

## 2020 USDA EXPLANATORY NOTES – AGRICULTURAL RESEARCH SERVICE

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***AGENCY-WIDE*****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); Act of June 29, 1935 (7 U.S.C. 427); Agricultural Marketing Act of 1946, as amended (7 U.S.C. 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. 1281 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.

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 15 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, 2018, there were 4,985 permanent, full-time employees including 438 in the Headquarters offices and 4,547 in field offices.

**OIG and GAO Reports*****Table ARS-1. Completed OIG Reports***

<b>ID</b>	<b>Date</b>	<b>Title</b>
50024-0001-22	03/14/2018	CIGIE Purchase Card Initiative - USDA Controls Over Purchase Card Use
50401-0013-11	11/17/2017	U.S. Department of Agriculture’s Consolidated Balance Sheet for Fiscal Year 2017
50501-0015-12	11/03/2017	U.S. Department of Agriculture, Office of the Chief Information Officer Fiscal Year 2017 Federal Information Security Modernization Act
50601-0006-31	03/05/2018	Reviewing the Integrity of USDA’s Scientific Research Program
50701-0001-21	09/17/2018	USDA Agency Activities for Agroterrorism Prevention, Detection, and Response

***Table ARS-2. In-Progress OIG Reports***

<b>ID</b>	<b>Title</b>
50401-0016-11	Department of Agriculture’s Consolidated Balance Sheet for Fiscal Year 2018
50501-0017-12	Security Over Select USDA Agencies’ Networks and Systems
50501-0020-12	Improper Usage of USDA’s Information Technology Resources
50501-0021-12	Data Encryption Controls Over Personally Identifiable Information on USDA Information Technology Systems Review
50701-0002-21	United States Department of Agriculture’s Controls to Prevent the Unauthorized Access and Transfer of Research Technology

**Table ARS-3. Completed GAO Reports**

<b>ID</b>	<b>Date</b>	<b>Title</b>	<b>Result</b>
GAO-18-11	10/4/2017	Southwest Border Security: Actions Needed to Enhance CBP's Maintenance of Roads Used for Its Operations	ARS is evaluating GAO recommendations.
GAO-18-72	10/26/2017	Federal Facility Security: Selected Agencies Should Improve Methods for Assessing and Monitoring Risk	ARS is evaluating GAO recommendations.
GAO-18-110	05/24/2018	Small Unmanned Aircraft Systems: FAA Should Improve Its Management of Safety Risks	ARS is evaluating GAO recommendations.
GAO-18-145	10/31/2017	High-Containment Laboratories: Coordinated Actions Needed to Enhance the Select Agent Program's Oversight of Hazardous Pathogens	ARS is evaluating GAO recommendations.
GAO-18-155	10/11/2017	Biodefense: Federal Efforts to Develop Biological Threat Awareness	ARS is evaluating GAO recommendations.
GAO-18-199	04/16/2018	Food Safety: Federal Efforts to Manage the Risk of Arsenic in Rice	ARS is evaluating GAO recommendations.
GAO-18-221	04/03/2018	Defense Budget: Actions Needed to Improve the Management of Foreign Currency Fund	ARS is evaluating GAO recommendations.
GAO-18-249	03/16/2018	Committee on Foreign Investment in the United States: Treasury Should Coordinate Assessments of Resources Needed to Address Increased Workload	ARS is evaluating GAO recommendations.
GAO-18-257	02/16/2018	Federal Personal Property: Opportunities Exist to Improve Identification of Unneeded Property for Disposal	ARS is evaluating GAO recommendations.
GAO-18-272	04/18/2018	Food Safety: USDA Should Take Further Action to Reduce Pathogens in Meat and Poultry Products	ARS is evaluating GAO recommendations.
GAO-18-290	03/23/2018	Science, Technology, Engineering, and Mathematics Education: Actions Needed to Better Assess the Federal Investment	ARS is evaluating GAO recommendations.
GAO-18-307	03/12/2018	Chemical Innovation: Technologies to Make Processes and Products More Sustainable	ARS is evaluating GAO recommendations.
GAO-18-459	05/31/2018	Animal Use in Federal Research: Agencies Share Information, but Reporting and Data Quality Could be Strengthened	ARS is evaluating GAO recommendations.
GAO-18-656	09/26/2018	Science and Technology: Considerations for Maintaining U.S. Competitiveness in Quantum Computing, Synthetic Biology, and Other Potentially Transformational Research Areas	ARS is evaluating GAO recommendations.
GAO-19-36	12/2018	Federal Budget: Government-Wide Inventory of Accounts with Spending Authority and Permanent Appropriations, Fiscal Years 1995 to 2015, 100774	ARS is evaluating GAO recommendations.

**Table ARS-4. In-Progress GAO Reports**

<b>ID</b>	<b>Title</b>
101406	Renewable Fuel Standard (RFS) Effect on Transportation Fuel Prices and Greenhouse Gas Emissions in the United States
101434	USDA's Regional Climate Hubs
101732	Federal Grants Workforce Training
102051	USDA's Preparedness for Foot-and-Mouth Disease (FMD)
102077	Agent Orange
102093	Biological Select Agents and Toxins: Actions Needed to Improve Management of DOD's Biosafety and Biosecurity Program
102103	Assessing Technologies that Can Help Reduce the Agricultural Sector's Impact on Water Supplies
102299	Information Technology Cloud Computing
102451	Access to Federally Funded Research and Data
102509	Federal Preparedness for Responding to Antimicrobial-Resistant Pathogens
102595	Date Labels on Packaged Food
102599	Network for Manufacturing Innovation Program
102874	Alternatives to Animal Research
102947	Transfer of National Bio and Agro-Defense Facility Operations

**AVAILABLE FUNDS AND STAFF YEARS****Table ARS-5. Available Funds and Staff Years (thousands of dollars, staff years (SY))**

Item	2017		2018		2019		2020	
	Actual	SY	Actual	SY	Estimate	SY	Budget	SY
Salaries and Expenses:								
Discretionary Appropriations.....	\$1,170,235	5,952	\$1,202,766	5,572	\$1,244,766	5,596	\$1,203,491	5,656
Buildings and Facilities:								
Discretionary Appropriations.....	99,600	-	162,600	-	140,600	-	50,000	-
Transfers In.....	90	-	60	-	13,000	-	-	-
Transfers Out.....	-	-	-350	-	-	-	-	-
Adjusted Appropriation.....	1,269,925	5,952	1,365,076	5,572	1,398,366	5,596	1,253,491	5,656
Balance Available, SOY.....	263,554	-	231,119	-	379,417	-	295,733	-
Other Adjustments (Net).....	16,022	-	14,648	-	-	-	-	-
Total Available.....	1,549,501	5,952	1,610,843	5,572	1,777,783	5,596	1,549,224	5,656
Lapsing Balances.....	-742	-	-2,437	-	-	-	-	-
Balance Available, EOY.....	-231,119	-	-379,417	-	-295,733	-	-216,217	-
Subtotal Obligations, ARS.....	1,317,640	5,952	1,228,989	5,572	1,482,050	5,596	1,333,007	5,656
Ob. Under Other USDA Appr.:								
Agricultural Marketing Service, AMS ...	141	1	131	-	131	-	131	-
Animal & Plant Health Inspection								
Service, APHIS.....	20,048	64	26,046	82	26,046	82	26,046	82
Economic Research Service, ERS.....	3,488	11	3,409	11	3,409	11	3,409	11
Farm Service Agency, FSA.....	280	1	260	1	260	1	260	1
Food & Nutrition Services, FNS.....	244	1	312	1	312	1	312	1
Food Safety & Inspection Service, FSIS	4,014	13	3,905	12	3,905	12	3,905	12
Foreign Agricultural Service, FAS.....	996	3	603	2	603	2	603	2
Forest Service, FS.....	1,019	3	813	3	813	3	813	3
Grain Inspection, Packers and								
Stockyard Administration, GIPSA...	103	-	-	-	-	-	-	-
Hazardous Waste.....	1,652	5	5,540	17	5,540	17	5,540	17
National Agricultural Statistics Service,								
NASS.....	4,307	14	4,277	14	4,277	14	4,277	14
National Institute of Food and								
Agriculture, NIFA.....	23,502	74	15,774	50	15,774	50	15,774	50
Natural Resources Conservation								
Service, NRCS.....	3,585	11	5,295	17	5,295	17	5,295	17
Office of Secretary, OSEC.....	400	1	502	2	502	2	502	2
Office of the Chief Economist, OCE.....	356	1	1,407	4	1,407	4	1,407	4
Quarters and Subsistence.....	462	2	130	-	130	-	130	-
Revocable Permits & Easements.....	1,388	4	549	2	549	2	549	2
Risk Management Agency.....	116	-	120	-	120	-	120	-
Sale of Animals & Personal Property								
(Proceeds).....	8,831	28	12,867	41	12,867	41	12,867	41
Travel and Miscellaneous								
Reimbursements.....	103	-	-	-	-	-	-	-
Misc., Other USDA Funds.....	312	1	430	1	430	1	430	1
Total, Other USDA.....	75,347	238	82,370	260	82,370	260	82,370	260
Total, Agriculture Appropriations.....	1,392,987	6,190	1,311,359	5,832	1,564,420	5,856	1,415,377	5,916
Other Federal Funds:								
Agency for International Development..	7,516	24	4,928	16	4,928	16	4,928	16
Department of Defense, DOD.....	4,328	14	5,259	17	5,259	17	5,259	17
Department of Energy, DOE.....	1,522	5	1,264	4	1,264	4	1,264	4
Department of Health & Human								
Services, DHHS.....	20,632	65	26,031	82	26,031	82	26,031	82
Department of Homeland Security,								
DHS.....	933	3	1,234	4	1,234	4	1,234	4
Department of State, DOS.....	324	1	213	1	213	1	213	1
Department of the Interior, DOI.....	2,566	8	2,197	7	2,197	7	2,197	7
Department of Treasury, DOT.....	138	-	142	-	142	-	142	-
Environmental Protection Agency, EPA	679	2	404	1	404	1	404	1

## 2020 USDA EXPLANATORY NOTES – AGRICULTURAL RESEARCH SERVICE

Item	2017		2018		2019		2020	
	Actual	SY	Actual	SY	Estimate	SY	Budget	SY
Federal Emergency Management								
Agency, FEMA.....	316	1	316	1	316	1	316	1
National Aeronautics & Space								
Administration, NASA.....	1,118	4	1,184	4	1,184	4	1,184	4
Misc., Other Federal Funds.....	6	-	4	-	4	-	4	-
Total, Other Federal.....	40,078	127	43,176	137	43,176	137	43,176	137
Non-Federal Funds:								
Arizona, University of.....	-	-	122	-	122	-	122	-
Arkansas, University of.....	-	-	210	1	210	1	210	1
Binational Agricultural Research & Development (BARD).....	199	1	172	1	172	1	172	1
Brigham Young University.....	230	1	-	-	-	-	-	-
California, State of.....	2,164	7	1,051	3	1,051	3	1,051	3
California Strawberry Commission.....	-	-	101	-	101	-	101	-
California, University of.....	1,430	5	706	2	706	2	706	2
California Walnut Board & Commission.....	-	-	302	1	302	1	302	1
Citrus Research & Development Foundation.....	1,627	5	915	3	915	3	915	3
Citrus Research Board.....	1,264	4	1,124	4	1,124	4	1,124	4
Colorado State University.....	-	-	316	1	316	1	316	1
Commodity Credit Corporation.....	231	1	-	-	-	-	-	-
Cornell University.....	775	2	968	3	968	3	968	3
Cotton Incorporated.....	850	3	1,174	4	1,174	4	1,174	4
Florida, State of.....	701	2	450	1	450	1	450	1
Florida, University of.....	517	2	623	2	623	2	623	2
Georgia Institute of Technology.....	135	-	-	-	-	-	-	-
Georgia, University of.....	461	1	274	1	274	1	274	1
Idaho, State of.....	109	-	-	-	-	-	-	-
Idaho State University.....	155	1	195	1	195	1	195	1
Idaho, University of.....	186	1	121	-	121	-	121	-
Illinois, University of.....	335	1	506	2	506	2	506	2
Iowa State University.....	938	3	367	1	367	1	367	1
Kansas State University.....	958	3	605	2	605	2	605	2
Louisiana State University.....	312	1	-	-	-	-	-	-
Maine, University of.....	342	1	555	2	555	2	555	2
Maryland, University.....	-	-	103	-	103	-	103	-
Michigan State University.....	1,232	4	1,064	3	1,064	3	1,064	3
Minnesota Corn Research and Promotion Council.....	122	-	-	-	-	-	-	-
Mississippi Soybean Promotion.....	151	1	148	-	148	-	148	-
Mississippi State University.....	129	-	-	-	-	-	-	-
Missouri Soybean Merchandising Council.....	143	1	143	1	143	1	143	1
National Cattlemen's Beef Association..	192	1	-	-	-	-	-	-
National Ecological Observatory Network (NEON).....	-	-	744	2	744	2	744	2
National Peanut Foundation.....	211	1	-	-	-	-	-	-
National Pork Board.....	190	1	-	-	-	-	-	-
Nebraska, University of.....	136	-	361	1	361	1	361	1
New Mexico Consortium.....	402	1	124	-	124	-	124	-
New Mexico State University.....	198	1	-	-	-	-	-	-
Noble Foundation.....	-	-	130	-	130	-	130	-
North Carolina State University.....	276	1	535	2	535	2	535	2
North Dakota State University.....	174	1	-	-	-	-	-	-
Ohio State University.....	439	1	703	2	703	2	703	2
Oklahoma State University.....	-	-	116	-	116	-	116	-
Oregon State University.....	248	1	222	1	222	1	222	1
Pennsylvania State University.....	-	-	305	1	305	1	305	1
Purdue University.....	106	-	146	-	146	-	146	-
Qualisoy Inc.....	193	1	-	-	-	-	-	-

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Item	2017		2018		2019		2020	
	Actual	SY	Actual	SY	Estimate	SY	Budget	SY
Rutgers University .....	155	1	271	1	271	1	271	1
Saint Louis University .....	-	-	121	-	121	-	121	-
South Dakota State University .....	270	1	253	1	253	1	253	1
South Florida Water Management District .....	904	3	925	3	925	3	925	3
Texas A&M University (TAMU) .....	-	-	150	1	150	1	150	1
United Soybean Board .....	3,592	11	3,444	11	3,444	11	3,444	11
U.S. Highbush Blueberry Council.....	-	-	170	1	170	1	170	1
Utah State University.....	-	-	343	1	343	1	343	1
Vermont University .....	173	1	-	-	-	-	-	-
Virginia Institute of Marine Science .....	-	-	110	-	110	-	110	-
Washington, State of.....	-	-	163	1	163	1	163	1
Washington State University.....	250	1	249	1	249	1	249	1
Wisconsin, University of.....	236	1	-	-	-	-	-	-
Misc., Non-Federal Funds.....	2,974	9	2,363	7	2,363	7	2,363	7
Total, Non-Federal.....	27,015	89	24,263	76	24,263	76	24,263	76
Miscellaneous Contributed Funds.....	25,389	77	23,316	97	23,316	97	23,316	97
Total, ARS .....	1,485,469	6,483	1,402,114	6,142	1,655,175	6,166	1,506,132	6,226

**PERMANENT POSITIONS BY GRADE AND STAFF YEARS***Table ARS-6. Permanent Positions by Grade and Staff Years*

Item	2017 Actual			2018 Actual			2019 Estimate			2020 Budget		
	D.C.	Field	Total	D.C.	Field	Total	D.C.	Field	Total	D.C.	Field	Total
SES.....	12	17	29	12	17	29	12	17	29	12	17	29
GS-15.....	50	717	767	46	708	754	46	711	757	46	719	765
GS-14.....	59	488	547	52	465	517	52	467	519	53	472	525
GS-13.....	135	308	443	123	283	406	123	284	407	124	287	411
GS-12.....	133	292	425	134	267	401	134	268	402	135	271	406
GS-11.....	42	521	563	41	496	537	41	498	539	41	504	545
GS-10.....	1	1	2	1	1	2	1	1	2	1	1	2
GS-9.....	55	956	1,011	37	942	979	37	946	983	37	957	994
GS-8.....	14	295	309	12	274	286	12	275	287	12	278	290
GS-7.....	34	546	580	34	499	533	34	501	535	34	507	541
GS-6.....	13	175	188	9	136	145	9	137	146	9	139	148
GS-5.....	4	101	105	4	94	98	4	94	98	4	95	99
GS-4.....	5	30	35	4	17	21	4	17	21	4	17	21
GS-3.....	-	19	19	-	10	10	-	10	10	-	10	10
GS-2.....	-	6	6	-	4	4	-	4	4	-	4	4
GS-1.....	-	3	3	-	3	3	-	3	3	-	3	3
Other Graded.....	4	-	4	4	-	4	4	-	4	4	-	4
Ungraded.....	-	442	442	-	414	414	-	414	414	-	414	414
Total Permanent.....	561	4,917	5,478	513	4,630	5,143	513	4,647	5,160	516	4,695	5,211
Unfilled, EOY.....	81	68	149	75	83	158	73	78	151	70	72	142
Total Perm. FT EOY..	480	4,849	5,329	438	4,547	4,985	440	4,569	5,009	446	4,623	5,069
Staff Year Est.....	510	5,973	6,483	471	5,671	6,142	473	5,693	6,166	479	5,747	6,226

**VEHICLE FLEET****Motor Vehicle Fleet**

The 2020 Budget Estimates proposes no planned replacements of owned passenger motor vehicles. Passenger motor vehicles are defined as sedans and station wagons.

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. Vehicle 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.

The composition of the ARS fleet is primarily light duty trucks, which includes sport utility vehicles, vans, and pick-up trucks. These multi-purpose type vehicles enable research personnel to move equipment and transport personnel. Past practices have allowed ARS to decrease the number of passenger vehicles by relying on multi-purpose type vehicles. 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.

*Table ARS-7. Size, Composition, and Annual Costs of Motor Vehicle Fleet<sup>a</sup>*

Fiscal Year	Sedans and Station Wagons	Lt. Trucks, SUVs, and Vans (4x2)	Lt. Trucks, SUVs, and Vans (4x4)	Medium Duty Vehicles	Ambulances	Buses	Heavy Duty Vehicles	Total Vehicles	Annual Operating Costs
2017	215	1,121	932	733	-	2	168	3,171	\$4,556
Change	-10	-46	+10	-11	-	+1	-5	-61	+72
2018	205	1,075	942	722	-	3	163	3,110	4,628
Change	-12	+323	-376	-17	-	-	-3	-85	+25
2019	193	1,398	566	705	-	3	160	3,025	4,653
Change	-4	-	-	-	-	-	-	-4	+140
2020	189	1,398	566	705	-	3	160	3,021	4,793

<sup>a</sup> Vehicle count include those owned by agency and leased from commercial sources or GSA.

**SHARED FUNDING PROJECTS****Table ARS-8. Shared Funding Projects (dollars in thousands)**

Item	2017 Actual	2018 Actual	2019 Estimate	2020 Budget
<b>Working Capital Fund:</b>				
Administration:				
HR Enterprise System Management.....	\$130	\$129	\$136	\$146
Integrated Procurement Systems .....	1,609	1,752	1,827	1,842
Mail and Reproduction Services.....	1,190	952	822	741
Material Management Service Center .....	170	141	264	292
Procurement Operations Division.....	31	33	30	27
Subtotal .....	3,130	3,007	3,079	3,048
Communications:				
Creative Media & Broadcast Center.....	301	298	410	367
Finance and Management:				
Financial Shared Services.....	5,301	5,417	5,543	5,600
Internal Control Support Services .....	158	147	153	153
National Finance Center .....	2,165	2,285	2,123	2,224
Subtotal .....	7,624	7,849	7,819	7,977
Information Technology:				
Client Experience Center.....	3,640	3,583	4,946	4,808
Digital Infrastructure Services Center .....	1,189	1,122	1,257	1,257
Enterprise Network Services .....	1,507	1,836	5,556	5,771
Subtotal .....	6,336	6,541	11,759	11,836
Correspondence Management:				
Office of the Executive Secretariat .....	119	107	390	388
Total, Working Capital Fund.....	17,510	17,802	23,457	23,616
<b>Department-Wide Shared Cost Programs:</b>				
1890's USDA Initiatives .....	236	-	-	-
Advisory Committee Liaison Services .....	3	3	4	4
Agency Partnership Outreach.....	-	484	490	490
Classified National Security Information .....	41	-	-	-
Continuity of Operations Planning .....	130	-	-	-
Emergency Operations Center.....	149	-	-	-
Facility and Infrastructure Review and Assessment.....	29	-	-	-
Faith-Based Initiatives and Neighborhood Partnerships.....	26	-	-	-
Hispanic-Serving Institutions National Program .....	125	-	-	-
Honor Awards .....	-	1	4	4
Human Resources Self-Service Dashboard .....	37	38	37	41
Human Resources Transformation .....	106	57	-	-
Identity Access Management.....	427	-	-	-
Intertribal Technical Assistance Network.....	-	-	-	-
Medical Services .....	36	31	99	99
Office of Customer Experience .....	-	125	196	237
People's Garden .....	41	31	-	-
Personnel and Document Security.....	-	102	95	95
Personnel Security Branch.....	58	-	-	-
Security Detail.....	219	287	289	289
Security Operations .....	-	673	663	663
TARGET Center.....	93	85	72	72
USDA 1994 Program .....	51	-	-	-
USDA Enterprise Data Analytics Services.....	-	-	-	338
Virtual University.....	128	65	-	-
Total, Department-Wide Reimbursable Programs.....	1,935	1,982	1,949	2,332
<b>E-Gov:</b>				
Budget Formulation and Execution Line of Business.....	7	7	7	7
Disaster Assistance Improvement Plan.....	-	-	-	-
Enterprise Human Resources Integration .....	139	139	139	139
E-Rulemaking.....	-	-	-	-
E-Training .....	-	-	-	-
Financial Management Line of Business.....	5	5	5	5
Geospatial Line of Business .....	-	-	-	-
GovBenefits.gov.....	-	-	-	-

2020 USDA EXPLANATORY NOTES – AGRICULTURAL RESEARCH SERVICE

Item	2017 Actual	2018 Actual	2019 Estimate	2020 Budget
Grants.gov .....	-	-	-	-
Human Resources Line of Business .....	20	19	19	19
Integrated Acquisition Environment.....	190	194	209	-
Total, E-Gov.....	361	364	379	170
Agency Total.....	19,805	20,147	25,785	26,118

**ACCOUNT 1: SALARIES AND EXPENSES****APPROPRIATIONS LANGUAGE**

The appropriations language follows (new language underscored; deleted matter enclosed in brackets):

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, \$1,203,491,000 of which \$13,100,000, to remain available until expended, shall be used for transition and equipment purchases for the National Bio and Agro-Defense Facility located in Manhattan, Kansas: 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 \$500,000, except for headhouses or greenhouses which shall each be limited to \$1,500,000, except for 10 buildings to be constructed or improved at a cost not to exceed \$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 \$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.

**LEAD-OFF TABULAR STATEMENT*****Table ARS-9. Lead-Off Tabular Statement***

<b>Item</b>	<b>Amount</b>
2019 Annualized Continuing Resolution.....	\$1,244,766,000
Change in Appropriation .....	-41,275,000
Budget Estimate, 2020.....	<u>1,203,491,000</u>

**PROJECT STATEMENT****Table ARS-10. Project Statement (thousands of dollars, staff years (SY))**

Item	2017		2018		2019		Inc. or Dec.	Chg Key <sup>a</sup>	SY	2020	
	Actual	SY	Actual	SY	Estimate	SY				Budget	SY
Discretionary Appropriations:											
New Product Quality/Value											
Added.....	\$101,544	656	\$101,336	599	\$101,336	599	-\$5,991	(1)	-	\$95,345	599
Livestock Production .....	89,365	415	93,937	383	93,937	383	-3,278	(2)	-	90,659	383
Crop Production .....	225,876	1,229	241,479	1,138	241,479	1,138	-3,500	(3)	-	237,979	1,138
Food Safety .....	112,441	659	112,441	659	112,441	659	-3,027	(4)	-	109,414	659
Livestock Protection .....	94,305	434	95,113	408	95,113	408	+6,085	(5)	+18	101,198	426
Crop Protection .....	197,922	1,014	201,521	933	201,521	933	-14,676	(6)	-	186,845	933
Human Nutrition .....	87,380	235	87,980	235	87,980	235	-42,882	(7)	-16	45,098	219
Environmental Stewardship .....	217,467	1,218	219,024	1,125	219,024	1,125	-5,106	(8)	-	213,918	1,125
National Agricultural Library ...	23,791	92	25,791	92	25,791	92	-2,000	(9)	-	23,791	92
National Bio and Agro-Defense Facility (Operations and Maintenance/Transition Costs)											
Maintenance/Transition Costs)	-	-	4,000	-	46,000	24	+33,100	(10)	+58	79,100	82
Repair and Maintenance.....	20,144	-	20,144	-	20,144	-	-	(11)	-	20,144	-
Total Appropriation.....	1,170,235	5,952	1,202,766	5,572	1,244,766	5,596	-41,275		+60	1,203,491	5,656
Transfers In:											
Cong. Relations .....	90	-	60	-	-	-	-	-	-	-	-
DHS-NBAF .....	-	-	-	-	13,000	-	-13,000	-	-	-	-
Total.....	90	-	60	-	13,000	-	-13,000	-	-	-	-
Transfers Out:											
IT Modernization.....	-	-	-350	-	-	-	-	-	-	-	-
Subtotal.....	-	-	-350	-	-	-	-	-	-	-	-
Recoveries, Other (Net).....	16,023	-	14,648	-	-	-	-	-	-	-	-
Bal. Available, SOY.....	14,889	-	30,123	-	44,254	-	-44,254	-	-	-	-
Total Available .....	1,201,237	5,952	1,247,247	5,572	1,302,020	5,596	-98,529		60	1,203,491	5,656
Lapsing Balances .....	-742	-	-2,437	-	-	-	-	-	-	-	-
Bal. Available, EOY .....	-30,123	-	-44,254	-	-	-	-	-	-	-	-
Total Obligations .....	1,170,372	5,952	1,200,556	5,572	1,302,020	5,596	-98,529		+60	1,203,491	5,656
Staff Years:											
Direct.....		5,952		5,572		5,596			+60		5,656
Other.....		531		570		570			-		570
Total, Staff Year Estimate.....		6,483		6,142		6,166			+60		6,226

<sup>a</sup> The numbered justifications items are keyed to the Change Key (Chg Key) column on the Project Statement.

**JUSTIFICATION OF INCREASES AND DECREASES****Salaries and Expenses**

ARS is requesting \$1,203,491,000 in FY 2020 for its Salaries and Expenses account, a decrease of \$41,275,000 from the FY 2019 Continuing Resolution level. There is an increase of \$41,100,000 for the new National Bio and Agro-Defense Facility (NBAF) and related program improvements at the new facility (\$33.1 million for operations and maintenance/transition costs and \$8 million in research on Livestock Protection). NBAF, which replaces the outdated and inadequate Plum Island Animal Disease Center, will be a state-of-the-art biocontainment facility for the study of foreign, emerging, and zoonotic animal diseases that pose a threat to the U.S. animal agriculture and public health. Offsetting the increase is \$82,375,000 in decreases, for the elimination of ongoing extramural research projects and selected intramural research projects.

ARS provides research support to other USDA agencies that require new science information and technologies to deliver their results to the public. ARS also partners with and supports the science needs of external Federal agencies as well as State and local governments. In addition, ARS supports the science needs of a broad array of private sector customers -- producers, businesses, nongovernmental organizations, and trade organizations -- to enable them to further develop and/or apply improved technologies to advance U.S. and global food and agricultural systems. These partnerships are designed to augment research programs, expedite the transfer of research results to the

private sector, exchange information and knowledge, stimulate new business and economic development, enhance U.S. trade, preserve the environment, and improve the quality of life for all Americans.

### ***New Products/Product Quality/Value Added***

- (1) A decrease of \$5,991,000 (with no staff year change) for New Products/Product Quality/Value Added research (\$101,336,000 and 599 staff years available in 2019).

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

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

ARS' New Products/Product Quality/Value Added research program is carried out at numerous locations where agency scientists frequently collaborate with researchers from other Federal/State governments, academia, and private industry. Their research supports many of USDA's Strategic Goals, particularly: Promote American Agricultural Products and Exports; and Maximize the Ability of American Agricultural Producers to Prosper by Feeding and Clothing the World.

The funding change is requested for the following item:

- A) A decrease of \$5,991,000 from ongoing research projects to support higher priority research.

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 reset priorities within the existing portfolio of projects. As a result, some projects no longer qualify for continued support. The 2020 Budget has identified the following ongoing projects for elimination given that the majority of their research is carried out by other research institutions including universities and land grant institutions.

MD, Beltsville - Forest Products Research (-\$3,500,000)

MS, Oxford - Natural Products (-\$2,491,000)

### ***Livestock Production***

- (2) A decrease of \$3,278,000 (with no staff year change) for Livestock Production research (\$93,937,000 and 383 staff years available in 2019).

ARS' Livestock Production research program is directed toward fostering an abundant, safe, nutritionally wholesome, and competitively priced supply of animal products produced in a viable, competitive, and sustainable animal agriculture sector of the U.S. economy by: safeguarding and utilizing animal genetic resources, associated genetic and genomic databases, and bioinformatic tools; developing a basic understanding of food animal physiology to address priority issues related to animal production, animal well-being, and product quality and healthfulness; and developing information, best management practices, novel and innovative tools, and technologies that improve animal production systems, enhance human health, and ensure domestic food security. The research is heavily focused on the development and application of genomics technologies to increase the efficiency and product quality of beef, dairy, swine, poultry, aquaculture, and sheep systems. Areas of emphasis include increasing the efficiency of nutrient utilization, increasing animal well-being and reducing stress in production systems, increasing reproductive rates and breeding animal longevity, developing and evaluating non-traditional production systems (e.g., organic and natural), and evaluating and conserving animal genetic resources.

Continuing Livestock Production base funding is essential for ARS to carry out its research mission and responsibilities. Base funding supports ARS' program goal of providing scientific information and biotechnologies which will ensure an abundant supply of competitively priced animal and aquaculture products. This includes: developing genome analysis tools; identifying economically important genetic traits; preserving

agricultural animal genetic resources; improving the efficiency of nutrient utilization and conversion of feeds and forages to animal products; enhancing reproductive performance; and improving aquaculture production systems. In addition to the activities and functions specifically described in the budget request, current year and budget year base funds will be used to carry out activities and functions consistent with the full range of authorities and activities delegated to the agency.

ARS' Livestock Production research program is carried out at numerous locations where agency scientists frequently collaborate with researchers from other Federal/State governments, academia, and private industry. Their research supports many of USDA's Strategic Goals, particularly: Maximize the Ability of American Agricultural Producers to Prosper by Feeding and Clothing the World; Promote American Agricultural Products and Exports; and Improve Rural America's Infrastructure.

The funding change is requested for the following item:

A) decrease of \$3,278,000 from ongoing research projects to support higher priority research.

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 reset priorities within the existing portfolio of projects. As a result, some projects no longer qualify for continued support. The 2020 Budget has identified the following ongoing projects for elimination given that the majority of their research is carried out by other research institutions including universities and land grant institutions.

ID, Aberdeen - Aquaculture Systems - Rainbow Trout - University of ID (-\$322,000)

KY, Lexington - Improved Forage Livestock Production (-\$540,000)

MD, Beltsville - Bovine Genetics (-\$216,000)

WV, Leetown - Aquaculture Systems - Rainbow Trout - University of CT (-\$441,000)

WV, Leetown - Aquaculture Research - Coldwater Aquaculture (-\$1,759,000)

### ***Crop Production***

(3) A decrease of \$3,500,000 (with no staff year change) for Crop Production research (\$241,479,000 and 1,138 staff years available in 2019).

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

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

ARS' Crop Production research program is carried out at numerous locations where agency scientists frequently collaborate with researchers from other Federal/State governments, academia, and private industry. This research supports many of USDA's Strategic Goals, particularly: Maximize the Ability of American

Agricultural Producers to Prosper by Feeding and Clothing the World; Promote American Agricultural Products and Exports; and Improve Rural America's Infrastructure.

The funding change is requested for the following item:

A) A decrease of \$3,500,000 from ongoing research projects to support higher priority research.

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 reset priorities within the existing portfolio of projects. As a result, some projects no longer qualify for continued support. The 2020 Budget has identified the following ongoing projects for elimination given that the majority of their research is carried out by other research institutions including universities and land grant institutions.

HI, Hilo - Tropical Crops Research (-\$401,000)

IA, Ames - Bioinformatics Institute for Model Plants (-\$593,000)

IA, Ames - Michael Fields Agricultural Institute (-\$172,000)

MD, Beltsville - Cocoa, Coffee, and Alternative Crops Research (-\$494,000)

MD, Beltsville – Staffing and Operation for National Clonal Repositories (-\$52,000)

MD, Beltsville - Evaluation of Germplasm of Horticultural and Sugarcrops (-\$278,000)

MD, Beltsville - Information Transfer - Genetic Resources (-\$48,000)

MO, Columbia - Mid-West/Mid-South Irrigation (-\$52,000)

MS, Stoneville - Agricultural Genomics (-\$699,000)

MS, Stoneville - Kenaf & Medicinal Plants (-\$489,000)

OH, Wooster - Greenhouse and Hydroponics (-\$222,000)

***Food Safety***

(4) A decrease of \$3,027,000 (with no staff year change) for Food Safety research (\$112,441,000 and 659 staff years available in 2019).

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, Animal and Plant Health Inspection Service (APHIS), Food and Drug Administration, Centers for Disease Control and Prevention (CDC), Department of Homeland Security (DHS), and the Environmental Protection Agency (EPA). The agency also collaborates in international research programs to address and resolve global food safety issues. Specific research efforts are directed toward developing new technologies that assist ARS stakeholders and customers, including regulatory agencies, industry, and commodity and consumer organizations in detecting, identifying, and controlling foodborne diseases that affect human health.

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

ARS' Food Safety research program is carried out at numerous locations where agency scientists frequently collaborate with researchers from other Federal/State governments, academia, and private industry. Their research supports many of USDA's Strategic Goals, particularly: Provide All Americans Access to a Safe, Nutritious, and Secure Food Supply.

The funding change is requested for the following item:

A) A decrease of \$3,027,000 from ongoing research projects to support higher priority research.

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 reset priorities within the existing portfolio of projects. As a result, some projects no longer qualify for continued support. The 2020

Budget has identified the following ongoing projects for elimination given that the majority of their research is carried out by other research institutions including universities and land grant institutions.

AR, Booneville - Agroforestry (-\$111,000)

KY, Bowling Green - Waste Management (-\$243,000)

MS, Stoneville - Center for Food Safety & Postharvest Technology (-\$985,000)

PA, Wyndmoor - Food Safety Engineering (-\$1,688,000)

### ***Livestock Protection***

- (5) An increase of \$6,085,000 and 18 staff years for Livestock Protection research (\$95,113,000 and 408 staff years available in 2019).

ARS' Livestock Protection research program is directed at protecting and ensuring the safety of the Nation's agriculture and food supply through improved disease detection, prevention, control, and treatment. Basic and applied research approaches are used to solve animal health problems of high national priority. Emphasis is given to methods and procedures to control animal diseases through the discovery and development of diagnostics, vaccines, biotherapeutics, animal genomics applications, disease management systems, animal disease models, and farm biosecurity measures. The research program has the following strategic objectives: establish ARS laboratories into a fluid, highly effective research network to maximize use of core competencies and resources; use specialized high containment facilities to study zoonotic and emerging diseases; develop an integrated animal and microbial genomics research program; establish core competencies in bovine, swine, ovine, and avian immunology; launch a biotherapeutic discovery program providing alternatives to animal drugs; build a technology driven vaccine and diagnostic discovery research program; develop core competencies in field epidemiology and predictive biology; establish a best-in-class training center for our Nation's veterinarians and scientists; and develop a model technology transfer program to achieve the full impact of ARS research discoveries. The ARS animal research program includes the following core components: biodefense research, animal genomics and immunology, zoonotic diseases, respiratory diseases, reproductive and neonatal diseases, enteric diseases, parasitic diseases, and transmissible spongiform encephalopathies.

Continuing Livestock Protection base funding is essential for ARS to carry out its research mission and responsibilities. Base funding supports ARS' program goal of preventing and controlling pests and animal diseases that pose a threat to agriculture, public health, and the well-being of Americans. This includes: identifying genes involved in animals with disease-resistant phenotypes; improving our understanding of microbial pathogenesis, transmission, and immune responses to develop countermeasures to prevent and control animal diseases; analyzing microbial genomes to better understand host-pathogen interactions; developing new vaccines to prevent disease in aquaculture species; developing new methods to minimize tick bites; identifying measures to restrict the cattle fever tick; developing methods to control stable flies, horn flies, and house flies and their impact on livestock; supporting the screwworm eradication program; and developing control methods for U.S. vectors of Rift Valley fever. In addition to the activities and functions specifically described in the budget request, current year and budget year base funds will be used to carry out activities and functions consistent with the full range of authorities and activities delegated to the agency.

ARS' Livestock Protection research program is carried out at numerous locations where agency scientists frequently collaborate with researchers from other Federal/State governments, academia, and private industry. Their research supports many of USDA's Strategic Goals, particularly: Provide All Americans Access to a Safe, Nutritious, and Secure Food Supply; and Maximize the Ability of American Agricultural Producers to Prosper by Feeding and Clothing the World.

The funding change is requested for the following items:

- A) An increase of \$5,000,000 and 15 staff years for Research Program Improvements at the National Bio and Agro-Defense Facility (NBAF).

#### *Need for Change*

The Plum Island Animal Disease Center's (PIADC) research operations will be transferred once construction of the National Bio and Agro-Defense Facility (NBAF) in Manhattan, Kansas has been completed. With the transfer, improvements will be made to ARS' research program. Prior to the PIADC--Manhattan transfer, and completion of NBAF, new scientists and support personnel will be hired and trained at PIADC, Manhattan, and other ARS research laboratories.

ARS' biodefense research program is critical to protecting U.S. agriculture and the public from foreign and emerging zoonotic diseases. NBAF will provide an enhanced national capability for exotic, infectious, vector-borne and zoonotic disease research.

*Means to Achieve Change*

- Research program improvements (\$5,000,000). ARS will:
  - Develop veterinary medical countermeasures to control and eliminate zoonotic infectious agents in reservoir animal species that have a role in disease transmission.
  - Develop experimental animal disease models to evaluate the efficacy and safety of veterinary medical countermeasures.
  - Determine mechanisms of protective immunity that can be modulated to prevent disease transmission against highly infectious foreign animal disease agents of swine.
  - Determine the genetic and physiological factors necessary for the vector competence of priority arthropod-borne foreign animal diseases, including the mechanisms that enable their adaptation to vector and animal hosts.

Note: The “Outcomes,” “Strategic Goals,” and “Collaborators” for this proposed increase are detailed in the NBAF proposed increase, under #10.

B) An increase of \$3,000,000 and 3 staff years for the Initialization of the Biological Development Module (BDM).

*Need for Change*

NBAF will provide larger and more technologically sophisticated facilities including the first biosafety level-4 biocontainment facility for large livestock in the United States for the study of foreign, emerging, and zoonotic animal diseases that pose a threat to U.S. animal agriculture and public health. This capacity will enable USDA to conduct research and diagnostics, and develop countermeasures for high consequence zoonotic livestock diseases. Current facilities at the PIADC do not have the dedicated specialized space needed to support the early development of veterinary medical countermeasures. There is, therefore, a critical need for a BDM to support the early development of veterinary medical countermeasures to enable their successful transfer to the pharmaceutical industry for development, registration, stockpiling, and distribution.

*Means to Achieve Change*

- Initialization of the BDM (\$3,000,000). ARS will:
  - Initiate capacity building for bioassay development at the BDM.
  - Develop bioassays such as ELISA assays, Hemagglutinin (HA) tests, Hemagglutinin Inhibition (HAI) tests, and TCID50 assays to support the development of veterinary medical countermeasures.
  - Develop diagnostic reagents to support the development of compatible diagnostic tests to differentiate infected from vaccinated animals.
  - Develop and validate viral potency assays and other release assays for final product release.

Note: The “Outcomes,” “Strategic Goals,” and “Collaborators” for this proposed increase are detailed in the NBAF proposed increase, under #10.

C) A decrease of \$1,915,000 from ongoing research projects to support higher priority research.

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 reset priorities within the existing portfolio of projects. As a result, some projects no longer qualify for continued support. The 2020 Budget has identified the following ongoing projects for elimination given that the majority of their research is carried out by other research institutions including universities and land grant institutions.

MD, Beltsville - Microbial Ecology of Antimicrobial Resistance (-\$500,000)

MD, Beltsville - Emerging Animal Diseases that Exist Offshore (-\$199,000)

MD, Beltsville - Develop Alternatives to Antibiotics for Priority Diseases in Animal Agriculture (-\$500,000)

MS, Stoneville - Red Imported Fire Ants - MS State University (-\$215,000)

MS, Stoneville - Red Imported Fire Ants - University of MS (-\$501,000)

***Crop Protection***

- (6) A decrease of \$14,676,000 (with no staff year change) for Crop Protection research (\$201,521,000 and 933 staff years available in 2019).

ARS' Crop Protection research program is directed to protect crops from insect and disease loss through research to understand pest and disease transmission mechanisms, and to identify and apply new technologies that increase our understanding of virulence factors and host defense mechanisms. The program's research priorities include: identification of genes that convey virulence traits in pathogens and pests; factors that modulate infectivity, gene functions, and mechanisms; genetic profiles that provide specified levels of disease and insect resistance under field conditions; and mechanisms that reduce the spread of pests and infectious diseases. ARS is developing new knowledge and integrated pest management approaches to control pest and disease outbreaks as they occur. Its research will improve the knowledge and understanding of the ecology, physiology, epidemiology, and molecular biology of emerging diseases and pests. This knowledge will be incorporated into pest risk assessments and management strategies to minimize chemical inputs and increase production. Strategies and approaches will be available to producers to control emerging crop diseases and pest outbreaks and to address quarantine issues.

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

ARS' Crop Protection research program is carried out at numerous locations where agency scientists frequently collaborate with researchers from other Federal/State governments, academia, and private industry. Their research supports many of USDA's Strategic Goals, particularly: Provide All Americans Access to a Safe, Nutritious, and Secure Food Supply; and Maximize the Ability of American Agricultural Producers to Prosper by Feeding and Clothing the World.

The funding change is requested for the following item:

- A) A decrease of \$14,676,000 from ongoing research projects to support higher priority research.

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 reset priorities within the existing portfolio of projects. As a result, some projects no longer qualify for continued support. The 2020 Budget has identified the following ongoing projects for elimination given that the majority of their research is carried out by other research institutions including universities and land grant institutions.

FL, Gainesville - Biological Control and Ag Research (-\$48,000)  
 HI, Hilo - U.S. Pacific Basin Ag Research - University of HI (Hilo) (-\$158,000)  
 HI, Hilo - U.S. Pacific Basin Ag Research - University of HI (Manoa) (-\$158,000)  
 HI, Hilo - Fruit Fly Eradication (-\$151,000)  
 HI, Hilo - Minor Crop Pest Control (-\$186,000)  
 HI, Hilo - Papaya Ringspot (-\$196,000)  
 IN, West Lafayette - Oat Virus (-\$65,000)  
 MD, Beltsville - Potato Research (-\$1,342,000)  
 MD, Beltsville - Floriculture and Nursery Research Initiative (-\$2,681,000)  
 MD, Beltsville - Small Fruit and Nursery Research (-\$1,071,000)  
 MD, Beltsville - National Plant Diseases Recovery System (-\$1,384,000)  
 MD, Beltsville - Minor Use Pesticides Umbrella Project (-\$336,000)  
 MD, Beltsville - Area-Wide Management of Agricultural Pests (-\$5,246,000)  
 MD, Beltsville - Fusarium Head Blight of Wheat and Barley (-\$816,000)  
 MD, Beltsville - Wheat Stripe Rust Initiative (-\$200,000)  
 MS, Stoneville - Cropping Systems Research (-\$120,000)  
 MS, Stoneville - Cotton Genomics & Breeding (-\$272,000)  
 NY, Ithaca - Pear Thrips (Knapweed) (-\$39,000)  
 NY, Ithaca - Golden Nematode (-\$207,000)

**Human Nutrition**

- (7) A decrease of \$42,882,000 and 16 staff years for Human Nutrition research (\$87,980,000 and 235 staff years available in 2019).

Maintenance of health throughout the lifespan along with prevention of obesity and chronic diseases via food-based recommendations are the major emphases of ARS' Human Nutrition research program. These health-related goals are based on the knowledge that deficiency diseases are no longer primary public health concerns in the U.S. Excessive consumption has become the primary nutrition problem in the American population. This is reflected by increased emphasis on prevention of obesity from basic science through intervention studies to assessments of large populations. The agency's research program also actively studies bioactive components of foods that have no known requirements but have health-promoting qualities. Four specific areas of research are emphasized: nutrition monitoring; the scientific basis for dietary recommendations; prevention of obesity and related diseases; and life stage nutrition and metabolism, in order to better define the role of nutrition in pregnancy and growth of children, and for healthier aging.

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

ARS' Human Nutrition research program is carried out at numerous locations where agency scientists frequently collaborate with researchers from other Federal/State governments, academia, and private industry. Their research supports many of USDA's Strategic Goals, particularly: Provide All Americans Access to a Safe, Nutritious, and Secure Food Supply.

The funding change is requested for the following item:

- A) A decrease of \$42,882,000 from ongoing research projects to support higher priority research.

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 reset priorities within the existing portfolio of projects. As a result, some projects no longer qualify for continued support. The 2020 Budget has identified the following ongoing projects for elimination given that the majority of their research is carried out by other research institutions including universities and land grant institutions.

AR, Little Rock - Impact of Early Dietary Factors on Child Development and Health (-\$8,574,000)  
 MD, Beltsville - Healthy Eating and Lifestyle for Total Health (HEALTH) (-\$3,626,000)  
 MA, Boston - Immunity, Inflammation, and Nutrition in Aging (-\$1,791,000)  
 MA, Boston - Sarcopenia, Nutrition, and Physical Activity (-\$1,190,000)  
 MA, Boston - Nutrients, Aging, and Musculoskeletal Function (-\$1,791,000)  
 MA, Boston - One Carbon Nutrients and Metabolism (-\$529,000)  
 MA, Boston - Plant Components and Aging (-\$1,251,000)  
 MA, Boston - Cardiovascular Nutrition and Health (-\$1,253,000)  
 MA, Boston - Vision, Aging, and Nutrition (-\$907,000)  
 MA, Boston - Cancer Prevention via Diet (-\$1,374,000)  
 MA, Boston - Rural Aging Study (-\$186,000)  
 MA, Boston - Nutritional Epidemiology (-\$704,000)  
 MA, Boston - Energy Regulation and Obesity (-\$2,098,000)  
 MA, Boston - Genomics, Nutrition, and Health (-\$1,235,000)  
 MA, Boston - Nutrition, Brain, and Aging (-\$1,783,000)  
 TX, Houston - Nutritional Metabolism in Mothers, Infants, and Children (-\$2,902,000)  
 TX, Houston - Pediatric Clinical Nutrition (-\$2,417,000)  
 TX, Houston - Childhood Obesity Prevention (-\$3,305,000)  
 TX, Houston - Developmental Determinants of Obesity in Infants and Children (-\$3,229,000)  
 TX, Houston - Molecular, Cellular, and Regulatory Aspects of Nutrition during Development (-\$2,737,000)

***Environmental Stewardship***

- (8) A decrease of \$5,106,000 (with no staff year change) for Environmental Stewardship research (\$219,024,000 and 1,125 staff years available in 2019).

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

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

ARS' Environmental Stewardship research program is carried out at numerous locations where agency scientists frequently collaborate with researchers from other Federal/State governments, academia, and private industry. Their research supports many of USDA's Strategic Goals, particularly: Strengthen the Stewardship of Private Lands through Technology and Research; and Ensure Productive and Sustainable Use of Our National Forest System Lands.

The funding change is requested for the following item:

- A) A decrease of \$5,106,000 from ongoing research projects to support higher priority research.

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 reset priorities within the existing portfolio of projects. As a result, some projects no longer qualify for continued support. The 2020 Budget has identified the following ongoing projects for elimination given that the majority of their research is carried out by other research institutions including universities and land grant institutions.

AR, Booneville - Agroforestry (-\$1,000,000)  
 KY, Lexington - Improved Forage Livestock Production (-\$360,000)  
 KY, Bowling Green - Waste Management (-\$472,000)  
 MD, Beltsville - Global Change Research (-\$125,000)  
 MD, Beltsville - Combined Water Quality Research (-\$96,000)  
 MD, Beltsville - Air Quality Associated with Agricultural Operations (-\$628,000)  
 MS, Oxford - Acoustics (-\$784,000)  
 MO, Columbia - Mid-West/Mid-South Irrigation (-\$120,000)  
 TX, Bushland - Ogallala Aquifer - KS State University (-\$601,000)  
 TX, Bushland - Ogallala Aquifer - TX A&M University (-\$538,000)  
 TX, Bushland - Ogallala Aquifer - TX Tech University (-\$269,000)

TX, Bushland - Ogallala Aquifer - West TX A&M University (-\$113,000)

### ***Library and Information Services***

- (9) A decrease of \$2,000,000 (with no staff year change) for Library and Information Services (\$25,791,000 and 92 staff years available in 2019).

The National Agricultural Library (NAL) is the largest and most accessible agricultural research library in the world. It provides services directly to the staff of USDA and to the public, primarily via its web site, <http://www.nal.usda.gov>. NAL was created with the USDA in 1862, and was named a national library in 1962 by Congress as the “primary agricultural information resource of the United States”. NAL is the premier library for collecting, managing, and disseminating agricultural knowledge. The Library is the repository of our 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 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.”

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

The funding change is requested for the following item:

- A) A decrease of \$2,000,000 from ongoing projects and to help finance and support the Administration’s budget priorities.

The goal of ARS is to make the most efficient use of taxpayer dollars within available resources. The 2020 Budget has identified the following lower priority project for elimination:

MD, Beltsville - Ag Law Partnership (-\$2,000,000)

### ***New National Bio and Agro-Defense Facility***

- (10) An increase of \$33,100,000 and 58 staff years for the National Bio and Agro-Defense Facility (\$46,000,000 and 24 staff years available in 2019).

The funding change is requested for the following item:

- A) An increase of \$33,100,000 for NBAF’s Operations/Maintenance, One-Time Program Transition Costs, and Equipment Purchases.

#### ***Need for Change***

The facilities at PIADC are at the end of their life cycle and require substantial investment to maintain safe operations. ARS is unable to expand the existing research program at PIADC to address problems of high national priority. The current facilities have limited BSL3-Ag animal rooms, resulting in a backlog of experiments hampering the development of effective countermeasures to foreign animal diseases. Additionally, at PIADC, there are no BSL-4 facilities which greatly limits ARS’ ability to address emergent zoonotic diseases. To address these issues, the Department of Homeland Security (DHS) and its Federal partners (ARS and APHIS) have designed and begun to build NBAF. The transfer of PIADC operations NBAF will enable program expansion into zoonotic and arthropod-borne emerging diseases. It is anticipated that NBAF will be operational by December 2022.

APHIS, in its 2020 Budget, is requesting \$7,200,000 (\$3,000,000 for equipment; \$3,000,000 to address partnership/innovation activities; and \$1,200,000 for recurring program costs). ARS and APHIS will require additional funding before the facility becomes fully operational. All costs are closely associated with and largely dependent on the DHS timeline for construction, commissioning, and select agent registration.

*Means to Achieve Change*

- Operations and maintenance (\$20,000,000). NBAF’s research and laboratory equipment, machinery, building infrastructure, and supporting utilities will be maintained and inspected.
- One-time costs for program transition and equipment purchases (\$13,100,000). From PIADC, ARS will transition its research program to NBAF as well as purchase new research equipment to replace equipment confined to high containment laboratories at PIADC that cannot be decontaminated and transferred to NBAF.

*Outcomes*

As a result of this initiative, ARS will provide:

- New solutions to prevent economic losses from foreign animal diseases in agricultural and wildlife species.
- Effective countermeasures to prevent and eliminate the threat of zoonotic diseases in agricultural and wildlife species.
- 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.
- Experimental animal disease models that will serve the veterinary and public health research communities to significantly shorten the timelines for developing breakthrough medicines and disease prevention tools.

*Strategic Goals*

This facility/research supports many USDA’s Strategic Goals, particularly: Provide All Americans Access to a Safe, Nutritious, and Secure Food Supply.

*Collaborators*

Kansas State University  
 Iowa State University  
 Mississippi State University  
 University of Connecticut  
 Animal and Plant Health Inspection Service  
 Department of Homeland Security  
 Animal Health Institute  
 Global Foot-and-Mouth Research Alliance  
 Global African Swine Fever Research Alliance  
 STAR-IDAZ (International Collaboration on Research on Animal and Emerging Zoonotic Diseases)  
 PROCINORTE  
 CaribVET  
 United States Animal Health Association  
 American Association of Veterinary Medical Colleges  
 American Veterinary Medical Association

***Repair and Maintenance***

(11) No change in Repairs and Maintenance of ARS’ Laboratories and Facilities (\$20,144,000 available in 2019).

ARS’ Repair and Maintenance (R&M) program is intended to improve existing facilities, that is, primarily for the protection of life and property, and implementation of mandated regulations including energy conservation, compliance with building codes, and more effective space utilization. Examples of R&M expenditures include: HVAC/electrical/plumbing component repair and maintenance; roof replacement; site utility system replacement/maintenance/repair; fire protection installation/repair; road paving; correction of site damage; etc. There is currently a backlog of R&M needs. The funding level can only address ARS’ highest priorities.

**GEOGRAPHIC BREAKDOWN OF OBLIGATIONS AND STAFF YEARS****Table ARS-11. Geographic Breakdown of Obligations and Staff Years (thousands of dollars, staff years (SY))**

State/Territory/Country	2017 Actual	SY	2018 Actual	SY	2019 Estimate	SY	2020 Budget	SY
<b>ALABAMA</b>								
Auburn .....	\$6,394	41	\$6,325	38	\$6,442	38	\$6,442	38
Total .....	6,394	41	6,325	38	6,442	38	6,442	38
<b>ARIZONA</b>								
Maricopa .....	9,691	65	9,993	66	9,914	66	9,914	66
Tucson .....	6,951	51	6,463	49	6,420	49	6,420	49
Total .....	16,642	116	16,456	115	16,334	115	16,334	115
<b>ARKANSAS</b>								
Booneville .....	3,888	20	3,977	20	3,929	20	2,929	20
Fayetteville.....	2,015	10	2,074	10	1,862	10	1,862	10
Jonesboro .....	1,306	7	1,297	8	1,424	8	1,424	8
Little Rock .....	7,395	-	7,564	-	7,939	-	-	-
Stuttgart.....	7,656	62	7,730	60	7,888	60	7,888	60
Total .....	22,260	99	22,642	98	23,042	98	14,103	98
<b>CALIFORNIA</b>								
Albany.....	40,240	206	39,671	193	38,433	193	38,433	193
Davis .....	13,695	90	13,558	79	11,673	79	11,673	79
Parlier.....	11,046	86	12,239	85	12,219	85	12,219	85
Riverside .....	5,188	33	5,183	31	5,164	31	5,164	31
Salinas.....	7,203	42	6,212	42	8,352	42	8,352	42
Total .....	77,372	457	76,863	430	75,841	430	75,841	430
<b>COLORADO</b>								
Akron .....	1,779	17	1,878	14	1,981	14	1,981	14
Fort Collins .....	18,147	140	18,997	138	19,581	138	19,581	138
Total .....	19,926	157	20,875	152	21,562	152	21,562	152
<b>DELAWARE</b>								
Newark.....	2,075	15	1,967	15	2,000	15	2,000	15
Total .....	2,075	15	1,967	15	2,000	15	2,000	15
<b>DISTRICT OF COLUMBIA</b>								
National Arboretum .....	10,303	56	12,245	55	13,783	55	13,783	55
Headquarters								
Federal Administration.....	123,476	510	124,881	488	87,513	488	66,445	484
Total .....	133,779	566	137,126	543	101,297	543	80,228	539
<b>FLORIDA</b>								
Canal Point.....	2,908	27	2,764	26	2,936	26	2,936	26
Fort Lauderdale.....	2,391	30	2,374	33	2,446	33	2,446	33
Fort Pierce .....	14,166	120	15,532	109	13,823	109	13,823	109
Gainesville .....	11,424	92	11,812	82	12,025	82	11,981	82
Miami .....	4,431	30	5,524	27	5,928	27	5,928	27
Total .....	35,320	299	38,006	277	37,157	277	37,113	277
<b>GEORGIA</b>								
Athens .....	29,020	145	27,265	140	29,173	140	29,173	140
Byron .....	3,695	33	3,540	30	3,559	30	3,559	30
Dawson .....	3,380	26	3,275	25	3,714	25	3,714	25
Griffin .....	2,283	16	2,259	15	2,410	15	2,410	15
Tifton.....	10,655	83	10,256	78	10,161	78	10,161	78
Total .....	49,033	303	46,595	288	49,017	288	49,017	288
<b>HAWAII</b>								
Hilo .....	10,220	60	9,603	55	9,360	55	8,233	55
Total .....	10,220	60	9,603	55	9,360	55	8,233	55
<b>IDAHO</b>								
Aberdeen.....	6,141	44	7,020	41	6,941	41	6,652	41
Boise .....	3,681	20	2,953	25	2,878	25	2,878	25
Dubois .....	1,923	14	2,115	11	2,141	11	2,141	11
Kimberly .....	4,427	35	5,289	34	4,270	34	4,270	34
Total .....	16,172	113	17,377	111	16,230	111	15,941	111
<b>ILLINOIS</b>								
Peoria .....	31,488	206	31,288	186	32,757	186	32,757	186
Urbana.....	5,556	37	5,513	31	5,562	31	5,562	31

State/Territory/Country	2017 Actual	SY	2018 Actual	SY	2019 Estimate	SY	2020 Budget	SY
Total .....	37,044	243	36,801	217	38,319	217	38,319	217
<b>INDIANA</b>								
West Lafayette .....	7,280	52	8,094	51	7,537	51	7,479	51
Total .....	7,280	52	8,094	51	7,537	51	7,479	51
<b>IOWA</b>								
Ames .....	53,433	354	55,486	339	54,358	339	53,669	339
Total .....	53,433	354	55,486	339	54,358	339	53,669	339
<b>KANSAS</b>								
Manhattan .....	15,704	84	16,980	81	58,032	105	95,022	181
Total .....	15,704	84	16,980	81	58,032	105	95,022	181
<b>KENTUCKY</b>								
Bowling Green .....	2,792	15	2,660	15	2,621	15	1,978	15
Lexington .....	2,596	12	2,520	11	2,705	11	1,895	11
Total .....	5,388	27	5,180	26	5,326	26	3,873	26
<b>LOUISIANA</b>								
Baton Rouge.....	2,525	20	2,615	19	3,087	19	3,087	19
Houma.....	4,078	45	4,179	44	3,957	44	3,957	44
New Orleans.....	20,171	127	21,228	114	20,781	114	20,781	114
Total .....	26,774	192	28,022	177	27,825	177	27,825	177
<b>MAINE</b>								
Orono .....	2,552	17	2,438	17	2,260	17	2,260	17
Total .....	2,552	17	2,438	17	2,260	17	2,260	17
<b>MARYLAND</b>								
Beltsville .....	119,963	617	121,213	579	119,354	579	119,160	579
National Ag Library .....	25,409	81	25,813	77	24,997	77	23,197	77
Frederick .....	6,087	33	5,467	28	6,096	28	6,096	28
Total .....	151,459	731	152,493	684	150,448	684	148,454	684
<b>MASSACHUSETTS</b>								
Boston .....	15,169	8	15,178	6	15,173	6	-	-
Total .....	15,169	8	15,178	6	15,173	6	-	-
<b>MICHIGAN</b>								
East Lansing.....	1,684	10	1,879	9	1,495	9	1,495	9
Total .....	1,684	10	1,879	9	1,495	9	1,495	9
<b>MINNESOTA</b>								
Morris.....	2,715	23	2,647	21	2,530	21	2,530	21
St. Paul.....	7,120	49	8,862	42	6,855	42	6,855	42
Total .....	9,835	72	11,509	63	9,385	63	9,385	63
<b>MISSISSIPPI</b>								
Mississippi State .....	10,336	63	13,404	60	14,202	60	14,202	60
Oxford.....	14,986	75	15,629	71	15,355	71	12,407	71
Poplarville.....	5,724	32	5,429	27	5,897	27	5,897	27
Stoneville .....	42,926	243	43,795	233	46,244	233	43,291	233
Total .....	73,972	413	78,257	391	81,698	391	75,797	391
<b>MISSOURI</b>								
Columbia.....	9,351	67	8,862	59	9,323	59	9,169	59
Total .....	9,351	67	8,862	59	9,323	59	9,169	59
<b>MONTANA</b>								
Miles City.....	3,475	22	3,644	22	3,755	22	3,755	22
Sidney .....	5,085	43	4,899	40	5,271	40	5,271	40
Total .....	8,560	65	8,543	62	9,026	62	9,026	62
<b>NEBRASKA</b>								
Clay Center .....	22,293	117	22,036	110	22,752	110	22,752	110
Lincoln .....	5,630	51	5,633	50	5,619	50	5,619	50
Total .....	27,923	168	27,669	160	28,370	160	28,370	160
<b>NEVADA</b>								
Reno .....	2,333	18	2,543	17	2,274	17	2,274	17
Total .....	2,333	18	2,543	17	2,274	17	2,274	17
<b>NEW MEXICO</b>								
Las Cruces.....	7,578	53	7,406	47	7,404	47	7,404	47
Total .....	7,578	53	7,406	47	7,404	47	7,404	47
<b>NEW YORK</b>								
Geneva .....	4,404	33	4,048	31	3,894	31	3,894	31

## 2020 USDA EXPLANATORY NOTES – AGRICULTURAL RESEARCH SERVICE

State/Territory/Country	2017 Actual	SY	2018 Actual	SY	2019 Estimate	SY	2020 Budget	SY
Greenport .....	3,979	20	4,978	17	4,130	17	4,130	17
Ithaca .....	13,784	56	17,953	51	12,849	51	12,628	51
Total .....	22,167	109	26,979	99	20,873	99	20,652	99
<b>NORTH CAROLINA</b>								
Raleigh .....	10,933	64	10,752	75	10,728	75	10,728	75
Total .....	10,933	64	10,752	75	10,728	75	10,728	75
<b>NORTH DAKOTA</b>								
Fargo .....	16,601	98	16,867	91	17,862	91	17,862	91
Grand Forks.....	9,257	46	9,517	41	9,273	41	9,273	41
Mandan .....	3,735	32	4,624	29	4,166	29	4,166	29
Total .....	29,593	176	31,008	161	31,302	161	31,302	161
<b>OHIO</b>								
Columbus .....	1,670	15	1,511	15	1,454	15	1,454	15
Wooster .....	6,135	43	7,338	41	6,786	41	6,586	41
Total .....	7,805	58	8,849	56	8,240	56	8,040	56
<b>OKLAHOMA</b>								
El Reno.....	6,864	52	8,415	53	6,876	53	6,876	53
Stillwater.....	5,046	28	4,548	28	3,709	28	3,709	28
Woodward.....	2,231	16	2,198	16	2,219	16	2,219	16
Total .....	14,141	96	15,161	97	12,803	97	12,803	97
<b>OREGON</b>								
Burns.....	3,183	21	3,914	18	4,407	18	4,407	18
Corvallis.....	13,847	90	15,409	88	12,792	88	12,792	88
Pendleton.....	2,025	18	1,957	15	1,900	15	1,900	15
Total .....	19,055	129	21,280	121	19,099	121	19,099	121
<b>PENNSYLVANIA</b>								
University Park .....	5,739	39	6,318	36	6,157	36	6,157	36
Wyndmoor .....	30,789	164	30,317	151	31,525	151	30,007	151
Total .....	36,528	203	36,635	187	37,682	187	36,163	187
<b>SOUTH CAROLINA</b>								
Charleston .....	4,669	39	5,287	36	5,039	36	5,039	36
Florence.....	3,846	27	3,849	27	3,919	27	3,919	27
Total .....	8,515	66	9,136	63	8,958	63	8,958	63
<b>SOUTH DAKOTA</b>								
Brookings.....	2,843	23	2,676	20	2,974	20	2,974	20
Total .....	2,843	23	2,676	20	2,974	20	2,974	20
<b>TEXAS</b>								
Bushland .....	6,355	39	6,721	39	6,447	39	5,079	39
College Station.....	14,849	78	13,054	72	13,125	72	13,125	72
Houston.....	13,717	6	13,891	6	13,704	6	-	-
Kerrville .....	6,056	37	6,610	34	7,118	34	7,118	34
Lubbock .....	9,352	80	10,262	77	9,840	77	9,840	77
Temple .....	4,565	31	4,533	32	4,660	32	4,660	32
Total .....	54,894	271	55,071	260	54,894	260	39,822	254
<b>UTAH</b>								
Logan .....	8,988	70	9,277	70	9,721	70	9,721	70
Total .....	8,988	70	9,277	70	9,721	70	9,721	70
<b>WASHINGTON</b>								
Pullman .....	20,959	127	22,275	121	20,801	121	20,801	121
Wapato .....	6,200	46	5,872	44	5,885	44	5,885	44
Wenatchee.....	2,032	19	2,415	20	2,485	20	2,485	20
Total .....	29,191	192	30,562	185	29,172	185	29,172	185
<b>WEST VIRGINIA</b>								
Kearneysville .....	7,076	53	8,290	53	7,082	53	7,082	53
Leetown.....	7,602	33	7,435	33	7,589	33	5,609	33
Total .....	14,678	86	15,725	86	14,671	86	12,691	86
<b>WISCONSIN</b>								
Madison.....	18,852	104	18,872	100	19,563	100	19,563	100
Total .....	18,852	104	18,872	100	19,563	100	19,563	100
<b>PUERTO RICO</b>								
Mayaguez.....	3,489	35	3,195	33	3,159	33	3,159	33
Total .....	3,489	35	3,195	33	3,159	33	3,159	33

2020 USDA EXPLANATORY NOTES – AGRICULTURAL RESEARCH SERVICE

State/Territory/Country	2017 Actual	SY	2018 Actual	SY	2019 Estimate	SY	2020 Budget	SY
<b>OTHER COUNTRIES</b>								
France, Montpellier .....	3,833	1	3,967	1	3,201	1	3,201	1
Total .....	3,833	1	3,967	1	3,201	1	3,201	1
<b>Extramural &amp; Funds</b>								
Administered from								
Headquarters-Held Funds.	19,491	-	20,099	-	128,302	-	68,664	-
Repair & Maintenance of								
Facilities .....	20,144	-	20,137	-	20,144	-	20,144	-
Obligations.....	1,170,372	6,483	1,200,556	6,142	1,302,020	6,166	1,203,491	6,226
Lapsing Balances .....	742	-	2,437	-	-	-	-	-
Bal. Available, EOY .....	30,123	-	44,254	-	-	-	-	-
Total, Available.....	1,201,237	6,483	1,247,247	6,142	1,302,020	6,166	1,203,491	6,226

**CLASSIFICATION BY OBJECTS***Table ARS-12 Classification by Objects (thousands of dollars)*

<b>Item No.</b>	<b>Item</b>	<b>2017 Actual</b>	<b>2018 Actual</b>	<b>2019 Estimate</b>	<b>2020 Budget</b>
	Personnel Compensation:				
	Washington D.C. ....	\$43,336	\$38,116	\$38,116	\$38,495
	Personnel Compensation, Field .....	446,177	437,133	437,133	441,479
11	Total personnel compensation .....	489,513	475,249	475,249	479,974
12	Personal benefits .....	172,950	168,526	168,875	170,553
13.0	Benefits for former personnel .....	393	349	-	-
	Total, personnel comp. and benefits .....	662,856	644,124	644,124	650,527
	Other Objects:				
21.0	Travel and transportation of persons.....	10,399	11,095	13,832	13,880
22.0	Transportation of things.....	577	428	533	535
23.1	Rental payments to GSA.....	4,760	4,834	4,891	4,984
23.2	Rental payments to others.....	530	857	1,068	1,072
23.3	Communications, utilities, and misc. charges .....	42,947	42,389	53,340	52,870
24.0	Printing and reproduction .....	394	485	605	607
25.1	Advisory and assistance services .....	1,321	1,082	1,349	1,354
25.2	Other services from non-Federal sources.....	23,615	24,049	29,979	30,082
25.3	Other goods and services from Federal sources.....	5,076	4,627	5,768	5,788
25.4	Operation and maintenance of facilities.....	43,035	52,618	65,593	65,819
25.5	Research and development contracts .....	211,541	244,211	269,320	163,624
25.6	Medical care .....	291	247	308	310
25.7	Operation and maintenance of equipment.....	18,902	15,584	19,427	19,494
25.8	Subsistence and support of persons .....	4	3	3	3
26.0	Supplies and materials .....	64,372	75,795	94,485	94,811
31.0	Equipment.....	55,042	48,148	60,022	60,229
32.0	Land and structures.....	7,499	7,964	9,928	9,963
41.0	Grants, subsidies, and contributions .....	17,211	22,016	27,445	27,539
	Total, Other Objects .....	507,516	556,432	657,897	552,964
99.9	Total, new obligations.....	1,170,372	1,200,556	1,302,020	1,203,491
	DHS Building Security Payments (included in 25.3).....	\$140	\$156	\$135	\$138
	Position Data:				
	Average Salary (dollars), ES Position.....	\$168,812	\$169,076	\$168,418	\$168,296
	Average Salary (dollars), GS Position .....	\$70,502	\$72,220	\$71,939	\$71,887
	Average Grade, GS Position .....	10.7	10.8	10.8	10.8

## **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. The research supports USDA's Strategic Goals. A brief summary of the agency's selected FY 2018 accomplishments and current activities, including the National Agricultural Library, are detailed below.

### ***Program Evaluations.***

In FY 2018, ARS conducted retrospective reviews of its Aquaculture; Crop Production; Veterinary, Medical, and Urban Entomology; and Sustainable Agricultural Systems Research 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, customer/stakeholder groups, and nonprofits. 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.

#### ***Selected Examples of Recent Progress:***

A treatment for peanut allergy. ARS researchers in New Orleans, Louisiana, collaborated in the characterization and development of the first peanut-based therapeutic oral immunotherapy (OIT) drug for the treatment of peanut allergy. The peanut OIT drug has been demonstrated to desensitize allergic individuals. The drug has passed Phase 3 clinical trials. Once it becomes available for public use it will be the first treatment available in the world for individuals with peanut allergy.

A new USDA standard protocol for determining wheat quality. "Falling number" (FN) is a procedure used by the USDA Agricultural Marketing Service (AMS) and industry to gauge the level of naturally occurring alpha-amylase in wheat, an enzyme responsible for grain starch break down. High levels of alpha-amylase activity lowers wheat starch concentration, giving low FN readings and resulting in lower quality, marketability, and price. This procedure is directly affected by barometric pressure and by elevation of the testing laboratory. Lower barometric pressure at elevations above 1,000 feet can lead to misleading FN values that when retested at sea level for marketable price determination can find previously high FN-graded wheat to have a critically low FN reading that results in a dramatic reduction in price. ARS scientists in Beltsville, Maryland, working at simulated elevations between 0 and 5,000 feet developed a correction equation model that allows all FN values, regardless of the barometric pressure, to be reported on a sea level basis. This correction equation was turned over to AMS for incorporation into a directive that guides Federal, State, and private laboratories on the FN procedure. This issue is important because overseas customers of U.S. wheat often have strict wheat FN requirements, thus making the procedure's accuracy a monetary concern to U.S. exporters, especially in the Pacific Northwest.

Fast and cheap detection of Zika virus in mosquitos. The accelerating global spread of arboviruses such as Zika virus highlights the need for more proactive mosquito surveillance. However, a major barrier to anticipating Zika virus outbreaks has been the lack of rapid and affordable tests for detection in mosquitoes. ARS researchers in Manhattan, Kansas, collaborated on research that showed for the first time use of near-infrared spectroscopy (NIRS) - a reagent free, instantaneous, low cost, and effective method—can be used to non-invasively detect Zika virus in whole, intact *Aedes aegypti* mosquitoes with a prediction accuracy of 99.3 percent. This relatively simple NIRS technology compares favorably to the current highly technological quantitative reverse transcription polymerase chain reaction (RT-qPCR) procedure. NIRS involves simply shining a beam of light on a whole mosquito for less than three seconds to collect a diagnostic spectrum. Given that NIRS is 18 times faster and 110 times cheaper than RT-qPCR, it is anticipated that use of NIRS will be expanded for identifying potential arbovirus hotspots and guiding the spatial prioritization of vector control of the Zika virus. A proposal based on these findings has been submitted to the Department of Defense by cooperators in Australia, Brazil, Kenya, Thailand, and the United States to develop a portable, handheld, cell phone-based technique for rapid surveillance of Zika, dengue, and malaria control programs.

Overcoming antibiotic resistance using a novel antibiotic. Beta-lactam antibiotics are a class of broad spectrum (i.e., effective against a large variety of organisms) antimicrobials that include penicillin derivatives and cephalosporins. The use of these important drugs has been limited over the years with the development of antibiotic resistant bacterial strains. Tunicamycin is a powerful antibiotic that can be combined with beta-lactam antibiotics to overcome this resistance to effectively kill harmful bacteria. Scientists have known about this antibiotic for decades, but toxicity in human and animal cells prevented it from being used for therapeutic application. Recently, ARS researchers in Peoria, Illinois, have chemically modified tunicamycin into less harmful derivatives. The modified tunicamycins did not show any toxicity to human and hamster cells but were still capable of increasing the efficacy of clinical penicillin-based drugs by 32 to 64 times. This significant discovery now allows older type antibiotics to once again be effective, and is an important step toward combating drug resistance. It is currently being evaluated by a U.S. drug company.

Repelling biting flies. Biting or blood sucking insects (i.e., flies, mosquitos, ticks, and bed bugs) can transmit various diseases that cause major health concerns and economic losses for both animals and humans worldwide. Currently, there are no effective pesticides available for use against either biting stable flies or biting face flies. ARS scientists in Peoria, Illinois, and Lincoln, Nebraska, identified and developed a new bio-based insect repellent formulation designed to meet the challenges posed by these insects. The researchers discovered that naturally derived fatty acids from coconut oil function as a very effective repellent with long-lasting effectiveness against multiple blood sucking insects. The all-natural aqueous formulation was effective in field trials conducted on cattle in North Platte, Nebraska. Biting flies in the United States currently cost the cattle industry more than \$2.4 billion annually. This new product is being tested by U.S. cattle farmers and ranchers as a sustainable, natural technology.

## **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.

### ***Selected Examples of Recent Progress:***

Lifetime merit indices for dairy cattle now include health traits. Genetic economic indices for dairy cattle are used to improve the efficiency of the U.S. dairy population by ranking animals based on their genetic merit for economically important traits. However, health traits had not been included because they were not available. ARS researchers in Beltsville, Maryland, collaborated with the Council on Dairy Cattle Breeding to develop genetic evaluations for disease resistance to the six most common and costly health events for U.S. dairy cattle and then added these traits to the lifetime merit indices. The economic impacts of direct expenses associated with health traits, such as clinical mastitis treatment, were given greater emphasis while traits previously correlated with health, such as somatic cell score, were given reduced emphasis. In August 2018, the Council on Dairy Cattle Breeding adopted and officially released the revised indices to the dairy industry. Breeders can now use the new indices to select for genetic traits to use in breeding new cow lines that are healthier and more profitable than cows with health conditions that require extra farm labor, veterinary treatment, and medicine.

Rumen microbiome community profiles are associated with feed efficiency. Feed costs are estimated to be 60 percent of the total cost of raising cattle. Improving feed efficiency and reducing subsequent levels of wastes such as manure will reduce feed inputs and their environmental impacts. In cattle, microbes in the rumen degrade forages into metabolites that can be used for growth, but more information is needed about how the rumen microbial composition affects feed efficiency. ARS researchers at Clay Center, Nebraska, and University of Nebraska collaborators characterized the rumen microbial communities (microbiomes) of each individual in two large animal cohorts (125 heifers and 122 steers) to identify specific bacterial members associated with feed efficiency traits in beef cattle. This innovative study showed that the species and abundance of the microbes present in the rumen account for 20 percent of the variation in feed efficiency. These data demonstrate that rumen microbial communities

have a significant effect on feed efficiency and will inform future strategies for altering these communities to improve feed efficiency in cattle.

Genetic resources for responsible lamb production. The efficiency of sheep production is significantly influenced by the number of lambs born per ewe. But sufficient feed resources, which may not always be available on western rangelands, are required to support lamb production. ARS researchers at Clay Center, Nebraska, evaluated reciprocal crosses between Romanov and Rambouillet breeds to identify genetic traits that could be used to increase lamb production and found that half blood Romanov crossbred ewes were equivalent in lamb production (two per year) regardless of whether they were descended from Romanov or Rambouillet males. However, ARS researchers in Dubois, Idaho, collaborated with Virginia Tech University scientists to test the limits of lamb production per ewe in the harsh conditions of the U.S. mountains. They determined that production levels of 2.2 lambs per ewe each year are optimal because ewes rearing triplets had higher lamb loss rates. These findings indicate that Romanov/Rambouillet crossbred ewes will be useful in increasing the number of lambs produced per ewe in the harsh U.S. production environments of the western mountains.

Demonstrating the impact of eliminating animal agriculture. Farmed animals provide essential nutrients in human diets, but also produce greenhouse gases and use food resources that could potentially be used by people. ARS scientists in Madison, Wisconsin, collaborated with Virginia Tech University scientists to evaluate the hypothetical impact of converting U.S. agriculture to a plant only system by completely eliminating livestock production. They found that removing livestock production resulted in the production of substantially more food; however, people consuming a plant only diet without supplementation would need to consume more calories than needed to meet dietary requirements for other nutrients. Even with this extra caloric intake, people consuming a plant only diet will have more nutrient deficiencies. While greenhouse gas emissions associated with U.S. agriculture were projected to decline 28 percent, agriculture only contributes 9 percent of greenhouse gas production to national levels, so total U.S. net greenhouse gas production would only be reduced 2.6 percent. The need to produce synthetic fertilizer to replace animal manures and other systemic changes also reduced the benefits of removing livestock from U.S. agricultural production. These findings show that changing a complex system may have some cost-effective results but may also generate unexpected impacts that reduce these benefits. Recommendations for changes in the U.S. agricultural system requires integrating studies from multiple disciplines to adequately evaluate potential impacts.

Genomic selection for growth and carcass yield in the Delta Select strain of channel catfish. Determining the relative value of an individual fish for breeding has depended on traditional methods that use parentage information and trait measurements. ARS scientists in Stoneville, Mississippi, collaborated with University of Georgia scientists to develop a technology that uses genome information to improve the accuracy of breeding value estimates. This approach led to 30 percent improvement in breeding value accuracy for growth and carcass yield in 2,000 Delta Select strain catfish. The improved breeding value accuracy will result in more rapid genetic gain for growth and carcass yield in the Delta Selects which will be released to U.S. catfish farmers to improve their production efficiency.

Gene editing in rainbow trout. Advancements in gene editing technologies have enabled the induction of targeted mutations in genes of interest, allowing for precise manipulation of the genome. ARS researchers at Leetown, West Virginia, have provided the first proof-of-concept for rainbow trout by demonstrating that this technology can produce fish that exhibit a desired trait and that these genetic modifications are transmitted to the next generation via typical reproduction. Gene editing provides a new opportunity to understand gene function and an alternative strategy that can complement other approaches to genetic improvement.

Use of woodchip bioreactors to improve water quality in fish farm effluents. As with all intensive agricultural systems, fish farms produce waste that has the potential to impact the surrounding environment. ARS extramural researchers in Shepherdstown, West Virginia, determined that woodchip bioreactors can capture nitrate nitrogen and suspended solids from aquaculture effluent streams to minimize nutrient discharge into surrounding waterways. A cost and engineering assessment demonstrated that the woodchip bioreactor is an affordable, low maintenance technology to treat aquaculture effluent, reduce environmental impacts, and reduce wastewater treatment costs.

## **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.

*Selected Examples of Recent Progress:*

Deciphering the genetics of fast cooking dry beans. Cooking time is an important consumer trait in dry bean; long cooking times discourage greater utilization of beans. ARS scientists in East Lansing, Michigan, previously discovered bean germplasm that significantly reduces cooking time, but the genetic control of the trait was unknown. The scientists developed a population from a cross between a slow cooking bean and a fast cooking bean. The cooking times for individuals in that population ranged from 21 - 135 minutes. The beans were grown in Tanzania under temperate and hot humid tropical climate for two field seasons. Scientists observed that beans grown in the hot humid zone took 15 minutes longer to cook than those grown in the temperate zone. They determined cooking time was strongly influenced by genetic factors that were controlled by interactions of four different regions of the genome. After tagging those four regions with DNA markers, the researchers identified several bean lines containing genes from all four regions which made them cook 16 minutes faster. The research demonstrated the potential value of integrating cooking time into breeding programs, and the value of using molecular markers to help select for fast cooking beans. Breeders are now using these lines and markers to develop fast cooking beans.

A high throughput automatic platform for root growth phenotyping. Drought threatens crop production in the United States and around the world. Drought tolerance is influenced by genetic, physiological, and environmental factors, including root traits, but more information is needed about the relationship between roots and drought tolerance in agronomic crops. ARS researchers in Columbia, Missouri, have developed a low cost robotic system to directly observe roots in soil and measure the growth rate response under both optimal and water deficit conditions. The robot, referred to as “RootBot,” was designed for use in a controlled environment and enables roots to develop normally in the dark and in soil. This technology has broad applications for use in multiple crops and with varying soil treatments, including water deficit stress. The platform facilitates the rapid assessment of root traits, which will support breeding efforts to improve drought tolerance in all major crops.

Novel hard white waxy winter wheat. Waxy wheats can be used for novel whole grain products and are a promising substrate for ethanol production. Hard red winter wheat and hard white winter wheat are both waxy wheats grown in the Great Plains region. White wheats do not contain the condensed tannins that confer the red grain color and have some potential advantages over red wheats, including wider application in non-pasta noodles and steamed wheat products, and the production of higher extraction flours. The lack of condensed tannins imparts a slightly sweeter, less bitter taste to whole grain products. In addition, white wheat products can be significantly brighter in color and have greater appeal to consumers than products made with red wheats. To fill potential demand for a hard white waxy wheat adapted to Great Plains production, ARS scientists in Lincoln, Nebraska, in cooperation with the University of Nebraska, developed and released “Matterhorn,” the first U.S. hard white waxy high yielding winter wheat.

New system for engineering novel traits into crop genomes. The genetic improvement of crops is one of the most effective ways to increase their productivity in agriculture. Until now, it has been difficult to genetically engineer improvements in complex traits like yield or disease resistance that require the action of multiple genes. An ARS scientist in Albany, California, developed a novel technology called Gene Assembly in Agrobacterium by Nucleic Acid Transfer using Recombinase Technology (GAENTRY), that enables the efficient assembly and introduction of multiple genes into plants. The system can interlink multiple genes in a simple, reliable, and highly effective process and then generate transformed plants that frequently produce all the introduced traits as desired. This technological breakthrough enables the use of crop biotechnology to effectively improve complex traits in a wide array of crop plants.

Successful cryopreservation of a honey bee embryo. ARS scientists from Fargo, North Dakota, collaborated with ARS bee breeders at Baton Rouge, Louisiana, to create the world’s first cryopreserved honey bee embryo. Honey bee sperm is currently stored by ARS’ National Animal Germplasm Program in Fort Collins, Colorado. Sperm preservation provides biodiversity, but embryo preservation enables breeders to access genetically identical lines of

bees. This is a major advancement in the ability to improve the biosecurity of honey bee germplasm and the accessibility of the nascent National Honey Bee Germplasm Repository.

Native pollinators support consistent high sunflower yields. Low or inconsistent yields are challenging for individual sunflower growers and the overall sunflower market. Pollinators are needed to ensure high yields especially when sunflower hybrids do not effectively self-pollinate because of crop genetics or environmental conditions during flowering. ARS scientists at Fargo, North Dakota, grew 15 confection sunflower hybrids over two years and documented contributions of bee pollination to crop yields. On average, bees accounted for 26 percent of yield and lines that attracted more bees obtained higher benefits from pollinators. Although honey bee colonies were located adjacent to the research plots, almost all bee visits to confection sunflowers were by solitary wild bees. These results document the contribution of wild bees to sunflower yield increases and their clear preference for certain hybrids. Growers are now using bee conservation as part of crop management, and breeders are now using pollinator attraction as a component of inbred and hybrid development.

Brown marmorated stink bug (BMSB) commercial pheromone lure development. BMSB is a highly invasive pest of agricultural and nursery crops and is a nuisance when it invades homes to overwinter. Based on the identification of the BMSB pheromone and pheromone synergist, ARS researchers at Kearneysville, West Virginia, and university collaborators around the country developed lures that are now commercially available from three commercial companies, AgBio, Trece and AlphaScents. The lures can be used with crop compatible trap designs to measure BMSB presence, relative abundance, and seasonal activity.

## **Food Safety**

### ***Current Activities:***

ARS' Food Safety research program is designed to yield science-based knowledge on the safe production, storage, processing, and handling of plant and animal products, and on the detection and control of pathogenic bacteria and fungi, parasites, chemical contaminants, and plant toxins. All of ARS' research activities involve a high degree of cooperation and collaboration with USDA's Research, Education, and Economics agencies, as well as with Food Safety and Inspection Service, Animal and Plant Health Inspection Service, Food and Drug Administration, Centers for Disease Control and Prevention, Department of Homeland Security, and the Environmental Protection Agency. 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.

### ***Selected Examples of Recent Progress:***

An effective method to dry and decontaminate wet whole almonds. California produces 80 percent of the world's almonds with a value of more than \$5.33 billion. Contamination of almonds with *Salmonella* has caused outbreaks of human illness, and several large and expensive recalls by the industry. Rain during the harvest season can result in the complete loss of an almond crop due to microbial contamination and lack of adequate drying. ARS scientists in Albany, California, developed an effective and energy saving new technology based on sequential infrared heat and hot air to simultaneously dry and decontaminate wet whole almonds. The findings from the new technology, which were provided to the almond industry, contributed to ARS receiving the 2018 Research and Development Award by the Institute of Food Technologists.

Improvements in radio frequency pasteurization of shell eggs. Raw shell eggs can be contaminated with *Salmonella*, causing illnesses and recalls. ARS developed and patented a radio frequency pasteurization (RFP) process/unit that produces safer eggs with exceptional quality in a small-scale prototype. Now ARS researchers in Wyndmoor, Pennsylvania, in collaboration with an industry partner, has assembled and successfully tested a larger scale RFP unit, thus paving the way for a commercial scale RFP unit. In addition, two breakthroughs were achieved that will facilitate commercialization. The first was the modification of RFP to operate at 40.68 MHz, which is an international frequency reserved for industrial, scientific, and medical purposes. The second modification of the RFP reduces the cost to use this technology. This will save between \$10,000 to \$100,000 per RFP unit. This technology can address a significant, widespread source of foodborne illness and make shell eggs safer.

Recognition of emerging food pathogens using the tools of artificial intelligence. Pathogen detection and data analysis are often limited to the types of samples present in a database. Problems often occur when new bacteria not present in the database are encountered. ARS in collaboration with the Center for Food Safety Engineering at Purdue University in West Lafayette, Indiana, explored the application of an artificial intelligence (AI) system to phenotypic characteristics of various foodborne pathogens. The aim was to determine the ability of the AI to identify

the number of present pathogenic classes, and to recognize new, unknown classes of foodborne pathogens that were not present in the databases. The research developed a functional prototype of an emerging pathogen detection system using AI methodology primarily based on the pattern recognition neural network created by data scientists at Google initially for the goal of classifying natural images. The technology integrates the cutting-edge machine learning tools with a unique optical phenotypic biosensing device developed in collaboration with Purdue University. The research demonstrated the tremendous potential of the AI technology in the areas of biosurveillance, biothreat detection, and agricultural biosafety. Additionally, it emphasized that leveraging the existing state-of-the-art informatics tools employed by the leading U.S. data management companies will lower the cost of adoption of the new AI technologies by food producers and regulatory agencies.

Raman sensing technology for chemical hazard detection. Detection of chemical contaminants during commercial food processing is critically important to rapidly authenticate food ingredients and determine potential adulteration. ARS scientists in Beltsville, Maryland, developed a line scan high-throughput Raman imaging method and apparatus for rapid, nondestructive detection of chemical contaminants in food materials. The system can directly and rapidly analyze a sample powder in just 10 minutes, compared with conventional instruments that might take hours to perform. The system has imaged a variety of food powders mixed with chemical additives. The results indicate that the system can provide quantitative measurement of chemical adulterants. This patented technology provides a practical industrial screening tool for determining chemical contamination and adulteration of food products.

Development of sensitive detection assays for abrin toxin. Abrin is a natural toxin found in the seeds of the jequirity pea. The toxin is similar to ricin, a poison found in the seeds of the castor oil plant. Abrin, like ricin, is considered a select agent toxin and a potential bioterror weapon. Researchers in Albany, California, developed new monoclonal antibodies against abrin and assembled sandwich enzyme linked immunosorbent assays (ELISA) (similar to a pregnancy test) capable of detecting a mixture of abrin isoforms. The ELISA can detect as little as one nanogram/milliliter of abrin in phosphate buffered saline, nonfat milk, and whole milk, an amount that is significantly below concentrations that would pose a health concern for consumers. Fortuitously, some of these antibodies can also neutralize abrin toxicity in cell-based assays so they may have vaccine potential. Easy, cost-effective, and more rapid methods of detection for abrin toxins are critically necessary during incidences of deliberate or suspected food contamination.

A box liner with a slow release sulfur dioxide pad enhances the killing of foodborne pathogens. California produces 99 percent of the commercial table grapes in the United States. Ensuring that they arrive safely and not contaminated at food stores for consumer purchase is a critical issue for the California Table Grape Commission and California agriculture. ARS researchers in Albany, California, at the request of the Commission, examined the survival of three common but important foodborne pathogens: *Listeria monocytogenes*, *Escherichia coli* O157:H7, and *Salmonella enterica* Thompson, inoculated on commercially packed table grapes under simulated refrigerated transit conditions. Results showed that a box liner in the shipping container enhances the bactericidal effect of a sulfur dioxide (SO<sub>2</sub>) pad in a pathogen dependent manner. The use of slow release SO<sub>2</sub> generating pad combined with box liner was found to be effective in killing *L. monocytogenes* and *S. enterica* Thompson, whereas the use of a SO<sub>2</sub> generating pad alone was more effective in killing *E. coli* O157:H7.

## **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.

*Selected Examples of Recent Progress:*

A subunit vaccine against *Streptococcus suis* in swine. The bacterium *Streptococcus suis* is an important and common cause of disease in pigs and costs the swine industry millions in losses annually. The World Organization for Animal Health ranks it as a high priority disease because improved vaccines could significantly reduce the need for antibiotic administration.

ARS researchers at Ames, Iowa, and University of Cambridge collaborators identified five candidate proteins of *S. suis* which were formulated into a vaccine with different adjuvants to help stimulate an immune response. The vaccine effectively prevented disease caused by *S. suis*, and antiserum from the vaccinated pigs was reactive against whole *S. suis* bacteria of differing serotypes, indicating a potential for cross protection. An animal health company is now developing these proteins into a vaccine that can be used by swine producers to protect against this devastating and costly swine disease. This technology may markedly improve the health and welfare of pigs, reduce pork production costs, and reduce the use of antibiotics in pigs by reducing the occurrence of diseases caused by an important bacterial pathogen.

Susceptibility of white-tailed deer to Rift Valley fever virus. Rift Valley fever virus (RVFV) is a zoonotic disease spread by mosquitos that will pose major health threats to livestock and humans if introduced into the United States. Domestic cattle, sheep, and goats are susceptible to RVFV, and infected animals can serve to amplify the disease in their bodies and enable disease spread by mosquitoes during epidemics. The potential role of wildlife species such as white-tailed deer in epidemics is unknown, but since white-tailed deer are abundant throughout the United States, there is concern they could also serve to amplify RVFV and become a reservoir and source of infection for livestock and humans. ARS scientists in Manhattan, Kansas, and Kansas State University scientists confirmed these deer are susceptible to RVFV and found infected deer developed hemorrhagic enteritis and bloody diarrhea that resulted in RVFV transmission to control animals. The results of this investigation provide evidence that white-tailed deer could potentially play a major epidemiologic role in disease transmission if a RVFV outbreak occurs in the United States.

Using gene editing as a tool to engineer an African swine fever vaccine. African swine fever (ASF) is a deadly disease that causes near 100 percent mortality in swine, and ASF outbreaks result in trade restrictions and significant economic losses globally. Since the introduction of ASF into the Republic of Georgia in 2007, 16 countries have reported new ASF outbreaks, including Belgium and China in 2018, and the risk for the introduction of ASF to the United States has never been higher. Currently, there is no commercially available vaccine to prevent this devastating disease, and despite more than 50 years of research, there are no efficient molecular tools available to help develop a safe and effective live recombinant ASF vaccine. Gene editing is a new type of genetic engineering in which DNA can be directly inserted, deleted, modified, or replaced in the genome of a living organism. Unlike early genetic engineering techniques that randomly inserts genetic material into a host genome, genome editing directs the modification to site specific locations. ARS scientists at Orient Point, New York, investigated the use of the “CRISPR-Cas9” gene editing system as a potentially more robust and efficient system to produce live recombinant ASF viruses. Compared to traditional genetic engineering techniques, the CRISPR-Cas9 system resulted in the successful development of a recombinant ASF virus in record time. These results demonstrate the potential advantage of using CRISPR/Cas9 over traditional methods and should significantly improve the ability to develop a first generation modified live ASF vaccine.

Identifying and breeding goats resistant to scrapie. Scrapie is a fatal and untreatable brain disease of goats and sheep that is caused by the progressive accumulation of an abnormal form of the prion protein and loss of brain cells. Historically, a single diagnosis of scrapie results in permanent quarantine or euthanasia of all goats and sheep on the farm. Sheep have acquired genetic resistance to scrapie through ARS breeding efforts and this has supported scrapie eradication efforts by the sheep industry, but goats do not exhibit the same genetic resistance. This recently changed with the discovery of two naturally occurring prion gene alleles in goats that have shown exceptional promise for conferring resistance. ARS scientists in Pullman, Washington, and scientists in other laboratories around the world have shown that even one copy of either of these genes confers strong resistance to classical scrapie in goats. Although the USDA National Scrapie Eradication Program has not yet formally recognized these alleles, USDA is planning pilot genetic-based cleanup plans for goats that are similar to programs used in sheep. Scrapie resistance should significantly enhance goat breeding programs and goat health. In addition, breeding scrapie resistant goats will benefit all small ruminant producers by reducing scrapie in the United States, and support efforts to designate the import-export status of the United States as a scrapie free country.

Widespread pyrethroid resistance in Florida mosquitoes that transmit Zika and dengue viruses. Recent outbreaks of locally transmitted Zika and dengue viruses in Florida have highlighted the importance of integrated vector management plans for the yellow fever mosquito (*Aedes aegypti*). ARS researchers at Gainesville, Florida, worked with collaborators to conduct a statewide examination of pyrethroid resistance in Florida populations of *Ae. aegypti* and demonstrated that permethrin resistance and the genetic markers for resistance are widely present, although the strength of the resistance varied. This information will be useful for managers who need to select the most effective pesticides to use in programs for controlling mosquitoes that transmit diseases to humans.

Models to improve integrated pest management of mosquitoes and determine risk of emerging disease threats to the United States. ARS scientists in Manhattan, Kansas, collaborated with Kansas State University researchers to develop models quantifying the risk from introduction of Japanese encephalitis and Rift Valley Fever viruses to the United States. The analysis suggests that airplanes and cargo ships currently present a minimal risk of introducing Japanese encephalitis. However, the results also indicate the behaviors of mosquitoes responsible for disease transmission play a more significant role than originally realized. Another model used disease outbreak data from South Africa to better understand host and vector roles in the spread of Japanese encephalitis and Rift Valley Fever viruses between farms in the Midwest, Texas, and the eastern seaboard. The results are useful to epidemiologists, State and Federal mosquito management districts, and health care specialists for improving the surveillance and population management of disease vectors to prevent disease outbreaks in humans and livestock, as well as to Federal emergency planners who may need to quickly develop plans for protecting food supplies from the introduction of exotic pathogens.

## **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 address quarantine issues.

### ***Selected Examples of Recent Progress:***

Characterization and selection of a new highly effective oat crown rust resistance gene from wild oat, *Avena strigosa*, into cultivated oat. Oat crown rust (*Puccinia coronata* f. sp. *avenae*) is a major disease that can result in a significant reduction in global oat production. ARS scientists in St. Paul, Minnesota, identified a new, highly effective resistance gene to oat crown rust from wild oat, *Avena strigosa*, and introduced it into cultivated oat through a technique called marker assisted selection. The gene confers broad resistance to this devastating disease of oat making it highly valuable to scientists around the globe.

Release of disease resistant germplasm from wild sunflowers. Sclerotinia basal stalk rot (BSR) and downy mildew are two fungal diseases that are major yield limiting factors in global sunflower production. The use of resistant hybrids, where available, is the most efficient and environmentally friendly means of managing these diseases. ARS scientists in Fargo, North Dakota, transferred resistance to BSR from three species of wild annual sunflowers into cultivated sunflower, resulting in the release of seven sunflower germplasm lines. All lines except one also contain resistance to downy mildew derived from one of the parents. These lines represent the first oilseed sunflowers with resistance to Sclerotinia BSR and downy mildew. They are being used across the United States and internationally to breed sunflower for resistance to multiple diseases that reduce seed quality and severely affect yield.

PhylloLux technology for crop protection. New approaches are needed for controlling strawberry diseases. Current strategies that rely mainly on the use of fungicides have significant limitations because they have become less effective in their ability to control plant pathogens. In addition, restrictions on the use of fungicides and public demand for produce free of pesticide residues are both increasing. ARS researchers in Kearneysville, West Virginia, developed PhylloLux technology, a plant disease management system that combines Ultraviolet C (UV-C) irradiation followed by a specific dark period with the application of biocontrol agents. The PhylloLux technology can also be used to control mites, the major arthropod pest in strawberry production. Microbiome analysis revealed

no major shift in the composition of the microflora of fruits and leaves that would indicate an increase in foodborne pathogens after treatment. The potential of this technology goes well beyond its application to strawberries to include other fruit and vegetable crops as well as ornamental plants and nursery stocks.

Completion of the synthetic pathway of a bioherbicide. No new herbicides with new modes of action have been discovered since the 1980s; this has exacerbated the herbicide resistance problem. ARS scientists in Oxford, Mississippi, previously discovered a compound called sorgoleone which gives sorghum its natural weed fighting properties. This compound holds potential to be an effective new bioherbicide with a new mode of action. ARS scientists have now identified the complete biosynthetic process for how the plant makes sorgoleone, including all the genes involved. In addition, they discovered the gene responsible for sorgoleone is produced only in the roots of the sorghum. With this information, scientists now have the tools in hand to develop the production of sorgoleone in other crop species which could lead to new crop varieties with enhanced resistance to weeds. Weed resistant crops could significantly reduce the need for chemical herbicide applications and increase options for crop rotations.

Discovery of a new class of safer insecticides. Methyl benzoate exists naturally as a floral fragrance in many plants. ARS scientists in Beltsville, Maryland, found that methyl benzoate also has insecticidal properties and is more toxic to gypsy moth larvae and brown marmorated stink bug nymphs than commercial insecticides. It was found to be five to 20 times more toxic to larvae of a fruitfly called the spotted wing drosophila than it is to these other two insects and is also environmentally friendly. ARS has patented it as a safe, new insecticide for use on this fruitfly. Furthermore, studies of methyl benzoate analogs may help explain how a related compound, DEET, works so well as an insect repellent. Further chemical analyses will help improve the efficacy of this new class of insecticide.

Impact of sub-lethal and long-term concentrations of insecticides on honey bee survival. Understanding the impact of pesticides through both direct and residue contact is important in developing strategies that mitigate their impact on honey bees. ARS scientists at Stoneville, Mississippi, fed honey bees with several different formulations of the insecticide clothianidin at concentrations typical for field residues. The scientists did not see any effects on adult bee survivorship but did observe reductions in body weight. They also found that long-term spray treatments with imidacloprid at low rates did not adversely affect bee survival, but higher concentrations did significantly reduce survival. Results from these studies are being used to determine the impacts of different insecticide concentrations on honey bee health.

## **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.

### ***Selected Examples of Recent Progress:***

Following the Dietary Guidelines for Americans has limited health benefit. The Dietary Guidelines for Americans (DGA) are the basis for Federal nutrition policy and are jointly published by USDA and HHS but they had never been tested in a controlled study. The DGA recommends more fruits, vegetables, whole grains, and dairy than are usually eaten. A controlled feeding study by ARS scientists in Davis, California, in which all foods were provided over eight weeks to 52 overweight or obese women who followed the DGA showed significant improvement in systolic blood pressure but no improvements in levels of insulin, glucose, or lipids in the blood compared with women who ate a typical American diet. This was the first controlled feeding trial of the DGA. The diets were designed to maintain body weight, so a follow-up study will be conducted to determine whether weight loss is needed from following the DGA.

A gene may be the reason for propensity to gain weight. The APOA2 gene, one of the most common proteins that moves fats through the body and plays an important role in the cardiovascular system, may also be associated with increased body mass index. ARS researchers and collaborators in Boston, Massachusetts, used a variety of

techniques as well as information gathered from previous studies which: (1) analyzed genes at the molecular level, and (2) examined the genetic backgrounds of people involved in the Boston Puerto Rican Health and the Framingham Heart studies. By closely examining the characteristics of people who reported eating high levels of red meat, poultry, cheese, and butter, the researchers found that only people with the APOA2 variant gene were likely to gain weight, whereas people without the variant maintained lower body mass index. These results may be important in understanding the variation of responses to specific dietary patterns implicated in obesity.

A new hormone discovered that controls desire to eat. Several hormones are involved in controlling appetite including insulin, glucagon, leptin, and ghrelin, however, altering levels of these hormones has not resulted in reduced eating or weight loss. Asprosin is a recently discovered hormone produced by fat cells and induced by fasting. Asprosin circulates in the blood and targets the liver to produce glucose. Scientists in Houston, Texas, found that asprosin enters the brain and activates nerves there through a series of steps that stimulate appetite and add weight and body fat. Obese humans and overweight mice have elevated levels of asprosin in their bloodstream. Blocking asprosin in mice was found to reduce appetite and weight. This is a new potential target for the prevention and treatment of obesity and type 2 diabetes.

Moderate exercise improves mobility of older adults. As people age and become less active they lose mobility, leading to falls, hip fractures, and often loss of independence. ARS funded researchers in Boston, Massachusetts, took part in the Lifestyle Interventions and Independence for Elders (LIFE) study, a large multi-center randomized controlled trial designed to compare the effects of moderate intensity physical activity with an established health education program. The study showed that previously inactive people in their 70s and 80s can improve their ability to move and function by walking at a moderate speed for at least 48 minutes a week. The researchers found participants in the exercise group increased their walking speed and distance and experienced less decline in mobility than study participants enrolled in a health education program that did not include walking. Influencing older adults to walk at least one hour a week may reduce healthcare costs and improve the quality of life for millions.

## **Environmental Stewardship**

### ***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.

### ***Selected Examples of Recent Progress:***

Windows Dam Analysis Modules (WinDAM) C adopted by world leaders in dam safety. [WinDAM C](#), a CCE-certified software, is a computational tool released in 2016 by ARS in cooperation with the USDA Natural Resources Conservation Service (NRCS) and Kansas State University. This decision support software is used by dam safety engineers in predicting potential dam breaches. The software incorporates algorithms developed by ARS scientists for predicting embankment dam failures from overtopping or internal erosion and includes breach outflow and breach timing estimates. Since its release, the software has been adopted by consulting engineers, academic researchers, and Federal agencies, including the U.S. Corps of Engineers, U.S. Bureau of Reclamation, NRCS, and the Tennessee Valley Authority. In 2018, ten countries across North America, South America, Europe, and Asia requested the software; the majority have incorporated WinDAM C into their educational and design analysis toolboxes. This technology is helping dam safety engineers prioritize the rehabilitation schedules for the aging U.S. embankment dams and levees. Dams built, evaluated (using WinDAM C), and maintained by NRCS provide an

estimated \$2.5 billion in annual benefits to producers, shippers, communities, and others. ARS and their collaborators are currently exploring options to use WinDAM C in developing early flood warning systems that can be used by emergency managers, city planners, and policymakers in establishing zoning regulations, developing flood inundation maps, and improving emergency action plans.

Managed deficit irrigation can save six inches of irrigation water per acre and boost yields. Development of sustainable and efficient irrigation strategies is a priority for agricultural producers faced with water shortages. Managed deficit irrigation is a promising management strategy for reducing water use: the crop is not fully irrigated, but greater irrigation is applied during grain set and early fill. ARS scientists in Bushland, Texas, collaborated with Texas A&M AgriLife Research and Extension Service to study managed deficit irrigation with grain sorghum. Yields from crops produced with managed deficit irrigation averaged 25 bushels per acre more than crops produced with deficit irrigated sorghum and used only 1.5 inches of additional irrigation compared with nearly 8 inches with fully irrigated sorghum. If irrigation water availability is limited, managed deficit irrigation has significant advantages over deficit irrigation.

Efficient nitrate recycling and re-use. Nitrate contamination of surface and ground waters is a serious problem in many agricultural regions. It is a human health risk and contributes to eutrophication of fresh water and the Gulf of Mexico. Most mitigation efforts focus on denitrification through a process of encouraging microbes to convert nitrate to nitrogen gas. This is inherently wasteful because much energy is required for the initial manufacture of nitrogen fertilizer. A more efficient solution would be to develop methods to recycle nitrate for re-use. ARS scientists in St. Paul, Minnesota, have developed a system that can remove nitrate from contaminated water and concentrate it for re-use as fertilizer. The system runs on electricity from solar panels so it is suitable for remote locations. A feasibility test was successfully conducted on a contaminated trout stream that has a nitrate concentration of more than 20 ppm (twice the EPA safety standard of 10 ppm). The system was able to remove an average of 42 percent of the nitrate from water passing through it, concentrating it in a tank that ultimately reached a concentration exceeding 500 ppm, which was subsequently used elsewhere as fertilizer. This approach could be used to recover nitrate from streams and contaminated wells, ponds, and lakes.

Nitrogen Index helps farmers better manage fertilizer, save money, and protect the environment. A problem faced by agricultural producers around the country and world is the proper use of nitrogen fertilizers. Agricultural system managers (e.g., farmers, landowners, government agencies) need data and information and tools to help them easily assess how their management decisions can increase the nitrogen use efficiency of crops or conversely, how they result in the loss of necessary nitrogen from the soil. Version 4.5.1 of the Nitrogen Index was developed by ARS scientists in Ft. Collins, Colorado, to enable users to conduct quick assessments of the effects of their management practices on nitrogen use efficiencies and to better manage their use of this important fertilizer. The index is now being used in California, Kentucky, South Dakota, Bolivia, Brazil, several Caribbean nations, Ecuador, Mexico, and other locations. Surveys conducted in 2016, 2017, and 2018 demonstrate that the index is in widespread use.

Poultry litter significantly lowers production costs for biofuel production. Under the Energy Independence and Security Act of 2007 and the Renewable Fuel Standard program, 36 billion gallons of biofuels must be produced annually by 2022, more than twice the level currently being produced. Temporal patterns of biofuel crop growth, composition, and nutrient removal affect the development of models for predicting optimal harvest times and nutrient inputs for large scale, sustainable bioenergy production. ARS researchers in Fayetteville, Arkansas, completed a series of experiments that evaluated environmental aspects and economic feasibility relative to the cost of specific fertilizers needed to grow biofuel crop switchgrass in the mid-South. They found that poultry litter was less expensive than synthetic fertilizer for production which lowered the breakeven price for a user by nearly 50 percent per acre.

Improving restoration practices to reduce wildfire threats. The accidental introduction and subsequent invasion of cheatgrass to Great Basin rangelands has increased the frequency of wildfires, and millions of dollars are spent annually fighting them. ARS scientists in Reno, Nevada, have been testing pre-emergent herbicides to control cheatgrass, diminish the levels of cheatgrass associated fuels for fires, and improve rangeland restoration efforts. This research has resulted in more than a ninefold increase in the growth of perennial grasses, shrubs, and forbs that successfully suppress cheatgrass. A reduction in cheatgrass associated fuels significantly reduces the chance, rate, spread, and season of wildfires. Converting cheatgrass dominated habitats back to perennial grasses, forbs, and shrubs has also substantially improved sustainable grazing resources and improved plant and wildlife diversity in the Great Basin. Using pre-emergent herbicides to control cheatgrass improves the overall health of the habitat and decreases the threat of wildfire, preserves wildlife, increases rangeland livestock production, and reduces the costs of fire control.

Identification of more competitive nitrogen fixing bacteria for use in alfalfa production. Most alfalfa seed is treated with symbiotic bacteria before planting to ensure the formation of nitrogen fixing nodules on roots. Improving nitrogen fixation reduces the need for synthetic fertilizers, but establishment of the necessary bacterial strains is hampered by competition from indigenous, less effective bacteria. ARS scientists in St. Paul, Minnesota, and University of Minnesota colleagues developed methods for identifying the origin of bacteria in root nodules in two field sites that had not been in alfalfa cultivation for more than 30 years. All bacteria in nodules originated from soil rather than from seed inoculation and were genetically diverse. However, approximately one-third of the bacterial strains in nodules had a gene involved in transfer of bacterial proteins to plant cells, which appears to accelerate nodulation, potentially making these strains more competitive in forming root nodules. This gene gives researchers a marker to rapidly identify additional strains that would be more effective as seed inoculants. Increasing nitrogen fixation and the amount of nitrogen available to alfalfa plants will increase crop yields without raising costs for crop production.

Increasing crop diversity increases economic returns and reduces risk. Increasing crop diversity by growing a larger variety of crops in rotation has been proposed to increase sustainability. However, for producers to adopt these rotations as standard practice, they need to be profitable. In a long-term crop rotation study, ARS researchers in Mandan, North Dakota, showed that crop productivity and economic returns increased with increasing crop diversity while economic risk decreased. In most cases, increasing crop diversity also resulted in higher soil organic carbon levels, which enabled producers in the region to simultaneously realize economic benefits of \$25 to \$83 per acre while maintaining or building soil organic carbon.

Decision support tools that help growers select biochars to improve soil health and economic return. Despite the known agronomic benefits of biochar, few farmers have adopted biochar-based strategies to improve soil health or increase plant productivity primarily because standards and agronomic recommendations regarding application rates and techniques are lacking. ARS researchers in Corvallis, Oregon, in collaboration with researchers from Oregon State University, published the [\*Pacific Northwest \(PNW\) Biochar Atlas\*](#), a suite of decision support tools designed to alleviate uncertainty regarding the use of biochar on farms. The atlas includes a soils property explorer that allows users to identify soil deficiencies in soils across the PNW. A biochar selection tool pairs these deficiencies with biochar types best suited to their soil needs and crop type and calculates the carbon sequestration, fertilizer, and liming value of amending at different rates. A cost-benefit calculator determines the cost savings from offsetting fertilizer, lime, and irrigation water, and potential income from increased crop yield. The website is useful for both growers and researchers and has had nearly 20,000 page visits in the first six months, with visitors from 75 countries.

## **Library and Information Services**

### ***Current Activities:***

The National Agricultural Library (NAL) is the largest and most accessible agricultural research library in the world. It provides services directly to the staff of USDA and to the public, primarily via its web site, <http://www.nal.usda.gov>. NAL, which was created with the USDA in 1862, was named a national library 100 years later, in 1962, 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:***

Ag Data Commons. In FY 2018, NAL continued development of the Ag Data Commons catalog for agricultural research datasets. Development focused on transferring most custom developed code to the professionally maintained DKAN Science product. Our REE one-stop-shop campaign brought growth of 562 percent in the number of catalogued datasets, resulting in significant growth in the ARS contribution to data.gov. Strategic partnerships with ARS and NIFA senior program leadership ensure consistent data management guidance to researchers. ARS and NIFA project proposals now require data management plans (DMPs), and the Ag Data Commons team launched a service to consult on DMP drafts before submission. NAL gathered customer perspectives on best practices in dairy agroecosystem research and agricultural economics via a NIFA funded workshop and a monthly data management webinar series. Ag Data Commons can be found at <https://data.nal.usda.gov>.

PubAg. During FY 2018, NAL continued technical development of PubAg and continued building up service content, and by the end of FY 2018, PubAg contained 2,140,000 citations to peer reviewed, agriculture-related

scientific articles. Each article citation in PubAg includes NAL Thesaurus subject terms and a link to the full text article if it is available from an internal NAL repository, PubMed Central, and/or the publisher. PubAg's Advanced Search function was improved in response to requests from the library community and in support of the effort to enrich the overall user experience. NAL nearly doubled the full text corpus in PubAg, adding 39,000 full text articles which better fulfills the Department's and U.S. Government's mandate for open access to Federally funded research. In addition, NAL entered into an agreement with the CHORUS organization (<https://www.chorusaccess.org/>) to provide access to even more full text content from cooperating publishers. NAL also upgraded the PubAg Submission system site, which will launch in FY 2019. PubAg can be found at <https://pubag.nal.usda.gov/>.

i5K Workspace. In FY 2018, NAL implemented new tools, added new data, and performed updates to the i5K Workspace@NAL, a web resource for arthropod genome access and curation. The i5k Workspace issued two major releases of its genomics workspace software, a web interface for BLAST, and other search tools that can be accessed by users of other genome databases. Several new user interface updates were developed and are awaiting release, including increased Section 508 compliance and a new mechanism to import FAIR metadata. New tools include the remap-gff3 software package for the remapping gff3 files to updated genome assemblies. The tool has been used to update three genome assemblies. NAL also drafted a five-year plan for future program guidance. Twelve new species, and at least 51 new datasets, including three Official Gene Sets, were added to the Workspace. The i5k Workspace has been cited 45 times in peer reviewed scientific papers since its inception five years ago, including a 50 percent increase in citations in FY 2018 over FY 2017 totals.

Long Term Agroecosystem Research Data Portal. In FY 2018, more than 400 metadata records describing LTAR-related data were added to GeoData/Ag Data Commons in a significant effort to inventory LTAR and other datasets. More than 550 datasets can currently be located through GeoData, the NAL geospatial data catalog. In related work, nearly 40 users were trained and given access to create records for their data. In FY 2018, the GeoData system became available to the public, although it was not formally launched. System developments made it more user-friendly, enhanced performance, and included implementation of ISO 19115-3, the latest version of the Federally required geospatial standard. As a result, NAL and USDA are ahead of NOAA, NASA, USGS, and EPA in upgrading to 19115-3 as the primary standard.

Life Cycle Assessment (LCA) Commons. In FY 2018, NAL implemented and documented repository management and data stewardship best management practices based on Open Archival Information System (OAIS) reference model. NAL completed development and deployed the openLCA Collaboration Server data collection, publication, and search application. Consequently, NAL has reduced LCA Commons product operating costs by 60 percent and reduced the time required for publishing a complex data set from months to days. NAL also led the development of the Global LCA Data Access (GLAD) application which provides distributed access to national level data sets around the world. The GLAD prototype launched at a European Commission event in April 2018. Also, NAL continued to lead the Federal LCA Commons interagency coordination activity which has expanded to include the U.S. Forest Service and the Federal Highway Administration, in addition to DOE, EPA, DOD, and NIST. In FY 2019, NAL will develop a continuous integration and deployment environment for the LCA Commons product. With an automated testing and deployment environment, the LCA Commons application will be ready for cloud migration per departmental requirements. [www.lcacommons.gov](http://www.lcacommons.gov) will also be redesigned to be more agency neutral to reflect that the LCA Commons is an interagency collaboration.

NAL mass digitization. In FY 2018, NAL digitized and created citation information for 14,954 items (713,548 pages), bringing total number of digitized items to 147,875 (6,761,642 pages). NAL continues a large-scale digitization project to digitize agricultural literature and provide public online access. During FY 2018, NAL digitization continued to focus on historic USDA issued publications, nursery and seed trade catalogs, and topic specific content to support NAL online exhibits and information. In addition, NAL continued contributing rare and historical titles to the Biodiversity Heritage Library. Until all mass-digitized publications are migrated to NAL web services, public access is available at <https://archive.org/details/usdanationalagriculturalallibrary>.

NAL digital collections. In FY 2018, the National Agricultural Library's Digital Collections (NALDC) consisted of more than 30,000 historical documents and reports across 10 major collections. Building on upgrades developed for PubAg, NAL modified database, search, and user interface technology to support an upgrade that was deployed in FY 2018. NAL migrated the upgraded metadata records for items in three collections (Organic Roots, Historical Dietary Guidance, and the Animal Welfare Act History) to the new NALDC location named NALDC Beta. Work also began on migrating the other remaining digital sub-collections to the new interface infrastructure. The National Agricultural Library's Digital Collections can be found at: <https://naldc.nal.usda.gov/>.

***ACCOUNT 2: BUILDINGS AND FACILITIES***

**APPROPRIATIONS LANGUAGE**

The appropriations language follows (new language underscored; deleted matter enclosed in brackets):

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, \$50,000,000 to remain available until expended.

**LEAD-OFF TABULAR STATEMENT**

***Table ARS-1. Lead-Off Tabular Statement***

<b>Item</b>	<b>Amount</b>
2019 Annualized Continuing Resolution .....	\$140,600,000
Change in Appropriation.....	-90,600,000
Budget Estimate, 2020 .....	<u>50,000,000</u>

**PROJECT STATEMENT****Table ARS-2. Project Statement (thousands of dollars, staff years (SY))**

Item	2017 Actual	SY	2018 Actual	SY	2019 Estimate	SY	Inc. or Dec.	2020 Budget	SY
Buildings and Facilities									
Discretionary Appropriations:									
Corvallis, OR, National Clonal Germplasm Repository.....	-	-	-	-	-	-	+\$900	\$900	-
Fort Detrick, MD, Foreign Disease-Weed Science Research Laboratory.....	\$64,300	-	-	-	-	-	-	-	-
Salinas, CA, U.S. Agricultural Research Station.....	30,200	-	\$71,200	-	\$71,200	-	-71,200	-	-
Kerrville, TX, Knipling Bushland Research Laboratory.....	3,700	-	50,700	-	50,700	-	-50,700	-	-
Madison, WI, U.S. Dairy Forage Research Center.....	-	-	-	-	-	-	+5,400	5,400	-
Temple, TX, Grassland, Soil and Water Research Laboratory.....	1,400	-	18,700	-	18,700	-	-18,700	-	-
Tifton, GA, Southeast Watershed Research Laboratory.....	-	-	-	-	-	-	+42,100	42,100	-
University Park, PA, U.S. Pasture Laboratory.....	-	-	-	-	-	-	+1,600	1,600	-
Subtotal .....	99,600	-	140,600	-	140,600	-	-90,600	50,000	-
Supplemental Appropriations:									
Emergency Supplemental.....	-	-	22,000	-	-	-	-	-	-
Total Appropriation .....	99,600	-	162,600	-	140,600	-	-90,600	50,000	-
Bal. Available, SOY.....	248,665	-	200,996	-	335,163	-	39,430	295,733	-
Total Available .....	348,265	-	363,596	-	475,763	-	-51,170	345,733	-
Bal. Available, EOY .....	-200,996	-	-335,163	-	-295,733	-	79,516	-216,217	-
Total Obligations .....	147,269	-	28,433	-	180,030	-	28,346	129,516	-

**JUSTIFICATION OF INCREASES AND DECREASES****Buildings and Facilities<sup>1</sup>**

ARS operates laboratories and facilities that have a capitalization value of nearly \$4 billion. Many of these laboratories/facilities are decades old, have outlived their functional lifespan, and are badly in need of major repairs, renovation, or replacement.

- (1) A decrease of \$90,600,000 for Buildings and Facilities (\$140,600,000 available in 2019).

The funding change is requested for the following items:

- A) An increase of \$42,100,000 for the programming, design, and construction of the Southeast Watershed Research Laboratory in Tifton, Georgia.

*Need for Change*

The Southeast Watershed Research Laboratory is one of six watershed hydrology research centers created by Congress to address critical hydrology and erosion research needs of major regions in the United States. Their purpose is to develop agricultural management practices and systems that conserve natural resources and maintain or enhance the quality of the environment.

The Southeast Watershed Research Laboratory in Tifton serves the Gulf-Atlantic Coastal Plain, an important agricultural region making up approximately 10 percent of the U.S. land area. Currently, the laboratory is assessing and measuring the impacts of agroecosystems on water supply/quality, and the effects of agricultural conservation practices and managed land use interfaces in agricultural watersheds. In addition, the laboratory is developing diversified rotational cropping systems for integrated crop-livestock

<sup>1</sup> ARS is in the process of updating the 2012 Capital Investment Strategy (CIS) to best allocate additional resources.

production systems that include: mixed cropping, reduced crop metal toxicity, year-round vegetable covers, and habitats for arthropod's natural enemies and pollinators.

The laboratory's facilities are in very poor condition, and are in need of significant upgrades for safety, energy, and research needs. In addition, the facilities are spread over the entire site, with more than 60 buildings, most small and inefficient. The proposed project will consolidate the Southeast Watershed Research Unit with the Crop Protection and Crop Genetics' laboratory/office buildings to create a more favorable research environment, and a greatly improved facility structure for safety, energy, and operations/maintenance. The consolidation will reduce approximately 55,000 gross square feet (gsf) of existing laboratory/office space to a new 43,000 gsf laboratory/office building.

In 2020, ARS is requesting \$42.1 million for the programming, design, and construction of the facilities at Tifton.

- B) An increase of \$5,400,000 for the programming and design of the U.S. Dairy Forage Research Center in Prairie du Sac, Madison, Wisconsin.

*Need for Change*

The U.S. Dairy Forage Research Center focuses on problems that are national in scope, and that limit the efficient use of forage for milk production. The center's research specifically is directed toward increasing yields and quality of forage grown and harvested; reducing losses associated with harvesting, storage, and feeding; and maximizing the use of forage nutrients by dairy cows for milk production. In addition, the research focuses on reducing the environmental footprint of the U.S. dairy industry. The research, coordinated with the University of Wisconsin-Madison and other land grant universities, involves engineers, microbiologists, chemists, and plant and animal scientists at locations in five states.

The facilities at Prairie du Sac are in poor condition and in need of both major renovations and new construction to meet current research needs. The current facilities do not meet the state-of-the-art research requirements for automated milking facilities. The proposed plan for the new facilities is to: construct 208,000 gsf of new facilities for the Milking and Transition Automated Cow Research Unit; renovate 37,800 gsf for the Intensive Animal Nutrient Research Facility; and construct 82,200 gsf of hoop buildings for silage cover. The existing facilities of approximately 190,000 gsf will be replaced with 328,000 gsf in new and renovated facilities.

In 2020, ARS is requesting \$5.4 million for the programming and design of the new and renovated facilities at the Dairy Forage Research Center in Prairie du Sac.

- C) An increase of \$1,600,000 for the programming and design of the Pasture Systems and Watershed Management Research Laboratory in University Park and Klingerstown, Pennsylvania.

*Need for Change*

The Pasture Systems and Watershed Management Research Laboratory develops sustainable management systems for Northeastern grazing and cropping enterprises. The laboratory's goal is to develop diverse, stable, and persistent forage and pasture lands that provide a permanent cover and protect the natural resource base for future generations. Currently, the laboratory is focused on: Improving sustainable intensification strategies of crop and integrated crop-livestock systems for farms, watersheds, and landscapes; developing management practices that farmers can use to reduce the environmental impacts of agriculturally derived contaminants on receiving waters; and identifying pasture-based dairy and livestock production systems and management practices that improve food security.

ARS' facilities at University Park and Klingerstown are in very poor condition and unable to sustain state-of-the-art research. Renovation of the laboratory/office space (26,000 gsf) is needed at the Pasture Systems and Watershed Management Unit located on the Penn State campus in University Park. In addition, new laboratory/office space (3,000 gsf) will be constructed to replace the outdated facilities at the Klingerstown worksite.

In 2020, ARS is requesting \$1.6 million for the programming and design of the new and renovated facilities.

- D) An increase of \$900,000 for the programming and design of National Clonal Germplasm Repository in Corvallis, Oregon.

*Need for Change*

The National Clonal Germplasm Repository is a genebank that safeguards genetic resource samples in field orchards, greenhouse plantings, tissue culture, and cryopreservation. The purpose of the repository is to collect and conserve living plant material, to help solve immediate agricultural production problems, and to safeguard plant genetic diversity for future needs. The mission has become critical because the loss of genetic diversity is accelerating with threats from global urbanization, habitat changes associated with climate, and changes in land use related to population growth and economic development. There are nine ARS clonal germplasm repositories in the United States. The repository for temperate small fruit, pears, hazelnut, butternut, and specialty crops is located in Corvallis, Oregon.

The repository's 7,200 gsf main laboratory/office space is in poor condition and in need of an upgrade to meet energy, safety, and research needs. The 17,850 gsf of screenhouses do not meet the requirements for research greenhouses and must be replaced with new greenhouses of the same gsf. In addition, the existing 15,000 gsf headhouse/greenhouse also needs renovation to meet energy, safety, and research needs. There is also a need to renovate 5,600 gsf of shops, and 1,700 gsf of shade houses. In total, the new and renovated facilities will include 47,350 gsf.

In 2020, ARS is requesting \$0.9 million for the programming and design of the laboratory/office, greenhouses, headhouse/greenhouse, and ancillary facilities.

- E) A decrease of \$140,600,000 for fully funded construction projects.

**CLASSIFICATION BY OBJECTS***Table ARS-3. Classification by Objects (thousands of dollars)*

<b>Item No.</b>	<b>Item</b>	<b>2017 Actual</b>	<b>2018 Actual</b>	<b>2019 Estimate</b>	<b>2020 Budget</b>
	Other Objects:				
32.0	Land and structures.....	\$147,269	\$28,433	\$180,030	\$129,516
99.9	Total, new obligations .....	<u>147,269</u>	<u>28,433</u>	<u>180,030</u>	<u>129,516</u>

**STATUS OF CONSTRUCTION*****Table ARS-4. Status of Construction***

## Status of Construction Projects as of December 2018

Status of research facilities authorized or funded in prior years and reported as uncompleted in the 2019 Explanatory Notes, are as follows:

NOTE: Program Of Requirement: 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%. YEARS: All references to years are fiscal years.

<b>Location and Purpose</b>	<b>Year</b>	<b>Amount of Funds Provided</b>	<b>Description</b>
Arizona, Tucson Southwest Watershed Research Center	2016 Design and Construction	\$12,400,000	Design/Programming completed 1st Quarter of 2018. Construction contract awarded 4th Quarter of 2018 with completion estimated for 2nd Quarter of 2020.
California, Albany Western Regional Center (Research and Development Facility)	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.
	2001 Construction	4,889,220	
	2002 Construction	3,800,000	
	2009 ARRA	15,624,460	
	2015 Rescission	(\$166)	
Total	26,913,514		
California, Davis Center for Advanced Viticulture and Tree Crop Research	2004 Planning and Design	\$2,684,070	POR completed 2nd Quarter 2007. Lease agreement with University was not executed.
	2005 Construction	2,976,000	
	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 Agricultural Research Station	2004 Planning and Design	\$4,473,450	Design (100%) completed 2nd Quarter 2007.
	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)	

Location and Purpose	Year	Amount of Funds Provided	Description
	2016 Design	1,300,000	A design update was awarded 1st Quarter of 2017 and completed 4th Quarter of 2018. Design changed from 3 phases to 2 phases for construction. Construction (both phases) estimated to be awarded by the end of 2nd Quarter of 2019.
	2017 Construction	30,200,000	
	2018 Construction	71,200,000	
	Total	106,516,375	
Connecticut, Storrs Center of Excellence for Vaccine Research	2008 Planning and Design	\$1,869,819	POR completed 4th Quarter 2010. Lease agreement was not executed.
	2009 Design and Construction	2,192,000	
	2010 Construction	3,654,000	
	2011 Rescission	(\$7,221,296)	
	Total	494,523	
District of Columbia U.S. National Arboretum	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.
	2001 Design and Construction	3,322,674	
	2002 Design and Construction	4,600,000	
	2003 Design and 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 Agricultural Research Service Laboratory	2008 Planning and Design	\$521,325	POR completed 2nd Quarter 2011. Land purchases complete. Historic preservation consultation completed and building demolition contract awarded 4th quarter of 2016. Demolition was completed in the 4th quarter of 2017.
	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 U.S. National Poultry Research Center	1992 Planning	\$400,000	Draft POR completed 1st Quarter 2007. The POR was awarded in the 3rd Quarter of 2015 and completed 4th Quarter 2015. Design was awarded 4th Quarter 2015 and completed in the 3rd Quarter of 2016. Design Build Construction Contract was awarded in the 4th Quarter of 2017. Total contract duration from notice to proceed to completion is expected to take 5½ years (all work to be completed by the 3rd Quarter of 2023). However, the Government will take ownership of buildings as they are completed and accepted. The estimated completion by building is as follows: B49 Hatchery/Brooding - 3rd Quarter 2019 B47 BLS-3 Animal Holding/Laboratory - 3rd Quarter 2020 B48 SPF Animal Holding - 3rd Quarter 2020 B45 Laboratory/Office/Administration - 1st Quarter 2021 B46 BSL-2 Animal Holding - 4th Quarter 2022 Finalize Roadways, Sidewalks etc. - 3rd Quarter 2023
	1993 Construction	677,000	
	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	

Location and Purpose	Year	Amount of Funds Provided	Description
Hawaii, Hilo U.S. Pacific Basin Agricultural Research Center	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.
	2000 Construction	4,500,000	
	2001 Construction	4,989,000	
	2002 Construction	3,000,000	
	2003 Design and 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	<u>31,808,304</u>		
Idaho, Hagerman Aquaculture Facility	2005 Planning and Design	\$992,000	Lease agreement is in place. POR completed 3rd Quarter 2007.
	2006 Construction	990,000	
	2008 Construction	695,100	
	2009 Construction	544,000	
	2011 Rescission	(\$2,907,600)	
	Total	<u>313,500</u>	
Illinois, Peoria National Center for Aquacultural Utilization Research (Central Wing)	2000 Design and Construction	\$1,800,000	The modernization of the Chemical Wing was completed in 3 segments. The construction of phases 1 and 2 is complete. Construction for all remaining phases of the Central Wing awarded 2nd Quarter 2010 using ARRA funding and completed 3rd Quarter 2012.
	2002 Construction	6,500,000	
	2004 Construction	2,684,070	
	2005 Construction	2,976,000	
	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	<u>37,705,239</u>	
Iowa, Ames National Centers for Animal Health	2001 Design and Construction	\$8,980,200	The accelerated plan for the completion of the modernization of ARS/APHIS animal facilities is in progress. All major components of the modernization are complete. -Phase 1 Lab/Office (APHIS) completed in 2004. -Large Animal BSL-3Ag facilities construction completed 2nd Quarter 2007. -Central Utility Plant and Infrastructure, Phase 1 and 2 construction is complete. Phase 3 construction completed 1st Quarter 2009.
	2002 Design and Construction	40,000,000	
	2002 Construction	50,000,000	
	2002 APHIS Transfers	15,753,000	
	[Supplemental]	[14,081,000]	
	[Other Transfers]	[1,672,000]	
	2002 Construction	25,000,000	

Location and Purpose	Year	Amount of Funds Provided	Description
	2003 Construction	32,785,500	-Construction of Consolidated Laboratory Facility completed 2nd Quarter 2009.
	2003 Construction	110,000,000	-Low Containment Large Animal Facility construction completed 1st Quarter of
	2005 Construction	121,024,000	2009. Demolition of existing facilities on 1st and 2nd Street completed 3rd
	2006 Construction	58,212,000	Quarter 2012. Buildings 1 and 2 demolitions are complete, but the site
	2015 Rescission	<u>(\$1,108,686)</u>	restoration will be completed in June 2018.
	Total	460,646,014	
Iowa, Ames National Laboratory for Agriculture and the Environment	2016 Design and Construction	\$13,500,000	Design awarded 4th Quarter 2016 and bridging documents were completed 4th Quarter of 2017. Construction awarded 4th Quarter of 2018 and will be completed 1st Quarter of 2020.
Kentucky, Bowling Green Animal Waste Management Research Laboratory	2005 Planning and Design	\$2,281,600	POR is complete for total project. Design (100%) for the Headhouse/Greenhouse only was completed 3rd Quarter 2008. Lease agreement is in place. Construction of the Headhouse/Greenhouse awarded 4th Quarter 2010 and completed 2nd Quarter 2012.
	2006 Construction	2,970,000	
	2008 Construction	1,390,200	
	2009 Construction	1,088,000	
	2010 Construction	2,000,000	
	2011 Rescission	<u>(\$5,880,338)</u>	
	Total	3,849,462	
Kentucky, Lexington Forage Animal Research Laboratory	2005 Planning and Design	\$2,976,000	POR is complete. Lease agreement terminated 2016. Design (100%) was completed 2nd Quarter 2011.
	2006 Construction	3,960,000	
	2008 Construction	2,085,300	
	2009 Construction	1,632,000	
	2010 Construction	2,000,000	
	2011 Rescission	<u>(\$9,678,689)</u>	
	Total	2,974,611	
Louisiana, Houma Sugarcane Research	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 completed 2nd Quarter 2008. Phase 1A construction completed 4th Quarter 2010. Phase 1b construction awarded 2nd Quarter 2011 and completed 3rd Quarter 2013.
	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	<u>(\$100)</u>	
	Total	15,935,504	
Louisiana, New Orleans Southern Regional Research Center (Industrial Wing)	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 completed 4th Quarter 2008. Construction of the LTR awarded 3rd Quarter 2009 and completed 3rd Quarter 2011.
	1999 Modernization	6,000,000	
	2000 Modernization	5,500,000	
	2006 Supplemental (design)	4,900,000	
	2006 Supplemental (const.)	<u>20,000,000</u>	

Location and Purpose	Year	Amount of Funds Provided	Description
	Total	37,500,000	
Maine, Orono/Franklin National Cold Water Marine Aquaculture Center	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 when funds are made available.
	2002 Construction	3,000,000	
	2003 Construction	9,090,525	
	2004 Design and Construction	2,684,070	
	2005 Design and Construction	2,976,000	
	2006 Design and Construction	2,475,000	
	2011 Rescission	(\$2,012,504)	
	Total	20,707,591	
Maryland, Beltsville Beltsville Agricultural Research Center, (BARC)	1988 Design and Construction	\$5,750,000	Study to evaluate boiler plants, steam lines, and electrical distribution completed 4th Quarter 2009. Construction contract for repairs to boiler plants and portions of the steam distribution system awarded 4th Quarter 2010 with ARRA funding and completed 2nd Quarter 2012. Design-Build contract for major renovations to Building 306 awarded 4th Quarter 2010 with ARRA funding and completed 4th Quarter 2012.
	1989 Design and Construction	6,100,000	
	1990 Design and Construction	9,860,000	
	1991 Design and Construction	15,999,792	
	1992 Design and Construction	16,000,000	
	1993 Design and Construction	13,547,000	
	1994 Design and Construction	19,700,000	
	1995 Design and Construction	3,960,000	
	1996 Design and Construction	8,000,000	
	1997 Design and Construction	4,500,000	
	1998 Design and Construction	3,200,000	
	1999 Design and Construction	2,500,000	
	2000 Design and Construction	13,000,000	
	2001 Design and Construction	13,270,740	
	2002 Design and Construction	3,000,000	
	2003 Design and Construction	4,152,830	
	2004 Design and Construction	2,684,070	
	2005 Design and Construction	2,976,000	
	2006 Design and Construction	3,588,750	
	2009 Design and Construction	2,192,000	
	2009 ARRA	21,513,046	
	2010 Construction	3,000,000	
2011 Rescission	(\$9,831,954)		
Renovate Building 307	2016 Design and Construction	37,100,000	A design update for Building 307 was awarded 4th Quarter of 2016 and completed 1st Quarter of 2018. Construction will be awarded 4th Quarter of 2019 and completed 2nd Quarter of 2021.
	Total	205,762,274	

Location and Purpose	Year	Amount of Funds Provided	Description
Maryland, Beltsville National Agricultural Library	1998 Design and 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 awarded 1st Quarter 2010 using ARRA funding and completed 3rd Quarter 2012.
	1999 Design and Construction	1,200,000	
	2001 Design and Construction	1,766,106	
	2002 Construction	1,800,000	
	2003 Design and Construction	1,490,250	
	2004 Design and Construction	894,690	
	2009 ARRA	6,357,422	
	2011 Rescission	<u>(\$115,175)</u>	
Total	15,893,293		
Maryland, Frederick (Fort Detrick) Foreign Disease-Weed Science Research Laboratory	2016 Design	\$4,900,000	Design/Programming awarded 4th Quarter of 2016 and completed 2nd Quarter of 2018. Construction currently scheduled to be awarded 4th Quarter of 2019.
	2017 Construction	<u>64,300,000</u>	
	Total	69,200,000	
Michigan, East Lansing Avian Disease and Oology Laboratory	1992 Planning	\$250,000	Design (100%) for this multi-phased facility modernization is complete.
	1993 Planning	212,000	
	1998 Planning and Design	1,800,000	
	2011 Rescission	<u>(\$63,193)</u>	
	Total	2,198,807	
Mississippi, Lorman Biotechnology Laboratory Alcorn State University	2006 Planning and Design	\$1,980,000	A lease agreement with Alcorn State University for the new facility completed 4th Quarter 2009. POR completed 3rd Quarter 2008.
	2008 Planning and Design	1,390,200	
	2009 Construction	1,176,000	
	2010 Construction	1,500,000	
	2011 Rescission	<u>(\$5,798,055)</u>	
	Total	248,145	
Mississippi, Poplarville Thad Cochran Southern Horticulture Laboratory	2002 Design	\$800,000	Construction of the Headhouse/Greenhouse awarded 4th Quarter 2007 and completed 1st Quarter 2008.
	2003 Construction	9,140,200	
	2006 Supplemental	4,300,000	
	2011 Rescission	<u>(\$9,178)</u>	
	Total	14,231,022	
Mississippi, Starkville Poultry Science Research Facility	2005 Planning and Design	\$2,976,000	Lease agreement is in place. Design (100%) completed 1st Quarter 2008.
	2006 Construction	4,950,000	
	2008 Construction	1,390,200	
	2009 Construction	3,177,000	
	2011 Rescission	<u>(\$10,345,645)</u>	
	Total	2,147,555	

<b>Location and Purpose</b>	<b>Year</b>	<b>Amount of Funds Provided</b>	<b>Description</b>
Mississippi, Stoneville Jamie Whitten Delta States Research Center	2004 Construction	\$4,831,326	Design (100%) completed. Construction of Phase 1 completed. Construction of mechanical, electrical, and plumbing systems for phases 2 thru 5 (of 5 total) and repair of deteriorated building envelope awarded 3rd Quarter 2010. Phase 2 and 3 completed 1st Quarter 2013, Phase 4 completed 2nd Quarter 2015, and Phase 5 completed 2nd Quarter 2016.
	2005 Construction	2,976,000	
	2008 Construction	2,780,400	
	2009 ARRA	36,347,783	
	2010 Construction	4,000,000	
	2011 Rescission	(\$6,047,327)	
	2015 Rescission	(\$134)	
Total	44,888,048		
Missouri, Columbia National Plant and Genetics Security Center	2004 Planning and Design	\$2,415,663	Design (100%) completed 4th Quarter 2008.
	2005 Construction	4,960,000	
	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 Animal Bioscience Facility	2005 Planning and Design	\$1,984,000	Lease agreement in place. Conceptual Design (35%) completed 3rd Quarter 2008.
	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 Northern Plains Agricultural Research Laboratory	1998 Planning and Design	\$606,000	Construction of Phase 1 (Lab/Office Building) completed 2003 and Phase 2 (Quarantine Lab) completed 4th Quarter 2008.
	1999 Construction	7,300,000	
	2004 Design and Construction	2,505,132	
	2011 Rescission	(\$29,505)	
	Total	10,381,627	
Nebraska, Lincoln Systems Biology Research Facility	2008 Planning and Design	\$1,390,200	POR completed 3rd Quarter 2011.
	2009 Planning and Design	1,088,000	
	2010 Construction	3,760,000	
	2011 Rescission	(\$5,782,528)	
	Total	455,672	
New York, Geneva Grape Genetics	2004 Planning and Design	\$2,415,663	Design (100%) completed 4th Quarter 2007.
	2005 Construction	2,976,000	
	2006 Construction	3,588,750	

Location and Purpose	Year	Amount of Funds Provided	Description
	2008 Construction	1,869,819	
	2009 Construction	2,192,000	
	2010 Construction	3,654,000	
	2011 Rescission	<u>(\$14,806,870)</u>	
	Total	1,889,362	
New York, Ithaca Crop-based Health Genomics	2004 Planning and Design	\$3,847,167	Design (100%) completed 2nd Quarter 2008.
	2005 Construction	2,976,000	
	2006 Construction	3,588,750	
	2011 Rescission	<u>(\$7,314,491)</u>	
	Total	3,097,426	
Ohio, Toledo University of Toledo	2005 Planning and Design	\$1,984,000	Design (100%) completed 1st Quarter 2010. Lease agreement in place.
	2006 Construction	1,584,000	
	2008 Construction	1,869,819	
	2009 Construction	2,192,000	
	2010 Construction	3,654,000	
	2011 Rescission	<u>(\$9,356,845)</u>	
	Total	1,926,974	
Oklahoma, Woodward Southern Plains Range Research Center	2002 Planning and Design	\$1,500,000	Phases 1 and 2 of the three-phased construction project completed.
	2003 Construction	7,948,000	
	2005 Construction	2,976,000	
	2011 Rescission	<u>(\$152,556)</u>	
	Total	12,271,444	
Pennsylvania, Wyndmoor Eastern Regional Research Center	1997 Construction	\$4,000,000	Modernization of the Center accomplished in nine phases, with construction of Phases 1 through 7 completed. Construction award for Phases 8 and 9 was made 4th Quarter 2010 with ARRA funding and completed 2nd Quarter 2012.
	1998 Construction	5,000,000	
	1999 Construction	3,300,000	
	2000 Construction	4,400,000	
	2002 Design and Construction	5,000,000	
	2009 ARRA	15,084,486	
	2015 Rescission	<u>(\$2)</u>	
	Total	36,784,484	
South Carolina, Charleston U.S. Vegetable Laboratory	1988 Feasibility Study	\$50,000	Construction of Phase 1 (laboratory) and Phase 2A (Headhouse) completed. Phase 2B (Greenhouse) construction awarded 2nd Quarter 2007 and completed 4th Quarter 2008.
	1990 Planning and Construction	1,135,000	
	1994 Construction	909,000	
	1995 Construction	5,544,000	
	1996 Construction	3,000,000	

Location and Purpose	Year	Amount of Funds Provided	Description
	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	<u>(\$517)</u>	
	Total	33,439,798	
***Reprogrammed from Horticultural Crop and Water Management Research Laboratory, Parlier, CA			
Texas, Houston Children's Nutrition Research Center	2016 Design and Construction	\$29,200,000	Design awarded 4th Quarter of 2016 and completed 4th Quarter 2017. Construction solicitation on hold pending Congressional B&F Funding decisions for ARS.
Texas, Kerrville Knipling Bushland Laboratory	2008 Planning and Design	\$1,390,200	POR completed 2nd Quarter 2010 for a new site.
	2009 Planning and Design	1,957,000	
	2011 Rescission	<u>(\$2,768,214)</u>	In 2017, funding was appropriated for planning and design of a replacement laboratory and animal facilities at the existing Kerrville location. Additional funding provided in 2018 for construction. The POR and Site Study will be awarded 2nd Quarter of 2019.
	2017 Planning and Design	3,700,000	
	2018 Construction	<u>\$50,700,000</u>	
	Total	54,978,986	
Texas, Temple Grassland Soil & Water Research Laboratory	2017 Planning and Design	\$1,400,000	In 2017, funding was appropriated for planning and design of a laboratory modernization at Temple and repairs at the associated field site in Riesel, TX.
	2018 Construction	<u>\$18,700,000</u>	The POR and Investigative Study was awarded 1st quarter of 2018. Additional funding provided in 2018 for construction.
	Total	\$20,100,000	
Utah, Logan Agricultural Research Center	2008 Planning and Design	\$5,560,800	Lease completed 3rd Quarter 2010. POR completed 4th Quarter 2010.
	2009 Design and Construction	4,351,000	
	2010 Construction	4,527,000	
	2011 Rescission	<u>(\$13,839,929)</u>	
	Total	598,871	
Washington, Pullman ARS Research Laboratory	2004 Planning and Design	\$3,936,636	Lease agreement with University in place. Conceptual Design (35%) completed.
	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	<u>(\$17,240,830)</u>	
	Total	1,062,375	

Location and Purpose	Year	Amount of Funds Provided	Description
West Virginia, Kearneysville Appalachian Fruit Laboratory	2003 Planning and Design	\$471,913	Construction of Phases 1 and 2 (immediate laboratory repairs and renovation) completed 3rd Quarter 2007. The construction of the Greenhouse completed 1st Quarter 2008. POR for the new laboratory completed 2nd Quarter 2010. Conceptual design for new laboratory completed 3rd Quarter 2011.
	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	<u>(\$3,430,725)</u>	
Total	8,776,234		
West Virginia, Leetown National Center for Cool and Cold Water Aquaculture (Broodstock Facility)	2002 Design and Construction	\$2,200,000	Construction completed 3rd Quarter 2008.
	2006 Construction	891,000	
	2011 Rescission	<u>(\$4,717)</u>	
	Total	\$3,086,283	
Wisconsin, Marshfield Nutrient Management Laboratory	2003 Planning, Design and Construction	\$2,980,500	Design (100%) of Phase 1 and Phase 2 completed. Phase 1 (Nutrient Lab) construction completed 4th Quarter 2008. Phase 2 construction (Animal Holding Facility) awarded 4th Quarter 2007. Phase 2 construction completed 1st Quarter 2010.
	2004 Construction	3,668,229	
	2005 Construction	4,860,800	
	2006 Construction	7,920,000	
	2011 Rescission	<u>(18,229)</u>	
	Total	19,411,300	
Wisconsin, Prairie du Sac Dairy Forage Agriculture Research Center	2008 Planning and Design	\$2,502,360	POR completed 3rd Quarter 2011
	2009 Construction	2,002,000	
	2010 Construction	4,000,000	
	2011 Rescission	<u>(7,675,381)</u>	
	Total	828,979	
Emergency Hurricane Supplemental Funding	2018 Planning, Design and Construction	\$22,000,000	Contract awarded for installation of lighting and controls in parking lot of Isabela, PR in 2018. Construction will be completed by the end of 1st Quarter of 2019. Planning and Design to begin 2nd Quarter of 2019 for solar farms, battery backups and generators for PR and US Virgin Island locations. Contract awarded for installation of roof in Ft. Lauderdale, FL in 2018. Construction will be completed 1st Quarter of 2019. A blanket purchase agreement for Planning on the remaining projects will be awarded 2nd Quarter of 2019. The blanket agreement is to procure engineering support for site assessments, statement of works, and estimates.