and Performance Measures and Targets are shown here.

USDA Strategic Goal 2: Ensure Our National Forests and Private Working Lands Are Conserved, Restored, and Made More Resilient to Climate Change, While Enhancing Our Water Resources.

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

In FY 2015, ARS scientists achieved many of their performance targets related to climate change, drought, and extreme weather. Some are detailed below in the "Key Performance Measures" table, under the "2015 Actual" column, while others are listed in the Explanatory Notes under the "Status of Program" section. For example, on January 31, 2015, the NASA Soil Moisture Active/Passive (SMAP) mission was successfully launched and deployed into Earth orbit. Developed in part by ARS scientists, SMAP will provide global measurements of soil moisture for weather prediction, drought and flood forecasting, and agricultural management.

Agency Strategic Goal	Agency Objectives	Programs that Contribute	Key Outcomes
Agency Goal Area 2: Natural Resources and Sustainable Agricultural Systems	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.

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.				
2013 Actual	**2014 Actual**	**2015 Actual**	**2016 Target**	**2017 Request**
•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.	•Create and make openly available, a database of air emissions from crop land agricultural production systems.	•Make available a database of air emissions from crop land agricultural production systems.

2013 Actual	2014 Actual	2015 Actual	2016 Target	2017 Request
•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	•Reduced risks to agricultural production/ ecosystem services from interacting climate-related stresses. •Developed technologies/ practices to adapt agricultural systems to climate variability and weather extremes. •Reduced 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.	•Demonstrate the utility of approaching agricultural climate change adaptation through the interaction of Genetics -- Environment -- Management. •Enable improvements to soil resources via management of microbes in the environment. •Identify/evaluate management practices that maximize genetic potential for 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. •Provide research on crops which are resilient, and

2013 Actual	2014 Actual	2015 Actual	2016 Target	2017 Request
	information from 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.	respond/adapt to climate change.

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

In FY 2015, ARS scientists achieved many of their performance targets related to protecting and enhancing water resources. Some are detailed below in the "Key Performance Measures" table, under the "2015 Actual" column, while others are listed in the Explanatory Notes under the "Status of Program" section. For example, in Temple, Texas, in collaboration with NRCS, scientists significantly improved the Soil and Water Assessment Tool (SWAT), which is the world's leading simulation model for assessing the watershed scale environmental effects of crop, forest, and range land management.

Agency Strategic Goal	Agency Objectives	Programs that Contribute	Key Outcomes
<u>Agency Goal Area 2</u>: Natural Resources and Sustainable Agricultural Systems	<u>Objective 2.1</u>: Integrated, effective, and safe water resource management.	Water Availability and Watershed Management	<u>Key Outcome 2.1</u>: Safe, abundant, and reliable water resources.

Key Performance Measures:

Develop technology and practices to promote improvement of integrated, effective, and safe water resource management.				
2013 Actual	**2014 Actual**	**2015 Actual**	**2016 Target**	**2017 Request**
•Developed or evaluated a method or technology to assess and conserve water availability through more efficient sensing, supply, delivery, and reuse systems. •Developed or evaluated a method or technology to reduce or prevent nutrient contamination of surface and ground waters. •Developed or evaluated a method or technology that reduces sediment loads to waterways, improves farm land sustainability, and improves or restores stream corridors and riparian ecosystems. •Developed or assessed a system or practice that ameliorates, offsets, or mitigates the impact of agricultural production and processing on water resources. •Expanded the ARS GRACEnet project into U.S. biomass and specialty crops.	•Developed or evaluated a method or technology to assess and conserve water availability through more efficient sensing, supply, delivery, and reuse systems. •Developed or evaluated a method or technology to reduce or prevent nutrient contamination of surface and ground waters. •Developed or evaluated a method or technology that reduces sediment loads to waterways, improves farm land sustainability, and improves or restores stream corridors and riparian ecosystems. •Developed or assessed a system or practice that ameliorates, offsets, or mitigates the impact of agricultural production and processing on water resources. •Expanded the ARS GRACEnet project into U.S.	•Developed tools and technologies to improve the effectiveness of agricultural water management. •Improved the scientific understanding of erosion, sedimentation, and contaminant transport processes from agricultural fields and landscapes to facilitate the development of tools and technologies to better protect agricultural water quality. •Developed 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 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 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	•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 development of tools and technologies to better protect agricultural water quality. •Continue to access the benefits, while developing strategies to enhance the effectiveness, of conservation practices in agroecosystems and agricultural landscapes. •Continue to conduct research on watershed management tools, technologies, and practices, to improve ecosystem services in agricultural landscapes. •Research water supplies related to the Great Basin, California Area Drought, and Non-Traditional Waters.

2013 Actual	2014 Actual	2015 Actual	2016 Target	2017 Request
•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. •Enhanced the quantity/quality of water resources for agriculture.	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. •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.	•Conducted research to improve watershed management and ecosystem services in agricultural landscapes.	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.	

Environmental Stewardship

Key Performance Measures

ARS has 14 Key Performance Measures related to its Agency mission and goals. Five of its Key Performance Measures are detailed in this exhibit. With regard to the specific Key Performance Measures related to Climate Change, Soils, and Emission research; and Water Availability and Watershed Management research, ARS has "met" all of its Targets.

Analysis of Results

Selected Past Accomplishments Toward the Achievement of the Key Outcome FY 2015:

- Developed the NASA Soil Moisture Active/Passive (SMAP) satellite which was launched on January 31, 2015. SMAP will provide global measurements of soil moisture for weather prediction, and drought and flood forecasting.
- Improved the Soil and Water Assessment Tool (SWAT), the world's leading watershed simulation model.
- Developed a national conservation practice standard for surface application of gypsum products, which can reduce dissolved phosphorus losses, improve soil physical characteristics, ameliorate subsoil acidity, and/or reduce pathogen losses from biosolids or manure amended soils.
- Developed a soil test that helps producers optimize fertilizer application rates.
- Isolated several naturally occurring bacteria that significantly reduce three grass weeds, and that do not harm crops or desirable native species. EPA has registered one of these bacteria as a herbicide, as a new tool to growers and land managers in combatting invasive grass weeds.
- Developed improved techniques for analyzing soil microbial community structure and function, which will lead to improved soil health and expanded crop production.
- Evaluated inexpensive anaerobic digesters for small U.S. diaries, for treatment of manure prior to storage and land application.
- Developed a new technology to recover concentrated ammonia from liquid manures, leading to reduced ammonia emissions and providing an alternative source of crop fertilizer.

Selected Accomplishments Expected at the FY 2017 Proposed Resource Level/Challenges for the Future:

- Make available a database of air emissions from crop land agricultural production systems.
- Demonstrate the utility of approaching agricultural climate change adaptation through the interaction of Genetics -- Environment -- Management.
- Enable improvements to soil resources via management of microbes in the environment.
- Identify/evaluate management practices that maximize genetic potential for 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.
- Provide research on crops which are resilient and respond/adapt to climate change.
- Determine the vulnerability of different agronomic systems to production losses associated with climate change.
- 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 development of tools and technologies to better protect agricultural water quality.
- Continue to access the benefits, while developing strategies to enhance the effectiveness of conservation practices in agro ecosystems and agricultural landscapes.
- Continue to conduct research on watershed management tools, technologies, and practices, to improve ecosystem services in agricultural landscapes.
- Research water supplies related to the Great Basin, California Area Drought, and Non-Traditional Waters.

USDA Strategic Goal 3: Help America Promote Agricultural Production and Biotechnology Exports as America Works to Increase Food Security.

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

In FY 2015, ARS scientists achieved many of their performance targets related to enhancing global food security. Some are detailed below in the "Key Performance Measures" table, under the "2015 Actual" column, while others are listed in the Explanatory Notes under the "Status of Program" section. For example, ARS scientists at Clay Center, Nebraska determined that feeding nursery pigs an antimicrobial enzyme, lysozyme, was an effective alternative to traditional antibiotics in promoting growth, improving feed efficiency, and reducing susceptibility to bacterial infections.

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: Livestock 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.

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.

2013 Actual	2014 Actual	2015 Actual	2016 Target	2017 Request
•Applied new genomic tools to accelerate genetic improvement of 'specialty crops'	•Applied new genomic tools to accelerate genetic improvement of 'specialty crops'	•Developed leading edge genomic technologies, and bred superior, new	•Devise innovative approaches to crop genetic improvement and trait analysis.	•Devise innovative approaches to crop genetic improvement and trait analysis.

2013 Actual	2014 Actual	2015 Actual	2016 Target	2017 Request
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. •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.	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. •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.	crops, varieties, and enhanced germplasm and genetic resources. •Devised innovative approaches to crop genetic improvement and trait analysis. •Expanded crop genomic information resources and advanced bioinformatic capabilities. •Expanded fundamental knowledge of plant biological and molecular processes. •Maintained and expanded USDA germplasm collections in a healthy, secure, and easily accessible form. •Increased crop genetic resource regeneration, and safeguarded collection. •Developed crop production strategies to optimize crop genetic potential, mitigate losses due to biotic and abiotic stresses, and increase production efficiency.	•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. •Integrate crop cultivars, manage-ment 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.	•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. •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.

2013 Actual	2014 Actual	2015 Actual	2016 Target	2017 Request
•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.	•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. •Developed plant varieties and ecologically-based soil/plant manage-ment strategies.	•Integrated crop cultivars, management strategies for abiotic and biotic stresses, and mechanization technologies into improved, productive, profitable, and environmentally acceptable crop production systems. •Distributed germplasm for research purposes. •Evaluated and characterized germplasm of wild relatives of crops to facilitate its use in crop breeding and research.	•Breed fruits and vegetables with enhanced nutritional value. •Develop best management practices to promote pollinator health and reduce/prevent Colony Collapse Disorder. •Improve agricultural sustainability.	•Develop best management practices to promote pollinator health and reduce/prevent Colony Collapse Disorder. •Improve agricultural sustainability.

Crop Production

Key Performance Measures

ARS has 14 Key Performance Measures related to its Agency mission and goals. Five of its Key Performance Measures are detailed in this exhibit. With regard to the specific Key Performance Measure related to Crop Production research, ARS has "met" all of its Targets.

Analysis of Results

Selected Past Accomplishments Toward the Achievement of the Key Outcome FY 2015:

- Demonstrated that the plant pathogen that causes downy mildew disease of lettuce changes the plant environment so that human enteric pathogens have higher survival and multiplication rates on lettuce leaves.
- Developed cotton germplasm resistant to cotton leaf curl virus, one of the most dangerous threats to U.S. agriculture.
- Developed a computational "pipeline" that will enable a researcher to assemble a rice genome sequence and characterize all of its genes, all in one day.
- Applied a new technology that optimizes tree shape for improved crop productivity and sustainability.
- Sequenced the full genome of two Asian honey bee species, the North American bumble bee species used for most commercial pollination, and the Alfalfa leaf cutting bee.
- Developed a new optical yield monitor which increases sugarcane harvest efficiency and profitability.
- Improved diagnostic reliability for detection of *Candidatus* Liberibacter asiaticus, the presumed causal agent of citrus greening.

Selected Accomplishments Expected at the FY 2017 Proposed Resource Level/Challenges for the Future:

- Devise innovative approaches to crop genetic improvement and trait analysis.
- Expand crop genomic information resources and advanced bioinformatics 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.
- 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.
- Develop best management practices to promote pollinator health and reduce/prevent Colony Collapse Disorder.
- Improve agricultural sustainability.

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.

2013 Actual	2014 Actual	2015 Actual	2016 Target	2017 Request
•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.	•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	•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, sheep, goat, poultry and swine genome sequences to identify genes impacting efficiency of nutrient utilization and adaptation to the production environment. •Developed 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.	•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. •Use metagenomics to identify microbial genes and microbial pathways affecting feed utilization efficiency, animal

2013 Actual	2014 Actual	2015 Actual	2016 Target	2017 Request
•Increased depth of sequence coverage in key genomic regions to identify causative mutations. •Used metagenomics to identify microbial genes and microbial pathways affecting feed efficiency, animal health, and odor 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 anagement strategies to optimize sustainable animal production. •Used data to achieve improved feed efficiency and reduced antimicrobial resistance in livestock.	•Increased depth of sequence coverage in key genomic regions to identify causative mutations. •Used metagenomics to identify microbial genes and microbial pathways affecting feed efficiency, animal health, and odor emissions in animal production. •Developed genome sequence resources for catfish, rainbow trout. •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 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 manage-ment 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.	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.

2013 Actual	2014 Actual	2015 Actual	2016 Target	2017 Request
		•Improved the efficiency and productivity of ruminant grazing systems through nationally and regionally coordinated collaborative research initiatives. •Advanced 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. •Improve agricultural sustainability.	•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. •Improve agricultural sustainability.

Livestock Production

Key Performance Measures

ARS has 14 Key Performance Measures related to its Agency mission and goals. Five of its Key Performance Measures are detailed in this exhibit. With regard to the specific Key Performance Measure related to Livestock Production research, ARS has "met" all of its Targets.

Analysis of Results

Selected Past Accomplishments Toward the Achievement of the Key Outcome FY 2015:

- Determined that feeding an antimicrobial enzyme, lysozyme, to nursery pigs was as effective as traditional antibiotics in increasing growth performance.
- Identified a gene that affects sheep susceptibility to ovine progressive pneumonia, one of the most costly sheep diseases in North America.
- Demonstrated that Marek's disease, an avian tumor virus induced disease, is primarily controlled by host genetics.
- Demonstrated that feeding prepared diets formulated with a yeast-based additive offered protection against columnaris disease, one of the most prevalent freshwater diseases.
- Developed a panel of genetic markers that will be used in a commercial breeding program to increase the efficiency of selective breeding for sea lice in Atlantic salmon.
- Evaluated the efficacy of salmon gonadotropin releasing hormone analog to induce ovulation in channel catfish.

Selected Accomplishments Expected at the FY 2017 Proposed Resource Level/Challenges for the Future:

- 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.
- 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.
- Improve agricultural sustainability.

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

USDA Strategic Objective 4.4: Protect Agricultural Health by Minimizing Major Diseases and Pests to Ensure Access to Safe, Plentiful, and Nutritious Food.

In FY 2015, ARS scientists achieved many of their performance targets related to minimizing major diseases and pests to ensure safe, plentiful, and nutritious food. Some are detailed below in the "Key Performance Measures" table, under the "2015 Actual" column, while others are listed in the Explanatory Notes under the "Status of Program" section. For example, ARS scientists at the Southeast Poultry Research Laboratory in Athens, Georgia developed, in record time, an effective vaccine against the highly pathogenic avian influenza (HPAI) virus strains that caused the death of over 49 million chickens and turkeys in the United States from December 2014 to May 2015.

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.

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.

2013 Actual	2014 Actual	2015 Actual	2016 Target	2017 Request
•Identified functional genes that convey specific disease-resistance traits. •Identified/characterized gene functions/ mechanisms responsible for disease-resistance traits. •Implemented an integrated emerging disease research program in pathogenesis, diagnostics, and intervention. •Implemented a technology driven vaccinology research program for control and eradication of biological threat agents. •Discovered genetic profiles that convey protective immunity against infectious diseases/parasites. •Developed control programs for invasive drug resistant nematodes and protozoa. •Developed alternatives to antibiotics to prevent/	•Identified functional genes that convey specific disease-resistance traits. •Identified/characterized gene functions/mechanisms responsible for disease-resistance traits. •Implemented an integrated emerging disease research program in pathogenesis, diagnostics, and intervention. •Implemented a technology driven vaccinology research program for control and eradication of biological threat agents. •Discovered genetic profiles that convey protective immunity against infectious diseases/parasites. •Developed control programs for invasive drug resistant nematodes and protozoa. •Selected vaccine candidates for prevention of cattle	•Identified/ characterized gene functions and mechanisms responsible for disease-resistance traits. •Discovered genetic profiles that convey protective immunity against infectious diseases/parasites. •Implemented a technology driven vaccinology research program for control and eradication of biological threat agents. •Continued to investigate the biology and genomics of important animal pathogens. •Continued to investigate the epidemiology and ecology of important animal pathogens. •Continued to form new partnerships and continue old partnerships with industry, universities and other government	•Identify/characterize 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 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.	•Develop new solutions to prevent economic losses from foreign animal disease outbreaks. •Identify predictors of emerging livestock diseases. •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 animal pathogens and arthropods that transmit pathogens, and arthropods that destroy property. •Develop integrated pest management strategies to control sea lice on salmon.

2013 Actual	2014 Actual	2015 Actual	2016 Target	2017 Request
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 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.	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. •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	agencies to promote production and marketing of inventions that protect animals from pathogens. •Implemented an integrated emerging disease research program in pathogenesis, diagnostics, and intervention. •Implemented a technology driven vaccinology research program for control and eradication of biological threat agents. •Developed control programs for invasive drug resistant nematodes, protozoa, and pests of livestock and poultry. •Developed alternatives to antibiotics to prevent/treat pathogens affecting poultry health. •Developed alternatives in farm animals to prevent/control animal diseases, reduce antibiotic resistance, and enhance livestock production. •Discovered and develop new diagnostic platforms	•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. •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	•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. •Develop detection systems and broad spectrum vaccines and biotherapeutics to counter the threat of emerging diseases or

2013 Actual	2014 Actual	2015 Actual	2016 Target	2017 Request
•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 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	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 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	for priority animal diseases. •Improved integrated pest management of pests that affect the health and well-being of livestock, poultry, and humans. •Assessed the risks associated with climate change as it affects pests that harm livestock, poultry, and humans. •Performed tests to achieve U.S. EPA licensing of etofenprox-treated clothing for protection of humans from mosquito bites. •Completed the sequencing of the horn fly genome.	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. •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	engineered biological weapons. •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

2013 Actual	2014 Actual	2015 Actual	2016 Target	2017 Request
and humans from biting arthropods. •Discovered and transferred new technologies for protection of animals from priority diseases. •Conducted research on countering biological threats.	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 protection of animals from priority diseases. •Conducted research on countering biological threats.		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.	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 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,

2013 Actual	2014 Actual	2015 Actual	2016 Target	2017 Request
				bacteriophage; modulators of innate and adaptive immunity; and immune modulators, including vaccines.

Livestock Protection

Key Performance Measures

ARS has 14 Key Performance Measures related to its Agency mission and goals. Five of its Key Performance Measures are detailed in this exhibit. With regard to the specific Key Performance Measure related to Livestock Protection research, ARS has "met" all of its Targets.

Analysis of Results

Selected Past Accomplishments Toward the Achievement of the Key Outcome FY 2015:

- Developed, in record time, an effective vaccine against the highly pathogenic avian influenza (HPAI) virus strains that caused the death of over 49 million chickens and turkeys in the United States, from December 2014 to May 2015.
- Developed an experimental vaccine to protect chickens against infectious laryngotracheitis virus (ILTV) and Newcastle disease virus (NDV), two of the most economically important infectious diseases of poultry.
- Developed an experimental vaccine that protects domestic pigs from the African swine fever virus.
- Increased understanding of the mechanisms that drive persistent infections in foot-and-mouth disease infected cattle.
- Developed a safer alternative to permethrin, the only currently available arthropod repellent for military and civilian clothing.
- Completed the sequencing of the horn fly genome which will facilitate the development of new fly control technologies.

Selected Accomplishments Expected at the FY 2017 Proposed Resource Level/Challenges for the Future:

- Develop new solutions to prevent economic losses from foreign animal disease outbreaks.
- Identify predictors of emerging livestock diseases.
- 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 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.

- Develop detection systems and broad spectrum vaccines and biotherapeutics to counter the threat of emerging diseases or engineered biological weapons.
- 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.
- 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.

Program Evaluations

In FY 2015, ARS conducted retrospective reviews of its Climate Change, Soils, and Emissions; Food Safety; and Plant Diseases programs.

FY 2015 Program Evaluations		
Strategic Objective and Program	Title	Summary
Objective 2.2: Lead Efforts to Mitigate and Adapt to Climate Change, Drought, and Extreme Weather in Agriculture and Forestry Climate Change, Soils, and Emissions research	Retrospective review of ARS' Food Safety research	The research program was evaluated by a panel of experts who represented government, private industry, and customer/stakeholder groups. Performance was evaluated based on the quality of research leading to actual impact, or progress toward anticipated benefits to end users, scientific communities, and the broader society. Overall, the research program was found to have had high impact, that is, significant benefit or influence.

FY 2015 Program Evaluations		
Strategic Objective and Program	Title	Summary
Objective 4.3: Protect Public Health by Ensuring Food is Safe Food Safety research	Retrospective review of ARS' Climate Change, Soils, and Emissions research	The research program was evaluated by a panel of experts who represented government, private industry, and customer/stakeholder groups. Performance was evaluated based on the quality of research leading to actual impact, or progress toward anticipated benefits to end users, scientific communities, and the broader society. Overall, the research program was found to have had high impact, that is, significant benefit or influence.
Objective 4.4.: Protect Agricultural Health by Minimizing Major Diseases and Pests to Ensure Access to Safe, Plentiful, and Nutritious Food Plant Diseases	Retrospective review of ARS' Plant Diseases research	The research program was evaluated by a panel of experts who represented government, private industry, and customer/stakeholder groups. Performance was evaluated based on the quality of research leading to actual impact, or progress toward anticipated benefits to end users, scientific communities, and the broader society. Overall, the research program was found to have had high impact, that is, significant benefit or influence.

Strategic Goal Funding Matrix
(Dollars in thousands)

Program / Program Items	2014 Actual	2015 Actual	2016 Enacted	Inc. or Dec.	2017 Estimate
Department Strategic Goal: Assist rural communities to create prosperity so they are self-sustaining, repopulating, and economically thriving					
Product Quality/Value Added	$98,756	$100,156	$100,956	-$268	$100,688
Staff Years	699	670	671	-	671
Livestock Production	43,342	43,517	43,517	+895	44,412
Staff Years	222	213	213	-	213
Crop Production	108,624	108,624	108,854	-540	108,314
Staff Years	657	631	634	-	634
National Agricultural Library	23,791	23,791	23,791	+169	23,960
Staff Years	95	92	92	-	92
Repair and Maintenance	20,144	20,144	20,144	-	20,144
Staff Years	-	-	-	-	-
Decentralized GSA and DHS Security Payments	-	5,115	5,115	-5,115	0
Staff Years	-	-	-	-	-
Total Costs, Strategic Goal	294,657	301,347	302,377	-4,859	297,518
Total Staff Years, Strategic Goal	1,673	1,606	1,610	-	1,610
Department Strategic Goal: Ensure our national forests and private working lands are conserved, restored, and made more resilient to climate change, while enhancing our water resources					
Environmental Stewardship	200,819	200,819	203,035	+9,499	212,534
Staff Years	1,299	1,245	1,245	+2	1,247
Total Costs, Strategic Goal	200,819	200,819	203,035	+9,499	212,534
Total Staff Years, Strategic Goal	1,299	1,245	1,245	+2	1,247
Department Strategic Goal: Help America promote agricultural production and biotechnology exports as America works to increase food security					
Livestock Production	43,342	43,342	43,342	+891	44,233
Staff Years	222	212	212	-	212
Crop Production	106,542	106,542	108,854	-574	108,280
Staff Years	645	619	622	-	622
Total Costs, Strategic Goal	149,884	149,884	152,196	317	152,513
Total Staff Years, Strategic Goal	867	831	834	-	834
Department Strategic Goal: Ensure that all of America's children have access to safe, nutritious, and balanced meals					
Food Safety	111,656	111,656	111,790	+4,581	116,371
Staff Years	659	659	659	+1	660
Human Nutrition	86,874	86,874	86,874	-1,597	85,277
Staff Years	235	235	235	-	235
Livestock Protection	89,632	90,632	92,765	+12,756	105,521
Staff Years	459	440	444	+6	450
Crop Protection	188,960	191,413	194,788	-3,182	191,606
Staff Years	1,073	1,030	1,035	-	1,035
Total Costs, Strategic Goal	477,122	480,575	486,217	+12,558	498,775
Total Staff Years, Strategic Goal	2,426	2,364	2,373	+7	2,380
Total Costs, All Strategic Goals	1,122,482	1,132,625	1,143,825	+17,515	1,161,340
Total FTEs, All Strategic Goals	6,265	6,046	6,062	+9	6,071

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 2014	FY 2015	FY 2016	FY 2017
	Direct Costs:				
	Research and Development	257,052	258,298	249,406	249,637
	Indirect Costs:				
	Program and Administrative/Financial Management	21,681	21,786	21,036	21,055
	USDA Central Charges	6,489	6,521	6,296	6,302
	Task Force, Advisory Committees, and Other Support Costs	391	393	380	380
	Total Indirect Costs	28,561	28,700	27,712	27,737
	Total Costs	**285,613**	**286,998**	**277,118**	**277,374**
	FTEs	1,673	1,606	1,610	1,610
	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		20,104	20,144	20,144	20,144
Miscellaneous Fees		195	1,064	13,680	0
Decentralized GSA and Security Payments		0	5,115	5,115	0
	FTEs	0	0	0	0
	Total Costs for Department Strategic Goal 1 (program, direct, indirect)	**305,912**	**313,321**	**316,057**	**297,518**
	FTEs	**1,673**	**1,606**	**1,610**	**1,610**

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 2014	FY 2015	FY 2016	FY 2017
	Direct Costs:				
	Research and Development	180,650	180,381	182,732	191,281
	Indirect Costs:				
	Program and Administrative/Financial Management	15,237	15,214	15,412	16,133
	USDA Central Charges	4,560	4,554	4,613	4,829
	Task Force, Advisory Committees, and Other Support Costs	275	275	278	291
	Total Indirect Costs	20,072	20,042	20,304	21,253
	Total Costs for Department Strategic Goal 2 (program, direct, indirect)	**200,722**	**200,423**	**203,035**	**212,534**
	FTEs	1,299	1,245	1,245	1,247

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 2014	FY 2015	FY 2016	FY 2017
	Direct Costs:				
	Research and Development	124,370	124,047	136,976	137,262
	Indirect Costs:				
	Program and Administrative/Financial Management	10,490	10,462	11,553	11,577
	USDA Central Charges	3,140	3,131	3,458	3,465
	Task Force, Advisory Committees, and Other Support Costs	189	189	209	209
	Total Indirect Costs	13,819	13,783	15,220	15,251
	Total Costs for Department Strategic Goal 3 (program, direct, indirect)	**138,189**	**137,830**	**152,196**	**152,513**
	FTEs	867	831	834	834

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 2014	FY 2015	FY 2016	FY 2017
	Direct Costs:				
	Research and Development	429,289	432,016	437,595	448,898
	Indirect Costs:				
	Program and Administrative/Financial Management	36,208	36,439	36,909	37,862
	USDA Central Charges	10,837	10,906	11,047	11,332
	Task Force, Advisory Committees, and Other Support Costs	653	658	666	683
	Total Indirect Costs	47,699	48,002	48,621	49,878
	Total Costs for Department Strategic Goal 4 (program, direct, indirect)	**476,988**	**480,018**	**486,217**	**498,775**
	FTEs	2,426	2,364	2,373	2,380

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)		**1,121,811**	**1,131,592**	**1,157,505**	**1,161,340**
	FTEs	6,265	6,046	6,062	6,071
Total Costs for Buildings and Facilities		**1,369**	**1,039**	**17,000**	**222,000**
	FTEs	0	0	0	0
Grand Total Costs for all Department Strategic Goals		**1,123,180**	**1,132,631**	**1,174,505**	**1,383,340**
	FTEs	**6,265**	**6,046**	**6,062**	**6,071**