

2023 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 Production, Crop Production; Food Safety; Livestock Protection, 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, 2021, there were 5,307 permanent, full-time employees including 528 in the Headquarters offices and 4,779 in field offices.

**OIG AND GAO REPORTS**

***Table ARS-1. OIG Reports***

<b>ID</b>	<b>Date</b>	<b>Title</b>	<b>Result</b>
50601-0006-31	3/5/2018	Reviewing the Integrity of USDA’s Scientific Research Program	The Office of the Chief Scientist (OCS) should strengthen communication with Department agencies about scientific integrity and work with the agencies to identify non-confrontational approaches to understand the perceptions identified in the survey. In addition, OCS should ensure appropriate personnel receive updated training materials and make them available in multiple formats.
50024-0001-22	3/14/2018	CIGIE Purchase Card Initiative - USDA Controls over Purchase Card Use	We recommend establishing requirements for documenting the use of non-required sources, issuing guidance for identifying split purchases, and creating guidelines for documenting the recovery of sales tax.
50701-0001-21	9/12/2018	USDA Agency Activities for Agroterrorism Prevention, Detection, and Response	All three agencies need to compile agroterrorism preparedness actions during the year. APHIS and ARS need to identify actions to report as vulnerability assessments, and all three agencies need to regularly assess and update the status of efforts to mitigate vulnerabilities. Finally, the agencies need to document processes to annually track and report on corrective actions from exercises or incident responses.
50501-0020-12	7/3/2019	Improper Usage of USDA’s Information Technology Resources	The Office of Human Resources Management and OCIO need to define improper usage and develop and implement a documented process for ensuring all parties are notified of incidents, agencies and staff offices need to track and monitor incidents, and OCIO and Departmental Administration need to ensure contractors and other non-Government employees are held accountable to the same improper usage standards as employees.
02026-0001-23	7/23/2019	ARS/Final Action Verification/U.S. Meat Animal Research Center Review	OIG determined that ARS provided sufficient documentation to OCFO to close the five recommendations we made in our September 30, 2016, audit report on U.S. Meat Animal Research Center Review.

<b>ID</b>	<b>Date</b>	<b>Title</b>	<b>Result</b>
02601-0001-24	10/03/2019	ARS' Animal Welfare Act Controls to Prevent Mistreatment of Animals Used For Researching Parasitic Diseases	OIG did not make any recommendations.
11601-0001-12	11/12/2019	USDA's Fiscal Year 2019, First Quarter DATA Act Submission	OIG recommended that the Office of Chief Financial Officer (OCFO) to strengthen USDA's DATA Act compliance through the establishment of new oversight processes. Additionally, the OIG recommended that agencies and offices coordinate with OCFO to establish procedures to identify their DATA Act reportable data, and made other recommendations to specific USDA agencies to improve the agencies' DATA Act Compliance.
50401-0018-11	11/27/2019	USDA's Consolidated Financial Statements for Fiscal Years 2019 and 2018	OIG did not make any recommendations.
50701-0002-21	04/03/2020	USDA's Controls to Prevent the Unauthorized Access and Transfer of Research Technology	Due to the nature of OIG findings and the agency's responses, the report contained sensitive content. OIG withheld their recommendations from public release due to concerns about the risk of circumvention of law.
50601-0009-31	05/15/2020	USDA's 2018 and 2019 Trade Mitigation Packages	OIG did not make any recommendations.
50024-0015-11	05/18/2020	U.S. Department of Agriculture's Fiscal Year 2019 Compliance with Improper Payment Requirements	OIG recommended USDA and its component agencies take steps to ensure its mandated actions are completed to meet improper payment requirements.
50501-0022-12	09/30/2020	Security Over Select USDA Agencies' Networks and Systems	Due to the nature of OIG findings and the agency's responses, the report contained sensitive content. OIG withheld their recommendations from public release due to concerns about the risk of circumvention of law.
50503-0003-12	10/29/2020	Fiscal Year 2020 Federal Information Security Modernization Act Audit	We recommend the Department mitigate existing security weaknesses by developing policy and implementing procedures; implementing a centrally managed software license program; prioritizing the remediation of outstanding vulnerabilities; removing unsupported software; revising regulations; implementing an improved patch and upgraded process; and implementing mechanisms and controls to ensure system contingency plans are

<b>ID</b>	<b>Date</b>	<b>Title</b>	<b>Result</b>
			tested annually, among other recommendations.
84801-0001-22	12/8/2020	USDA Research Integrity and Capacity	OIG recommend that REE identify and implement a standard mechanism across all REE agencies to enhance both USDA's and the public's ability to identify REE agencies' publications from USDA-funded research by subject areas.
50401-0019-11	12/14/2020	FY 2020 USDA Consolidated Financial Statements Audit	OIG did not make any recommendations.
50501-0024-12	2/25/2021	USDA's Security Controls Over the Prevention and Mitigation of Ransomware	This report contains sensitive content. It is being withheld from public release due to concerns about the risk of circumvention of law.
11601-0002-12	11/3/2021	USDA's Digital Accountability and Transparency Act Compliance Efforts for Fiscal Years 2020 and 2021	There were no OIG recommendations specific to ARS.
50401-0020-11	11/15/2021	USDA's Consolidated Financial Statements for Fiscal Years 2021 and 2020	OIG recommended that USDA ensure appropriate agency officials obtain training pertaining to Departmental Regulation 2230-001 to include review and monitoring of valid obligations and acceptable support for valid obligations.
50503-0005-12	10/29/2021	U.S. Department of Agriculture, Office of the Chief Information Officer, Fiscal Year 2021 Federal Information Security Modernization Act Audit Report	ARS is addressing OIG recommendations.

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

<b>ID</b>	<b>Title</b>
13601-0002-22	Agriculture and Food Research Initiative
14801-0001-24	Economic Research Service's Data Product Review Council Review Process
50401-0021-11	U.S. Department of Agriculture's Consolidated Balance Sheet for Fiscal Year 2022
50503-0006-12	Fiscal Year 2022 Federal Information Security Modernization Act Audit
50801-0002-12	Security Over USDA Web Applications Inspection

**Completed GAO Reports**

<b>ID</b>	<b>Date</b>	<b>Title</b>	<b>Result</b>
GAO-18-307	3/12/2018	Chemical Innovation: Technologies to Make Processes and Products More Sustainable	GAO made no recommendations.

<b>ID</b>	<b>Date</b>	<b>Title</b>	<b>Result</b>
GAO-18-199	4/16/2018	Food Safety: Federal Efforts to Manage the Risk of Arsenic in Rice	The GAO recommendation has been closed and implemented.
GAO-19-103	3/12/2019	Foot-and-Mouth Disease: USDA's Efforts to Prepare for a Potential Outbreak Could Be Strengthened	As of June 2020, GAO is evaluating the agency's response to this recommendation.
GAO-19-47	6/3/2019	Renewable Fuel Standard: Information on Likely Program Effects on Gasoline Prices and Greenhouse Gas Emissions	GAO made no recommendations.
GAO-19-466	7/31/2019	Foreign Assistance: Federal Monitoring and Evaluation Guidelines Incorporate Most but Not All Leading Practices	The GAO recommendation has been closed and implemented.
GAO-19-407	9/9/2019	Date Labels on Packaged Foods: USDA and FDA Could Take Additional Steps to Reduce Consumer Confusion	USDA agreed with GAO recommendation and is planning actions to implement the recommendation.
GAO-20-128SP	11/12/2019	Irrigated Agriculture: Technologies, Practices, and Implications for Water Scarcity	ARS is evaluating GAO recommendations.
GAO-20-81	11/21/2019	Federal Research: Additional Actions Needed to Improve Public Access to Research Results	GAO recommended that the Secretary of Agriculture should develop and implement a mechanism to ensure researcher compliance with the public access plan and associated requirements. The Secretary of Agriculture should complete development of guidance and provide training to agency officials or others involved in reviewing the merits of researchers' data management plans
GAO-20-101	12/20/2019	Federal Property: Improved Monitoring, Oversight, and Data Would Help Understand Effects of Providing Property to Non-Federal Recipients	ARS is evaluating GAO recommendations.
GAO 20-243	02/19/2020	USDA Administrative Services: More Could Be Done to Assess Effectiveness and Impact of Business Centers	ARS is evaluating GAO recommendations.
GAO 20-273	02/19/2020	National Biodefense Strategy: Additional Efforts Would Enhance Likelihood of Effective Implementation	GAO had no recommendations for USDA.
GAO-20-187	03/19/2020	Sexual Harassment in Stem Research: Agencies Have Taken Actions, but Need Complaint Procedures, Overall Plans, and Better Collaboration	ARS is evaluating GAO recommendations.
GAO-20-382	05/07/2020	POVERTY REDUCTION: HHS Can Improve Information to	GAO had no recommendations for USDA in the report.

ID	Date	Title	Result
		Assist States and Localities in Adopting Approaches That Serve Whole Families	
GAO-20-693	09/30/2020	Small Business Research Programs: Many Agencies' Award Issuances Are Not Timely; Some Practices May Improve Timeliness	ARS is evaluating GAO recommendations.
GAO-21-223R	1/29/2021	Small Business Innovation Research: Three Agencies Made Awards to Businesses Majority-Owned by Investment Companies and Funds	There were no GAO recommendations.
GAO-21-413	6/30/2021	Small Business Innovation Research: Agencies Need to Fully Implement Requirements for Managing Fraud, Waste, and Abuse	NIFA is addressing the GAO recommendations (Rec #1).
GAO-21-593	9/16/2021	Chronic Health Conditions: Federal Strategy Needed to Coordinate Diet-Related Efforts	There were no GAO recommendations.
GAO-22-104677	10/14/2021	Small Business Research Programs: Agencies Should Further Improve Award Timeliness	NIFA is addressing the GAO recommendations (Rec #3).

**Table ARS-3. In-Progress GAO Reports**

ID	Title
101434	USDA's Regional Climate Hubs
101732	Federal Grants Workforce Training
102299	Information Technology Cloud Computing
102509	Federal Preparedness for Responding to Antimicrobial-Resistant Pathogens
102599	Network for Manufacturing Innovation Program
102947	Transfer of National Bio- and Agro-Defense Facility Operations
103949	Food Program: DOD Should Formalize Its Process for Revising Food Ingredients and Better Track Dining Facility Use and Costs
104292	GAO Engagement on Interagency Biodefense Preparedness and Response
104434	Chemical Contamination of Food
104436	Compacts of Free Association Grants and Trust Funds Update
104449	Federal Efforts to Address Harmful Algal Blooms (HAB) and Hypoxia
104540	USDA Relocation Cost-Benefit Analysis
104602	Tribal Funding and Transparency
104709	USDA's Planning for and Relocation of Research Agencies
104740	Veteran Food Insecurity
105088	PFAS Technologies and Knowledge Gaps
105406	Bioforensic Technologies for Pandemic Origins
105525	International Life Sciences Research and National Security

**AVAILABLE FUNDS AND FTEs****Table ARS-4. Available Funds and FTEs (thousands of dollars, FTEs)**

Item	2020 Actual	FTE	2021 Actual	FTE	2022 Estimated	FTE	2023 Estimated	FTE
Salaries and Expenses:								
Discretionary Appropriations.....	\$1,414,366	5,075	\$1,491,784	5,462	\$1,491,784	5,855	\$1,858,719	6,908
Mandatory Appropriations.....	-	-	20,000	-	20,000	-	20,000	-
Mandatory Sequestration .....	-	-	-	-	-1,140	-	-1,140	-
Supplemental Appropriations .....	-	-	1,000	-	-	-	-	-
Buildings and Facilities:								
Discretionary Appropriations.....	192,700	-	35,700	-	35,700	-	45,405	-
Transfers In:	60	-	-	-	-	-	-	-
Total Discretionary Appropriations.....	1,607,126	5,075	1,527,484	5,462	1,527,484	5,855	1,904,124	6,908
Total Mandatory Appropriations .....	-	-	20,000	-	20,000	-	20,000	-
Total Mandatory Sequestration .....	-	-	-	-	-1,140	-	-1,140	-
Total Supplemental Appropriations.....	-	-	1,000	-	-	-	-	-
Total Adjusted Appropriation.....	1,607,126	5,075	1,548,484	5,462	1,546,344	5,855	1,922,984	6,908
Balance Available, SOY .....	759,506	-	183,786	-	188,855	-	127,316	-
Recoveries, Other .....	23,598	-	16,043	-	-	-	-	-
Total Available.....	2,390,230	5,075	1,748,313	5,462	1,735,199	5,855	2,050,300	6,908
Lapsing Balances.....	-2,508	-	-3,530	-	-	-	-	-
Balance Available, EOY .....	-183,786	-	-188,855	-	-127,316	-	-168,459	-
Total Obligations, ARS .....	2,203,936	5,075	1,555,928	5,462	1,607,883	5,855	1,881,841	6,908
Other USDA:								
Agricultural Marketing Service, AMS Animal & Plant Health Inspection Service, APHIS.....	133	-	121	0	121	0	121	0
Economic Research Service, ERS .....	36,028	116	21,230	76	21,230	71	21,230	76
Food & Nutrition Services, FNS.....	4,817	15	6,414	23	6,414	21	6,414	23
Food Safety & Inspection Service, FSIS .....	607	2	2,085	7	2,085	7	2,085	7
Foreign Agricultural Services, FAS....	5,778	19	5,090	18	5,090	17	5,090	18
Forest Service, FS .....	725	2	578	2	578	2	578	2
Hazardous Waste .....	1,054	3	1,048	4	1,048	4	1,048	4
National Agricultural Statistics Service, NASS .....	2,365	8	1,230	4	1,230	4	1,230	4
National Institute of Food and Agriculture, NIFA.....	9,387	30	7,377	27	7,377	25	7,377	27
Natural Resources Conservation Service, NRCS.....	30,593	98	41,402	149	41,402	138	41,402	149
Office of Budget & Program Analysis	7,000	22	6,423	23	6,423	21	6,423	23
Office of the Chief Economist, OCE ..	150	-	-	-	-	-	-	-
Office of the Chief Financial Officer, OCFO .....	-	-	169	1	169	1	169	1
Office of the Chief Information Officer, OCIO.....	5,000	16	8,000	29	8,000	27	8,000	29
Office of the Secretary .....	186	1	446	2	446	1	446	2
Quarters and Subsistence .....	235	1	151	1	151	1	151	1
Revocable Permits & Easements .....	151	1	-	-	-	-	-	-
Sale of Animals & Personal Property (Proceeds).....	696	2	549	2	549	2	549	2
Misc., Other USDA Funds.....	9,042	29	9,218	33	9,218	31	9,218	33
Total, Other USDA .....	85	-	204	1	204	1	204	1
Total, Agriculture Available.....	114,031	366	111,735	402	111,735	374	111,735	402
Total, Other Federal Funds:	2,317,967	5,441	1,667,663	5,864	1,719,618	6,229	1,993,576	7,310
Agency for International Development ..	2,331	7	1,053	4	1,053	4	1,053	4



## 2023 USDA EXPLANATORY NOTES – AGRICULTURAL RESEARCH SERVICE

Item	2020 Actual	FTE	2021 Actual	FTE	2022 Estimated	FTE	2023 Estimated	FTE
Department of Defense, DOD.....	2,158	7	1,674	6	1,674	6	1,674	6
Department of Energy, DOE.....	915	3	1,046	4	1,046	3	1,046	4
Department of Health & Human Services, DHHS.....	3,581	12	3,191	11	3,191	11	3,191	11
Department of Homeland Security, DHS.....	1,292	4	193	1	193	1	193	1
Department of State, DOS.....	129	-	-	-	-	-	-	-
Department of the Interior, DOI.....	2,530	8	3,009	11	3,009	10	3,009	11
Environmental Protection Agency, EPA.....	285	1	116	0	116	0	116	0
Federal Emergency Management Agency, FEMA.....	322	1	857	3	857	3	857	3
National Aeronautics & Space Administration, NASA.....	902	3	576	2	576	2	576	2
United States Geological Survey, USGS.....	299	1	411	1	411	1	411	1
Misc., Other USDA Funds.....	26	-	156	1	156	1	156	1
Total, Other Federal.....	14,771	47	12,282	44	12,282	41	12,282	44
Non-Federal Funds:								
Alaska, State of.....	187	1	109	0	109	0	109	0
Arizona State University.....	250	1	-	-	-	-	-	-
Arkansas, University of.....	129	-	186	1	186	1	186	1
Binational Agricultural Research & Development (BARD).....	192	1	299	1	299	1	299	1
California State University.....	-	-	683	2	683	2	683	2
California, State of.....	2,586	8	2,469	9	2,469	8	2,469	9
California, University of.....	1,734	6	1,775	6	1,775	6	1,775	6
California Walnut Board & Commission.....	132	-	170	1	170	1	170	1
Citrus Research & Development Foundation.....	1,023	3	798	3	798	3	798	3
Citrus Research Board.....	562	2	185	1	185	1	185	1
Clemson University.....	153	1	326	1	326	1	326	1
Commodity Credit Corporation.....	157	1	379	1	379	1	379	1
Connecticut, University of.....	-	-	130	0	130	0	130	0
Cornell University.....	254	1	314	1	314	1	314	1
Cotton Incorporated.....	1,063	3	1,037	4	1,037	3	1,037	4
Florida, State of.....	434	1	292	1	292	1	292	1
Florida, University of.....	977	3	949	3	949	3	949	3
Georgia, University of.....	285	1	181	1	181	1	181	1
Idaho, University of.....	210	1	100	0	100	0	100	0
Illinois, University of.....	814	3	949	3	949	3	949	3
John Hopkins University.....	133	-	-	-	-	-	-	-
Kansas State University.....	275	1	-	-	-	-	-	-
Kentucky, University of.....	116	-	-	-	-	-	-	-
Kings River Conservation.....	144	1	-	-	-	-	-	-
Maine, University of.....	243	1	-	-	-	-	-	-
Maryland, University of.....	-	-	192	1	192	1	192	1
Massachusetts, University of.....	-	-	126	0	126	0	126	0
Michigan State University.....	689	2	774	3	774	3	774	3
Minnesota, University of.....	217	1	180	1	180	1	180	1
Montana State University.....	-	-	563	2	563	2	563	2
Nebraska, University of.....	467	2	202	1	202	1	202	1
New Mexico State University.....	383	1	557	2	557	2	557	2
North Carolina A&T University.....	486	2	-	-	-	-	-	-
North Carolina State University.....	960	3	835	3	835	3	835	3

2023 USDA EXPLANATORY NOTES – AGRICULTURAL RESEARCH SERVICE

Item	2020 Actual	FTE	2021 Actual	FTE	2022 Estimated	FTE	2023 Estimated	FTE
North Carolina, University of.....	102	-	117	0	117	0	117	0
North Dakota State University.....	123	-	-	-	-	-	-	-
Ohio State University.....	587	2	663	2	663	2	663	2
Pennsylvania State University .....	440	1	355	1	355	1	355	1
Pennsylvania, University of.....	-	-	272	1	272	1	272	1
Purdue University .....	174	1	-	-	-	-	-	-
Saint Louis University .....	149	1	-	-	-	-	-	-
Santa Lucia Conservancy.....	111	-	-	-	-	-	-	-
SmithBucklin Corporation.....	3,249	10	2,421	9	2,421	8	2,421	9
South Dakota State University.....	146	1	166	1	166	1	166	1
South Florida Water Management District .....	961	3	923	3	923	3	923	3
Southern California, University of.....	-	-	112	0	112	0	112	0
Texas A&M University (TAMU) .....	319	1	277	1	277	1	277	1
United Soybean Board.....	334	1	381	1	381	1	381	1
U.S. Highbush Blueberry Council .....	134	-	-	-	-	-	-	-
Utah State University.....	-	-	156	1	156	1	156	1
Vermont, University of.....	173	1	-	-	-	-	-	-
Virginia Polytechnic Institute .....	101	-	112	0	112	0	112	0
Virginia, University of.....	-	-	122	0	122	0	122	0
Washington, State of.....	316	1	-	-	-	-	-	-
Washington State Dept of Agriculture	-	-	201	1	201	1	201	1
Washington State University .....	461	1	379	1	379	1	379	1
Western Illinois University.....	-	-	128	0	128	0	128	0
Misc., Non-Federal Funds.....	2,472	8	2,762	10	2,762	9	2,762	10
Total, Non-Federal.....	25,605	83	24,306	87	24,306	81	24,306	87
Miscellaneous Contributed Funds .....	17,412	54	17,681	50	17,681	54	17,681	50
Total Available, ARS .....	2,375,755	5,625	1,721,932	6,045	1,773,887	6,405	2,047,845	7,491

**PERMANENT POSITIONS BY GRADE AND FTEs****Table ARS-5. Permanent Positions by Grade and FTEs**

Item	2020 Actual			2021 Actual			2022 Estimated			2023 Estimated		
	D.C.	Field	Total	D.C.	Field	Total	D.C.	Field	Total	D.C.	Field	Total
SES.....	11	19	30	11	21	32	11	21	32	11	21	32
GS-15.....	51	714	765	51	710	761	54	758	812	64	903	967
GS-14.....	68	430	498	79	421	500	84	450	534	100	536	636
GS-13.....	143	303	446	155	333	488	166	356	522	198	424	622
GS-12.....	134	240	374	132	344	476	141	367	508	168	437	605
GS-11.....	56	449	505	66	457	523	71	488	559	85	581	666
GS-10.....	-	2	2	-	3	3	-	3	3	-	4	4
GS-9.....	59	912	971	51	937	988	54	1,001	1,055	64	1,193	1,257
GS-8.....	11	272	283	15	289	304	16	309	325	19	368	387
GS-7.....	34	504	538	49	492	541	52	525	577	62	626	688
GS-6.....	12	190	202	22	204	226	23	218	241	27	260	287
GS-5.....	11	104	115	6	108	114	6	115	121	7	137	144
GS-4.....	4	20	24	3	22	25	3	23	26	4	27	31
GS-3.....	1	6	7	1	12	13	1	13	14	1	15	16
GS-2.....	1	12	13	1	5	6	1	5	6	1	6	7
GS-1.....	-	5	5	-	4	4	-	4	4	-	4	4
Other Graded.....	5	-	5	5	-	5	5	-	5	6	-	6
Ungraded.....	-	415	415	-	486	486	-	519	519	-	618	618
Total Permanent.....	601	4,597	5,198	647	4,848	5,495	688	5,175	5,863	817	6,160	6,977
Unfilled, EOY.....	107	73	180	119	69	188	124	72	196	144	80	224
Total Perm. FT EOY..	494	4,524	5,018	528	4,779	5,307	564	5,103	5,667	673	6,080	6,753
FTE.....	549	5,076	5,625	469	5,576	6,045	505	5,900	6,405	614	6,877	7,491

## **VEHICLE FLEET**

### **Motor Vehicle Fleet**

The 2023 Budget Estimates proposes five planned replacements of owned passenger motor vehicles. Passenger motor vehicles are defined as sedans and stations 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 implemented telematics to automatically capture utilization data and improve data accuracy. ARS will continue to perform periodic surveys to help identify underutilized vehicles that may no longer be needed for the mission. 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 light duty trucks are six years or 50,000 miles.

The composition of the ARS fleet is primarily work 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 reduce vehicles longer required for the mission, realign vehicles where it is necessary without affecting the mission and control operating costs. The agency continues to review inventory information to accurately classify the fleet.

### ***Replacement Criteria***

ARS retires or replaces vehicles based on program management, vehicle mileage/age, and funding.

**Table ARS-6. Size, Composition, and Annual Costs of Motor Vehicle Fleet**

	Sedans and Station Wagons	Vans	SUVs	Light Trucks 4X2	Light Trucks 4X4	Medium Duty Vehicles	Buses	Heavy Duty Vehicles	Total Vehicles	Annual Operating Costs
<b>2018 End of Year Operating Inventory</b>	<b>205</b>	<b>245</b>	<b>738</b>	<b>438</b>	<b>596</b>	<b>722</b>	<b>3</b>	<b>163</b>	<b>3,110</b>	<b>\$4,628</b>
<b>2020 End of Year Operating Inventory</b>	<b>157</b>	<b>185</b>	<b>657</b>	<b>380</b>	<b>514</b>	<b>727</b>	<b>-</b>	<b>149</b>	<b>2,769</b>	<b>3,940</b>
2021 Planned Acquisitions .....	-	-	-	-	25	8	-	-	33	-
2021 Planned Disposals.....	8	12	13	19	-	-	-	2	54	-
<b>2021 End of Year Operating Inventory</b>	<b>149</b>	<b>173</b>	<b>644</b>	<b>361</b>	<b>539</b>	<b>735</b>	<b>-</b>	<b>147</b>	<b>2,748</b>	<b>3,985</b>
2022 Planned Acquisitions .....	-	3	4	-	10	10	-	3	30	-
2022 Planned Disposals.....	-	-	-	-	-	-	-	-	-	-
<b>2022 End of Year Operating Inventory</b>	<b>149</b>	<b>176</b>	<b>648</b>	<b>361</b>	<b>549</b>	<b>745</b>	<b>-</b>	<b>150</b>	<b>2,778</b>	<b>4,782</b>
2023 Planned Acquisitions .....	-	-	-	-	-	-	-	-	-	-
2023 Planned Disposals.....	-	-	-	-	-	-	-	-	-	-
<b>2023 End of Year Operating Inventory</b>	<b>149</b>	<b>176</b>	<b>648</b>	<b>361</b>	<b>549</b>	<b>745</b>	<b>-</b>	<b>150</b>	<b>2,778</b>	<b>4,973</b>

Statement of Proposed Purchase of Passenger Motor Vehicles

Fiscal Year	Net Active Fleet, SOY	Disposals	Replacements	Additions	Total Acquisitions	Net Active Fleet, EOY
2020	159	7	5	0	5	157
2021	157	10	2	0	2	149
2022	149	5	5	0	5	149
2023	149	5	5	0	5	149

SHARED FUNDING PROJECTS

Table ARS-7. Shared Funding Projects (dollars in thousands)

Item	2020 Actual	2021 Actual	2022 Estimated	2023 Estimated
<b>Working Capital Fund:</b>				
Administrative Services:				
Material Management Service.....	\$365	\$337	\$392	\$395
Mail and Reproduction Services .....	815	648	649	649
Integrated Procurement Systems .....	1,977	1,794	2,059	2,044
Procurement Operations Services.....	27	29	27	36
Human Resources Enterprise Management Systems.....	157	174	148	152
Subtotal .....	3,341	2,982	3,275	3,276
Communications:				
Creative Media & Broadcast Center.....	364	126	229	361
Finance and Management:				
National Finance Center.....	1,863	2,017	1,875	1,881
Internal Control Support Services .....	126	116	114	106
Financial Management Support Services .....	5,507	5,857	5,876	6,103
Subtotal .....	7,496	7,990	7,865	8,090
Information Technology:				
Client Experience Center.....	13,151	23,218	25,417	26,173
Department Administration Information Technology Office .....	47	584	36	1
Digital Infrastructure Services Center.....	1,633	2,704	4,838	5,563
Enterprise Network Services .....	5,537	6,836	5,352	4,254
Subtotal .....	20,368	33,342	35,643	35,991
Correspondence Management .....	393	26	33	33
Total, Working Capital Fund.....	31,962	44,466	47,045	47,751
<b>Department-Wide Shared Cost Programs:</b>				
Advisory Committee Liaison Services .....	4	3	5	5
Agency Partnership Outreach.....	467	419	471	471
Honor Awards .....	1	-	1	1
Human Resources Self-Service Dashboard .....	36	-	-	-
Medical Services .....	45	149	145	145
National Capital Region Interpreting Services .....	-	17	133	166
Office of Customer Experience .....	349	586	559	559
Personnel and Document Security Program .....	90	117	117	117
Physical Security .....	356	260	271	276
Security Detail.....	281	280	290	292
Security Operations Program .....	355	393	392	392
TARGET Center .....	69	72	85	85
USDA Enterprise Data Analytics Services.....	493	330	284	284
Total, Department-Wide Reimbursable Programs .....	2,546	2,626	2,753	2,793
<b>E-Gov:</b>				
Budget Formulation and Execution Line of Business .....	7	7	7	7
E-Rulemaking .....	-	5	13	14
Financial Management Line of Business.....	6	6	6	6
Hiring Assessment Tool .....	-	-	14	14
Human Resources Line of Business .....	18	19	18	18
Integrated Acquisition Environment .....	173	154	36	36
Total, E-Gov .....	204	191	94	95
Agency Total.....	34,712	47,283	49,892	50,639

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

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

1 For necessary expenses of the Agricultural Research Service and for acquisition of lands by donation, exchange, or  
 2 purchase at a nominal cost not to exceed \$100, and for land exchanges where the lands exchanged shall be of equal  
 3 value or shall be equalized by a payment of money to the grantor which shall not exceed 25 percent of the total  
 4 value of the land or interests transferred out of Federal ownership, [~~\$1,849,590,000: *Provided*, That of the funds~~  
 5 provided, \$192,000,000 is for activities related to climate change, including \$92,000,000 for climate science,  
 6 \$5,000,000 for climate hubs, and \$95,000,000 for an agreement with the Department of Energy for the Advanced  
 7 Research Projects Agency-Climate]\$1,858,719,000: *Provided*, That appropriations hereunder shall be available for  
 8 the operation and maintenance of aircraft and the purchase of not to exceed one for replacement only: *Provided*  
 9 *further*, That appropriations hereunder shall be available pursuant to 7 U.S.C. 2250 for the construction, alteration,  
 10 and repair of buildings and improvements, but unless otherwise provided, the cost of constructing any one building  
 11 shall not exceed \$500,000, except for headhouses or greenhouses which shall each be limited to \$1,800,000, except  
 12 for 10 buildings to be constructed or improved at a cost not to exceed \$1,100,000 each, and except for four buildings  
 13 to be constructed at a cost not to exceed \$5,000,000 each, and the cost of altering any one building during the fiscal  
 14 year shall not exceed 10 percent of the current replacement value of the building or \$500,000, whichever is greater:  
 15 *Provided further*, That the limitations on alterations contained in this Act shall not apply to modernization or  
 16 replacement of existing facilities at Beltsville, Maryland: *Provided further*, That appropriations hereunder shall be  
 17 available for granting easements at the Beltsville Agricultural Research Center: *Provided further*, That the foregoing  
 18 limitations shall not apply to replacement of buildings needed to carry out the Act of April 24, 1948 (21 U.S.C.  
 19 113a): *Provided further*, That appropriations hereunder shall be available for granting easements at any Agricultural  
 20 Research Service location for the construction of a research facility by a non-Federal entity for use by, and  
 21 acceptable to, the Agricultural Research Service and a condition of the easements shall be that upon completion the  
 22 facility shall be accepted by the Secretary, subject to the availability of funds herein, if the Secretary finds that  
 23 acceptance of the facility is in the interest of the United States: *Provided further*, That funds may be received from  
 24 any State, other political subdivision, organization, or individual for the purpose of establishing or operating any  
 25 research facility or research project of the Agricultural Research Service, as authorized by law.

**Change Description**

*The first change* (line 5 of paragraph 1) deletes the 2022 appropriation amount, appropriation language and funds for climate activities. This change would not require new authorizing legislation.

*The second change* (line 8 of paragraph 1) adds the 2023 appropriation amount. This change would not require new authorizing legislation.

**LEAD-OFF TABULAR STATEMENT**

*Table ARS-8. Lead-Off Tabular Statement (In dollars)*

<b>Item</b>	<b>Amount</b>
Estimate, 2022	\$1,491,784,000
Change in Appropriation	+ 366,935,000
Budget Estimate, 2023	<u>1,858,719,000</u>



**PROJECT STATEMENT APPROPRIATIONS****Table ARS-9. Project Statement Appropriations (thousands of dollars, FTE)**

Item	2020 Actual	FTE	2021 Actual	FTE	2022 Estimated	FTE	2023 Estimated	FTE	Inc. or Dec.	FTE Inc. or Dec.	Chg Key
Discretionary Appropriations:											
Salaries and Expenses .....	\$1,414,366	5,075	\$1,491,784	5,462	\$1,491,784	5,855	\$1,858,719	6,908	+\$366,935	+1,053	(1)
Subtotal .....	1,414,366	5,075	1,492,784	5,462	1,491,784	5,855	1,858,719	6,908	+366,935	+1,053	
Mandatory Appropriations:											
Human Nutrition .....	-	-	20,000	-	18,860	-	18,860	-	-	-	-
Subtotal .....	-	-	20,000	-	18,860	-	18,860	-	-	-	-
Supplemental Appropriations:											
Kelp and Seagrass (Discretionary) .....			1,000								
Subtotal .....			1,000								
Total Adjusted Approp.....	1,414,366	5,075	1,512,784	5,462	1,510,644	5,855	1,877,579	6,908	+\$366,935	+\$1,053	
Add back:											
Sequestration.....	-	-	-	-	1,140	-	1,140	-	-	-	-
Total Appropriation.....	1,414,366	5,075	1,512,784	5,462	1,511,784	5,855	1,878,719	6,908	+\$366,935	+\$1,053	
Transfers In:											
Cong. Relations.....	60	-	-	-	-	-	-	-	-	-	-
Total Transfers In.....	60	-	-	-	-	-	-	-	-	-	-
Sequestration.....	-	-	-	-	-1,140	-	-1,140	-	-	-	-
Recoveries, Other.....	23,529	-	15,137	-	-	-	-	-	-	-	-
Bal. Available, SOY.....	62,500	-	74,418	-	88,406	-	-	-	-88,406	-	-
Total Available <sup>1</sup> .....	1,500,455	5,075	1,602,339	5,462	1,599,050	5,855	1,877,579	6,908	+\$278,529	+\$1,053	
Lapsing Balances .....	-2,508	-	-3,530	-	-	-	-	-	-	-	-
Bal. Available, EOY .....	-74,418	-	-88,406	-	-	-	-	-	-	-	-
Total Obligations.....	1,423,529	5,075	1,510,403	5,462	1,599,050	5,855	1,877,579	6,908	+278,529	+1,053	
Staff Years											
Direct .....		5,075		5,462		5,855		6,908			
Other .....		550		583		550		583			
Total, Staff Years .....		5,625		6,045		6,405		7,491			

<sup>1</sup> Discrepancy between project statement and Max schedule X is the reimbursables.

**FUNDING DETAIL APPROPRIATIONS***Table ARS-10. Funding Detail (thousands of dollars)*

<u>Allocations</u>	2020	2021	2022	2023	Chg	Change from
	<u>Actual</u>	<u>Actual</u>	<u>Estimated</u>	<u>Budget</u>		2022
	<u>B.A.</u>	<u>B.A.</u>	<u>B.A.</u>	<u>B.A.</u>		<u>Estimate</u>
<b>Salaries &amp; Expenses</b>	<b>\$1,414,366</b>	<b>\$1,512,784</b>	<b>\$1,511,784</b>	<b>\$1,878,719</b>		<b>+\$366,935</b>
New Product Quality/Value Added .....	117,512	120,503	120,503	204,878	(1)	+84,375
Livestock Production .....	114,200	125,163	124,163	144,356	(2)	+20,193
Crop Production .....	282,748	299,882	299,882	346,744	(3)	+46,862
Food Safety .....	113,844	115,690	115,690	129,734	(4)	+14,044
Livestock Protection .....	116,808	127,376	127,376	160,065	(5)	+32,689
Crop Protection .....	217,186	223,267	223,267	248,792	(6)	+25,525
Human Nutrition .....	92,510	119,144	119,144	121,683	(7)	+2,539
Environmental Stewardship .....	231,523	251,675	251,675	354,996	(8)	+103,321
National Agricultural Library .....	28,791	28,884	28,884	35,211	(9)	+6,327
National Bio and Agro-Defense Facility (O&M/Transition Costs) .....	79,100	81,056	81,056	112,116	(10)	+31,060
Repair and Maintenance.....	20,144	20,144	20,144	20,144	(11)	0

**PROJECT STATEMENT OBLIGATIONS****Table ARS-11. Project Statement Obligations (thousands of dollars, FTE)**

Item	2020 Actual	FTE	2021 Actual	FTE	2022 Estimated	FTE	2023 Estimated	FTE	Inc. or Dec.	FTE Inc. or Dec.
Discretionary Obligations:										
Salaries and Expenses .....	\$1,423,529	5,075	\$1,490,135	5,462	\$1,580,190	5,855	\$1,858,719	6,908	+\$278,529	+1,053
Subtotal Disc Oblig .....	1,423,529	5,075	1,490,135	5,462	1,580,190	5,855	1,858,719	6,908	+278,529	+1,053
Mandatory Obligations:										
Human Nutrition .....	-	-	19,268	-	18,860	-	18,860	-	-	-
Subtotal Mand Oblig ...	-	-	19,268	-	18,860	-	18,860	-	-	-
Supplemental Obligations:										
Kelp and Seagrass (Discretionary) .....	-	-	1,000	-	-	-	-	-	-	-
Subtotal Supp Oblig ...	-	-	1,000	-	-	-	-	-	-	-
Total Obligations.....	1,423,529	5,075	1,510,403	5,462	1,599,050	5,855	1,877,579	6,908	+278,529	+1,053
Add back:										
Lapsing Balances.....	2,508	-	3,530	-	-	-	-	-	-	-
Balances Available, EOY:										
EOY Balance Available ..	74,418	-	88,406	-	-	-	-	-	-	-
Total Bal. Available, EOY ..	74,418	-	88,406	-	-	-	-	-	-	-
Total Available <sup>2</sup> .....	1,500,455	5,075	1,602,339	5,462	1,599,050	5,855	1,877,579	6,908	+278,529	+1,053
Less:										
Total Transfers In .....	-60	-	-	-	-	-	-	-	-	-
Sequestration .....	-	-	-	-	1,140	-	1,140	-	-	-
Recoveries, Other .....	-23,529	-	-15,137	-	-	-	-	-	-	-
Bal. Available, SOY .....	-62,500	-	-74,418	-	-88,406	-	-	-	+88,406	-
Total Appropriation.....	1,414,366	5,075	1,512,784	5,462	1,511,784	5,855	1,878,719	6,908	+366,935	+1,053
Staff Years:										
Direct.....		5,075		5,462		5,855		6,908		
Other.....		550		583		550		583		
Total, Staff Years .....		5,625		6,045		6,405		7,491		

<sup>2</sup> Discrepancy between project statement and Max schedule X is the reimbursables.

**FUNDING DETAIL OBLIGATIONS***Table ARS-12. Funding Detail (thousands of dollars)*

<u>Allocations</u>	<u>2020</u> <u>Actual</u> <u>B.A.</u>	<u>2021</u> <u>Actual</u> <u>B.A.</u>	<u>2022</u> <u>Estimated</u> <u>B.A.</u>	<u>2023</u> <u>Budget</u> <u>Request</u> <u>B.A.</u>	<u>Chg</u> <u>Key</u>	<u>Change from</u> <u>2022</u> <u>Estimate</u> <u>B.A.</u>
<b>Salaries &amp; Expenses</b>	<b>\$1,423,529</b>	<b>\$1,510,403</b>	<b>\$1,599,050</b>	<b>\$1,877,579</b>		<b>+\$278,529</b>
New Product Quality/Value Added.....	117,273	120,358	129,792	204,878	(1)	+75,086
Livestock Production .....	113,968	124,013	133,734	144,356	(2)	+10,622
Crop Production .....	282,173	299,521	322,998	346,744	(3)	+23,746
Food Safety .....	113,844	115,690	115,690	129,734	(4)	+14,044
Livestock Protection .....	140,270	127,223	137,195	160,065	(5)	+22,870
Crop Protection .....	216,744	222,998	240,478	248,792	(6)	+8,314
Human Nutrition .....	92,510	119,144	118,004	120,543	(7)	+2,539
Environmental Stewardship .....	231,052	251,372	271,075	354,996	(8)	+83,921
National Agricultural Library .....	29,551	28,884	28,884	35,211	(9)	+6,327
National Bio and Agro-Defense Facility (O&M/Transition Costs) .....	66,000	81,056	81,056	112,116	(10)	+31,060
Repair and Maintenance.....	20,144	20,144	20,144	20,144		0

**JUSTIFICATIONS OF INCREASES/DECREASES***Salaries and Expenses***ARS is requesting \$1,858,719,000 in FY 2023 for its Salaries and Expenses account, an increase of \$366,935,000 from the FY 2021 annualized CR.**

The FY 2023 Budget includes an increase of \$268,772,000 for high priority program initiatives. There is also an increase of \$47,500,000 for operations/maintenance, and research program improvements required for the new National Bio and Agro-Defense Facility (NBAF), which replaces the outdated and inadequate Plum Island Animal Disease Center (PIADC). NBAF will be a state-of-the-art biocontainment facility for the study of foreign, emerging, and zoonotic animal diseases that pose a threat to U.S. animal agriculture and to public health. In addition, the Budget includes \$50,663,000 for increases for pay costs, Federal Employees Retirement System (FERS), and the Department's Working Capital Fund and Shared Costs.

*New Products/Product Quality/Value Added*

- (1) An increase of \$84,375,000 and 270 staff years for New Products/Product Quality/Value Added research (\$120,503,000 and 549 staff years available in 2022 annualized CR).

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. The research supports many of USDA's Strategic Goals.

The funding change is requested for the following items:

- A) An increase of \$1,670,000 which includes \$1,137,000 for pay inflation and \$533,000 for 2022 Pay and FERS.

This increase supports the pay increase which went into effect January 1, 2022, of a 2.7 percent Cost of Living pay increases for civilian employees, and a 1.1 percent increase to cover the expenses for the mandated increase of USDA's contribution to FERS.

Funding for pay and retirement benefit costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Elimination of the pay and retirement benefit costs would require ARS to absorb these costs and reduce planned hiring levels, eroding USDA's ability to meet key Administration priorities.

- B) An increase of \$3,944,000 for 2023 Pay.

This increase will support the annualization of the 2022 2.7 percent Cost of Living pay increase and the 2023 4.6 percent Cost of Living pay increase.

Funding for pay costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Elimination of the pay costs would require ARS to absorb these costs and reduce planned hiring levels, eroding USDA's ability to meet key Administration priorities.

- C) An increase of \$93,000 for Department's Working Capital Fund and Shared Costs.

This includes \$87,000 for the Department's Working Capital Fund and \$6,000 for Department-Wide Shared Cost Programs. Elimination of these costs would require ARS to absorb these costs and erode USDA's ability to meet key Administration priorities.

- D) An increase of \$101,000,000 for Clean Energy of which \$75,668,000 is for ARS' New Products/Product Quality/Value Added Program.

President Joe Biden on January 27, 2021 signed the "[Executive Order on Tackling the Climate Crisis at Home and Abroad](#)" which ordered federal agencies to develop clean energy technologies and accelerate clean energy generation projects that stimulates clean energy industries and benefits rural economies. The change to clean energy, and away from fossil-based energy, works by producing power without the negative environmental impacts such as greenhouse gases, like carbon dioxide and methane. And is generated from renewable, zero emission sources that do not pollute the atmosphere, as well as energy saved by energy efficiency measures. The various sources of clean energy are wind, solar, tidal, geothermal, nuclear, hydrogen, and agriculturally based, renewable biomass feedstocks. The need for clean energy is multi-purposed: 1. it's important for future generations, as clean energy sources are inexhaustible and adapt well to natural cycles and do not emit greenhouse gases. 2. Clean Energy gives local economies an advantage by reducing the cycle of economic losses from a dependence on fossil fuels, to relying on locally produced renewable energy sources found everywhere and readily available for ensuring energy sustainability. 3. Clean Energy is becoming more affordable, with costs trending at a declining rate and becoming more competitive with natural gas, coal, and oil. And 4. Clean Energy is a benefit to local economies due to creating locally produced new jobs in the generation of energy. But research and development must happen faster to make

clean energy solutions viable. Therefore, although, clean energy already makes good business sense, fully realizing its potential, however, requires further innovation to optimize technologies and system integration. A robust new research and development effort would strengthen and ensure global leadership of the American agriculture industry as well as creating new initiatives for rural development through generation of Bioenergy.

#### *Means to Achieve Change*

- Sustainable Clean Energy (\$56,168,000). ARS will:
  - Develop sustainable clean energy conversion technologies (biochemical and thermochemical) focused on bio-jet, renewable marine fuels, oxygenated fuel additives, renewable natural gas, chemicals, and green hydrogen energy systems.
- Biowaste-stream to Bioenergy (\$19,500,000). ARS will:
  - Use existing low-value agricultural waste products to create a renewable flex-use biomethane gas or synthesis gas (a mixture of methane, hydrogen, and carbon oxides).

#### *Partnership and Collaborations*

This initiative requires contributions from ARS scientists working within the four national program areas: Human Nutrition, Food Safety and Quality; Crop Production and Protection; Animal Production and protection; and Natural Resources and Sustainable Agriculture. Along with the National Agricultural Library. External partners include but are not limited to other federal agencies e.g. US Department of Energy, universities, and commercial stakeholders.

- E) An increase of \$16,000,000 for USDA-ARS biotechnology innovation of which \$3,000,000 is for ARS' New Products/Product Quality/Value Added Program.

Biotechnology is providing transformative solutions to many of our Nation's greatest challenges, including human disease and pandemic threats (e.g. SARS-Cov-2) and biomanufacturing (e.g. new foods and industrial feedstocks). Biotechnology can provide the same for our Nation's greatest agricultural challenges, including climate change, invasive pests and disease, food supply inequality, and provide novel opportunities to grow the U.S. economy and workforce. The USDA-ARS biotechnology innovation plan (BI) will provide strategic research planning, organization, resource development, and coordination, to meet these challenges, and accelerate the development and commercialization of new breakthroughs in biotechnology.

The USDA-ARS BI mission is ***to accelerate biotechnology innovation and development, product regulatory approval, and transfer to stakeholders and partners*** for agricultural products grown across the United States, including areas historically left behind by technological innovations. BI will leverage ARS infrastructure, existing projects, and biotechnology expertise to create a "hub-and-spokes" platform for biotechnology discovery, product development, and technology transfer—analogueous to crop and animal breeding.

#### *Means to Achieve Change*

- To enhance crop, animal, and microbial productivity the USDA-ARS BI will develop, assemble, field validate, and gain regulatory approval for a new rapid Microbial Bioengineering Pipeline, including genome editing, synthetic biology, nanotechnology, and microbiome engineering (\$3,000,000). ARS will:
  - Develop new microbes and associated bioprocesses leading to biomanufacturing of new biocontrol agents for crop and animal disease and pest control, science-based principles, and guidance for synthetic biology.

#### *Partnerships and Collaborations*

Internal government collaborators will include action and regulatory agencies such as the Animal and Plant Health Inspection Service. External partners include but are not limited to Department of Health and Human Services: CDC, NIH, BARDA; DoD; DHS; Animal Health Institute; STAR-IDAZ (International Collaboration on Research on Animal and Emerging Zoonotic Diseases); United States Animal Health Association (USAHA); American Association of Veterinary Medical Colleges (AAVMC); and the American Veterinary Medical Association (AVMA).

### ***Livestock Production***

- (2) An increase of \$20,193,000 and 72 staff years for Livestock Production research (\$124,163,000 and 454 staff years available in 2022 annualized CR).

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 wellbeing 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. The research supports many of USDA's Strategic Goals.

The funding change is requested for the following items:

- A) An increase of \$1,381,000 which includes \$940,000 for pay inflation and \$441,000 for FERS for 2022 Pay and FERS.

This increase supports the pay increase which went into effect January 1, 2022, of a 2.7 percent Cost of Living pay increases for civilian employees, and a 1.1 percent increase to cover the expenses for the mandated increase of USDA's contribution to FERS.

Funding for pay and retirement benefit costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Elimination of the pay and retirement benefit costs would require ARS to absorb these costs and reduce planned hiring levels, eroding USDA's ability to meet key Administration priorities.

B) An increase of \$2,454,000 for 2023 Pay.

This increase will support the annualization of the 2022 2.7 percent Cost of Living pay increase and the 2023 4.6 percent Cost of Living pay increase.

Funding for pay costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Elimination of the pay costs would require ARS to absorb these costs and reduce planned hiring levels, eroding USDA's ability to meet key Administration priorities.

C) An increase of \$58,000 for Department's Working Capital Fund and Shared Costs.

This includes \$54,000 for the Department's Working Capital Fund and \$4,000 for Department-Wide Shared Cost Programs. Elimination of these costs would require ARS to absorb these costs and erode USDA's ability to meet key Administration priorities.

D) The President's FY 2023 Budget includes an increase of \$109,000,000 for Climate Science of which \$11,000,000 is for ARS' Livestock Production Program.

The urgency of the global climate crisis is growing. Nearly every aspect of the nation's agricultural enterprise is increasingly called on to contribute to climate change mitigation by reducing GHG emissions, sequestering carbon (C) to reduce atmospheric carbon dioxide (CO<sub>2</sub>), and developing agriculturally based approaches for generating energy as alternatives to fossil fuels. Agriculture is also faced with adapting quickly to unprecedented climate changes and weather extremes with minimal interruptions in production. These enormous challenges call for innovative research supported by bold, trans-disciplinary collaborations. USDA-ARS has research projects and scientific expertise that address many topics related to climate change mitigation and adaptation. This existing infrastructure positions ARS to enable these advancements by establishing new research efforts and collaborations described below to support agriculture's response to the climate crisis.

*Means to Achieve Change*

- Develop new animal feeds that reduce methane emissions (\$5,000,000). ARS will:
  - Develop feeds that meet the nutrient requirements of beef cattle throughout the production cycle while reducing methane emissions.
- Develop insects as animal and aquaculture feed (\$3,000,000). ARS will:
  - Design and implement insect production systems for supplementing poultry and aquaculture feeds with insect ingredients such that the nutrient requirements are met throughout the lifecycle for poultry, trout, hybrid striped bass.
- Develop methods to reduce and mitigate the impacts of climate change on pests and pathogens of livestock, poultry, and aquaculture. (\$3,000,000). ARS will:
  - Develop and implement strategies for reducing or eliminating the on-farm impacts of pests and pathogens on livestock, poultry, and aquaculture species due to climate change.
  - Evaluate germplasm for genetic resistance to pests and pathogens.

*Partnership and Collaborations*

External partners with ARS on this effort are extensive and will include those whose missions and needs contribute to Climate Science advances. These include USDA agencies such as ERS, NASS, NIFA, NRCS, Forest Service; other non-USDA federal agencies, such as EPA, DOE, NASA, NOAA, USGS, Health and



Human Services; state and regional government agencies focused on climate science and its beneficial outcomes; a wide spectrum of Land Grant Universities, their faculty, students, and extension teams; ecosystem service market quantifiers and brokers; NGOs and industry, including but not limited to: Soil Health communities; Conservation Districts; The Nature Conservancy; Field to Market, and other private industries involved with animal and plant breeding, germplasm development, animal welfare, and with sustainability commitments that depend on improved Climate Science.

E) An increase of \$15,000,000 for Improving Specialty Crop and Animal Production for Small Farm Profitability of which \$3,300,000 is for Livestock Production.

There are currently 671,000 growers managing small acreage farms, which includes Native American farmers on tribal lands and other minority-serving farmers and communities. They need highly profitable, climate-resilient crop and animal production to support a robust rural economy, and to meet their cultural and nutritional needs. Small farms represent 90 percent of all farms and more than half of all U.S. farmland. Small farms produced nearly half of U.S. food in 1991, but only 25 percent today. This is because some small farms grow relatively low volumes of lower-value commodities that are vulnerable to market drops, regulatory costs, and climate change impacts. Most specialty crops are grown on large farms that can afford investments in labor and inputs. Therefore, new ARS varieties for small farms must have traits for low input farming and dramatically reduced labor needs that are aligned with small farm management practices. Furthermore, the traditional cultivars of specialty crops are integral to meeting the economy, cultural, and nutritional needs of Native American, Black, and Hispanic populations. Each region of the U.S. produces unique specialty crops and animals adapted to that environment, so ARS needs to improve and identify a diverse portfolio of crops and animals that are regionally-important for small farms.

*Means to Achieve Change*

- Improved specialty crop cultivars and animal germplasm for small farm production (\$3,300,000). ARS will:
  - Identify traits that would enhance small farm production of regionally important specialty crops and animals.
  - Enable adoption of technologies and methods for rapid genomic selection of important traits in specialty crops and animals through support from Breeding Insight (ARS and Cornell University partnership) and other ARS laboratories.
  - Provide genetic resources of improved and traditional specialty crops that meet the economic, cultural, and nutritional needs of underserved Black, Hispanic, and Native American populations.
  - Implement coordinated on-farm trials of new specialty crop cultivars and animal (sheep and goat) lines or breeds using assisted reproductive technologies under small farm management practices.

*Partnership and Collaborations*

Funding will create nationwide coordination among specialty crop growers, animal producers, and small farm research projects in ARS, and opportunities for collaboration with NASS, NIFA, ERS, FS, APHIS, USDA Climate Hubs and NRCS, as well as with NSF, BLM, NOAA, USGS and Tribal Nations. Through these partnerships, ARS will lead the way for conducting research to safeguard the most efficient and safest food production systems in the world.

F) An increase of \$16,000,000 for USDA-ARS biotechnology innovation to which \$1,000,000 is for Livestock Production.

Biotechnology is providing transformative solutions to many of our Nation's greatest challenges, including human disease and pandemic threats (e.g. SARS-Cov-2) and biomanufacturing (e.g. new foods and industrial

feedstocks). Biotechnology can provide the same for our Nation’s greatest agricultural challenges, including climate change, invasive pests and disease, food supply inequality, and provide novel opportunities to grow the U.S. economy and workforce. The USDA-ARS biotechnology innovation plan (BI) will provide strategic research planning, organization, resource development, and coordination, to meet these challenges, and accelerate the development and commercialization of new breakthroughs in biotechnology.

The USDA-ARS BI mission is *to accelerate biotechnology innovation and development, product regulatory approval, and transfer to stakeholders and partners* for agricultural products grown across the United States, including areas historically left behind by technological innovations. BI will leverage ARS infrastructure, existing projects, and biotechnology expertise to create a “hub-and-spokes” platform for biotechnology discovery, product development, and technology transfer—analogue to crop and animal breeding.

#### *Means to Achieve Change*

- To prevent and reduce animal losses and resulting economic devastation due to emerging pathogens and diseases USDA-ARS BI will develop, assemble, field validate, and gain regulatory approval for a new rapid biotechnology-based Animal Biotechnology Development Pipeline (\$1,000,000). ARS will:
  - Develop a new rapid biotechnology-based Animal Veterinary Medical Countermeasures Development Pipeline; includes diagnostics, vaccines and biotherapeutics for the early detection, prevention, and treatment of animal diseases.
  - Develop a new rapid trait innovation pipeline that utilizes next generation sequencing, metabolomics, prediction models, genome editing, synthetic biology, and artificial intelligence and machine learning to address stakeholder priorities, including reduced production costs, reduced mortality and waste, reduced use of medically important antibiotics, and enhanced resistance to environmental stress.

#### *Partnerships and Collaborations*

External partners include but are not limited to:; Department of Health and Human Services: CDC, NIH, BARDA; DoD; DHS; Animal Health Institute; STAR-IDAZ (International Collaboration on Research on Animal and Emerging Zoonotic Diseases); United States Animal Health Association (USAHA); American Association of Veterinary Medical Colleges (AAVMC); and the American Veterinary Medical Association (AVMA).

- G) An increase of \$18,000,000 for Climate Adaptation and Resilience Activities to which \$1,000,000 is for Livestock Production.

President Joe Biden on January 27, 2021 signed the "[Executive Order on Tackling the Climate Crisis at Home and Abroad](#)" which directed federal agencies to develop plans to bolster adaptation and increase resilience to the impacts of climate change. It is critical to national security that agricultural systems have the tools and resources they need to adapt crop and animal production to be resilient to climate change impacts. Crop production must be resilient to drought, temperature extremes, and pests and disease. This includes crop systems based on annuals like corn, soybeans, and wheat; perennial systems like forages and grazed pastures; and larger ecosystems like rangelands. Crop management approaches include developing new crop varieties adapted to climate extremes and pest pressures, implementing crop rotations that reduce pest cycles and are less dependent on inputs, and managing rangeland landscapes to resist weed invasion, recover from wildfire, and provide abundant forage. Animal production must be resilient to temperature extremes and pest and disease pressures. Animal management approaches include promoting breeds adapted to production environments and developing tools so animals are resistant to new pest and disease pressures brought on by weather extremes, like more frequent flooding. Agricultural production must also explore new, more climate resilient approaches to food and animal feed production. A promising, innovative opportunity to diversify our feed production systems is to increase the applicability and impact of insect rearing to provide novel, nutritious livestock feeds while also potentially treating or utilizing certain waste streams. Such new agricultural opportunities hold promise for increasing the

sustainability, resilience and adaptability of feed and livestock production systems. Because climate is changing rapidly and often in unanticipated ways, fully realizing crop and animal production resilience requires further innovation to optimize technologies and system integration. A robust new research and development effort would strengthen the American agriculture industry, ensure the stability of food production, and creating new initiatives for farm enterprises and rural development.

#### *Means to Achieve Change*

- Innovating novel, resilient, high-protein feed production (\$1,000,000). ARS will:
  - Develop insect meal formulations that can improve adaptation of fish to higher temperatures.

#### *Partnership and Collaborations*

Funding will create nationwide coordination among crop, animal, and insect research projects in ARS, and opportunities for collaboration with USDA Climate Hubs, USFS, NRCS, APHIS, and NIFA, as well as with BLM, and Tribal Nations. Through these partnerships, ARS will lead the way for conducting research to safeguard the most resilient production systems in the world.

### ***Crop Production***

- (3) An increase of \$46,862,000 and 141 staff years for Crop Production research (\$299,882,000 and 1,175 staff years available in 2022 annualized CR).

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. The research supports many of USDA's Strategic Goals.

The funding change is requested for the following items:

- A) An total increase of \$3,574,000 which includes \$2,433,000 for pay inflation and \$1,141,000 for FERS for 2022 Pay and FERS.

This increase supports the pay increase which went into effect January 1, 2022, of a 2.7 percent Cost of Living pay increases for civilian employees, and a 1.1 percent increase to cover the expenses for the mandated increase of USDA's contribution to FERS.

Funding for pay and retirement benefit costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Elimination of the pay and retirement benefit costs would require ARS to absorb these costs and reduce planned hiring levels, eroding USDA's ability to meet key Administration priorities.

- B) An increase of \$6,110,000 for 2023 Pay.

This increase will support the annualization of the 2022 2.7 percent Cost of Living pay increase and the 2023 4.6 percent Cost of Living pay increase.

Funding for pay costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Elimination of the pay costs would require ARS to absorb these costs and reduce planned hiring levels, eroding USDA's ability to meet key Administration priorities.

- C) An increase of \$144,000 for Department's Working Capital Fund and Shared Costs.

This includes \$135,000 for the Department's Working Capital Fund and \$9,000 for Department-Wide Shared Cost Programs. Elimination of these costs would require ARS to absorb these costs and erode USDA's ability to meet key Administration priorities.

- D) The President's FY 2023 Budget includes an increase of \$101,000,000 for Clean Energy of which \$11,634,000 is for ARS' Crop Production Program.

President Joe Biden on January 27, 2021 signed the "[Executive Order on Tackling the Climate Crisis at Home and Abroad](#)" which ordered federal agencies to develop clean energy technologies and accelerate clean energy generation projects that stimulates clean energy industries and benefits rural economies. The change to clean energy, and away from fossil-based energy, works by producing power without the negative environmental impacts such as greenhouse gases, like carbon dioxide and methane. And is generated from renewable, zero emission sources that do not pollute the atmosphere, as well as energy saved by energy efficiency measures. The various sources of clean energy are wind, solar, tidal, geothermal, nuclear, hydrogen, and agriculturally based, renewable biomass feedstocks. The need for clean energy is multi-purposed: 1. it's important for future generations, as clean energy sources are inexhaustible and adapt well to natural cycles and do not emit greenhouse gases. 2. Clean Energy gives local economies an advantage by reducing the cycle of economic losses from a dependence on fossil fuels, to relying on locally produced renewable energy sources found everywhere and readily available for ensuring energy sustainability. 3. Clean Energy is becoming more affordable, with costs trending at a declining rate and becoming more competitive with natural gas, coal, and oil. And 4. Clean Energy is a benefit to local economies due to creating locally produced new jobs in the generation of energy. But research and development must happen faster to make clean energy solutions viable. Therefore, although, clean energy already makes good business sense, fully realizing its potential, however, requires further innovation to optimize technologies and system integration.

*Means to Achieve Change*

- Sustainable Clean Energy (\$2,834,000). ARS will:
  - Develop new sustainable varieties of sugar and oil crops.

- Clean Energy Feedstocks (\$8,800,000). ARS will:
  - Develop cellulosic feedstocks that overcome barriers to clean energy bioconversion and germplasm with greater resistance to insects and diseases for higher biomass yield potential.

#### *Partnership and Collaborations*

External partners include but are not limited to DOE and other federal agencies, universities, and commercial stakeholders.

#### E) An increase of \$109,000,000 for Climate Science of which \$11,050,000 is for ARS' Crop Production Program.

The urgency of the global climate crisis is growing. Nearly every aspect of the nation's agricultural enterprise is increasingly called on to contribute to climate change mitigation by reducing GHG emissions, sequestering carbon (C) to reduce atmospheric carbon dioxide (CO<sub>2</sub>), and developing agriculturally based approaches for generating energy as alternatives to fossil fuels. Agriculture is also faced with adapting quickly to unprecedented climate changes and weather extremes with minimal interruptions in production. These enormous challenges call for innovative research supported by bold, trans-disciplinary collaborations. USDA-ARS has research projects and scientific expertise that address many topics related to climate change mitigation and adaptation. This existing infrastructure positions ARS to enable these advancements by establishing new research efforts and collaborations described below to support agriculture's response to the climate crisis.

#### *Means to Achieve Change*

- Breed crops to survive climate change impacts while maintaining yield, agronomic, nutritional, and industrial output (\$3,000,000). ARS will:
  - Develop high yielding crop varieties with climate resilient traits that are equipped with genes to preserve improved nutritional quality when grown under extreme climates.
  - Apply novel methods, including AI and machine learning, to elucidate the underlying physiological and elements of exposure to changing climate, determine the sensitivity of crops to various elements of extreme climates and assess physiological outcomes of prolonged exposure to climate extremes.
  - Produce new varieties and cultivars for American farmers that ensure adequate production, processing, and utilization of nutritious food and rural prosperity.
- Uncover new sources of climate resilience in ARS gene banks through novel, leading-edge, high through-put evaluation. (\$3,000,000). ARS will:
  - Develop and implement novel, high through-put "phenomic" and multiple trait evaluations, analytical methods (involving hyperspectral imagery, weather sensors, UAVs), and data handling capacities to identify traits and germplasm for adapting crops in diverse US production regions to climate change.
- Mitigate climate change in crop production to develop crops with reduced greenhouse gas emissions and increased capacity for carbon banking. (\$2,000,000). ARS will:
  - Improve the capture and storage of carbon in woody, perennial, and cover crops.
  - Develop carbon monitoring, measuring, and storage technologies in both above- and below-ground agricultural production.
  - Reduce greenhouse gas emissions in specialty crop and field crop production systems using crop production innovations, microbes, and engineering alternatives.

- Protect pollinators from the damages of climate change. (\$2,300,000). ARS will:
  - Develop a Bee Climate Change Center to evaluate the use of bees as sentinel species of the negative effects of climate change, with the goal of protecting the Nation's pollinators and ensuring adequate pollination of specialty crops and survival of natural ecosystems.
- Understand climate change effects on the invasion biology of emerging and invasive pests. (\$250,000). ARS will:
  - Evaluate the unpredictability in weather patterns associated with early seasonal warmth and increased rainfall or drought to see how they affect pest populations, their movement in the environment, and their impact on crops and natural ecosystems.
- Develop effective tools to manage pests, pathogens, and weeds in a changing environment. (\$500,000). ARS will:
  - Enhance Climate Hub direct activities by strategic engagement of critical needs of each regional hub.
  - Promote and integrate climate hub programming and communication and synthesis needs.

#### *Partnership and Collaborations*

External partners with ARS on this effort are extensive and will include those whose missions and needs contribute to Climate Science advances. These include USDA agencies such as ERS, NASS, NIFA, NRCS, Forest Service; other non-USDA federal agencies, such as EPA, DOE, NASA, NOAA, USGS, Health and Human Services; state and regional government agencies focused on climate science and its beneficial outcomes; a wide spectrum of Land Grant Universities, their faculty, students, and extension teams; ecosystem service market quantifiers and brokers; NGOs and industry, including but not limited to: Soil Health communities; Conservation Districts; The Nature Conservancy; Field to Market, and other private industries involved with animal and plant breeding, germplasm development, animal welfare, and with sustainability commitments that depend on improved Climate Science.

#### F) An increase of \$15,000,000 for Improving Specialty Crop and Animal Production for Small Farm Profitability for which \$5,100,000 is for Crop Production.

There are currently 671,000 growers managing small acreage farms, which includes Native American farmers on tribal lands and other minority-serving farmers and communities. They need highly profitable, climate-resilient crop and animal production to support a robust rural economy, and to meet their cultural and nutritional needs. Small farms represent 90 percent of all farms and more than half of all U.S. farmland. Small farms produced nearly half of U.S. food in 1991, but only 25 percent today. This is because some small farms grow relatively low volumes of lower-value commodities that are vulnerable to market drops, regulatory costs, and climate change impacts. Most specialty crops are grown on large farms that can afford investments in labor and inputs. Therefore, new ARS varieties for small farms must have traits for low input farming and dramatically reduced labor needs that are aligned with small farm management practices. Furthermore, the traditional cultivars of specialty crops are integral to meeting the economy, cultural, and nutritional needs of Native American, Black, and Hispanic populations. Each region of the U.S. produces unique specialty crops and animals adapted to that environment, so ARS needs to improve and identify a diverse portfolio of crops and animals that are regionally important for small farms.

#### Means to Achieve Change

- Improved specialty crop cultivars and animal germplasm for small farm production (\$2,700,000). ARS will:
  - Identify traits that would enhance small farm production of regionally important specialty crops.

- Provide genetic resources of improved and traditional specialty crops that meet the economic, cultural, and nutritional needs of underserved Black, Hispanic, and Native American populations.
- Precision production systems that utilize AI and machine learning decision support tools (\$2,000,000). ARS will:
  - Develop small farm decision support tools for plant stress, disease incidence, insect monitoring, and crop development using continuous and real-time measurements from low-cost sensors such as cell phone cameras.
  - Investigate the application of advanced technology for automated weed, pest, and disease identification and precision management using UAVs and robotic systems.
  - Engineer labor-free, automated harvesting for small-scale specialty crop production.
- Disease, insect pest, and weed management practices for diversified small farm production of specialty crops and animals, especially under high-value or organic production systems (\$400,000). ARS will:
  - Low-cost, integrated insect, weed, and disease management systems that are suitable for organic or conventional production of specialty crops and animals, including intercropping, cover cropping, and multi-species cropping.

#### *Partnership and Collaborations*

Funding will create nationwide coordination among specialty crop growers, animal producers, and small farm research projects in ARS, and opportunities for collaboration with NASS, NIFA, ERS, FS, APHIS, USDA Climate Hubs and NRCS, as well as with NSF, BLM, NOAA, USGS and Tribal Nations. Through these partnerships, ARS will lead the way for conducting research to safeguard the most efficient and safest food production systems in the world.

#### G) An increase of \$14,000,000 for Mitigating the Impact of Extreme Weather Events to Ensure Production System Sustainability for which \$4,000,000 is for Crop Production.

The incidence of extreme weather events is increasing, and climate change is accelerating the rate of incidence. As of June 2021, 98 percent of the U.S. western states are experiencing some level of drought. Recent landslides in California were initiated by drought, then wind-enhanced wildfire, and finally storm runoff on burned areas without vegetative protection. Historic flooding in the Midwest in 2019 prevented farmers from planting 19.6 million acres and resulted in more than \$2 billion in crop losses and damage in Iowa alone. All these events were caused by a sequence of climate and weather extremes. Advanced informatics and data analytics technologies are needed to model and predict the impacts of these extreme events, advance the precision of surface and groundwater best management practices, and increase the ability of soils to absorb and hold water. These advances will improve the economic and environmental sustainability of food, fiber, and biofuels production, develop irrigation practices to optimize water use, and aide groundwater recharge and sustain surface water storage at different scales. Beyond crop and animal production losses, extreme weather events can lead to devastating soil loss through water erosion from flooding and wind erosion of excessively dry, bare soils. Once lost, soil resources are effectively gone for centuries. Advancing informatics and data analytics to better predict, model, and mitigate basic wind and water erosion processes through novel and optimized best management practices will improve the economic and environmental sustainability of agricultural production.

#### *Means to Achieve Change*

- Crop Improvement for drought and excess water tolerance (\$4,000,000).
  - Evaluate drought and water tolerance including environmental, nutrient, and management interactions under field conditions using high-throughput phenotyping technology on many genotypes.

- Identify genetic pathways for drought-resistance, water-tolerance, and beneficial root-microbiome interactions; and assess their potential in breeding.
- Accelerate breeding of drought-resistant and water-tolerant cultivars through selection based on a comprehensive testing and genome-enabled strategies.

#### *Partnership and Collaborations*

Funding will create nationwide coordination among crop and livestock producers and water and erosion research projects in ARS, and opportunities for collaboration with NRCS, USFS, BLM, USGS, NOAA, NASA, NIFA, USDA Climate Hubs, U.S. Army Corp of Engineers, U.S. Bureau of Reclamation, and FEMA. Through these partnerships, ARS will lead the way for conducting research to safeguard the most efficient food production systems in the world.

#### H) An increase of \$16,000,000 for USDA-ARS biotechnology innovation of which \$4,000,000 is for Crop Production.

Biotechnology is providing transformative solutions to many of our Nation’s greatest challenges, including human disease and pandemic threats (e.g. SARS-Cov-2) and biomanufacturing (e.g. new foods and industrial feedstocks). Biotechnology can provide the same for our Nation’s greatest agricultural challenges, including climate change, invasive pests and disease, food supply inequality, and provide novel opportunities to grow the U.S. economy and workforce. The USDA-ARS biotechnology innovation plan (BI) will provide strategic research planning, organization, resource development, and coordination, to meet these challenges, and accelerate the development and commercialization of new breakthroughs in biotechnology.

The USDA-ARS BI mission is ***to accelerate biotechnology innovation and development, product regulatory approval, and transfer to stakeholders and partners*** for agricultural products grown across the United States, including areas historically left behind by technological innovations. BI will leverage ARS infrastructure, existing projects, and biotechnology expertise to create a “hub-and-spokes” platform for biotechnology discovery, product development, and technology transfer—analogue to crop and animal breeding.

#### *Means to Achieve Change*

- To prevent and reduce animal losses and resulting economic devastation due to emerging pathogens and diseases USDA-ARS BI will develop, assemble, field validate, and gain regulatory approval for a new rapid biotechnology-based Animal Biotechnology Development Pipeline (\$2,000,000). ARS will:
  - Develop a new rapid trait innovation pipeline that utilizes next generation sequencing, metabolomics, prediction models, genome editing, synthetic biology, and artificial intelligence and machine learning to address stakeholder priorities, including reduced production costs, reduced mortality and waste, reduced use of medically important antibiotics, and enhanced resistance to environmental stress.
- To reduce crop losses and economic devastation due to diseases and pathogens and accelerate crop genetic improvement USDA-ARS BI will develop, assemble, field validate, and gain regulatory approval for a new rapid biotechnology-based Crop Biotechnology Development Pipeline (\$2,000,000). ARS will:
  - Develop a new rapid biotechnology-based trait innovation pipeline, including genome editing, synthetic biology, and nanotechnology; priority trait areas include disease and pest resistance, climate change resilience and mitigation, resource use efficiency, and feedstock enhancement for biomanufacturing.

#### *Partnerships and Collaborations*

Internal government collaborators will include action and regulatory agencies such as the Animal and Plant Health Inspection Service. External partners include but are not limited to Department of Health and Human



Services: CDC, NIH, BARDA; DoD; DHS; Animal Health Institute; STAR-IDAZ (International Collaboration on Research on Animal and Emerging Zoonotic Diseases); United States Animal Health Association (USAHA); American Association of Veterinary Medical Colleges (AAVMC); and the American Veterinary Medical Association (AVMA).

I) An increase of \$18,000,000 for Climate Adaptation and Resilience Activities to which \$1,250,000 is for Crop Production.

President Joe Biden on January 27, 2021 signed the "[Executive Order on Tackling the Climate Crisis at Home and Abroad](#)" which directed federal agencies to develop plans to bolster adaptation and increase resilience to the impacts of climate change. It is critical to national security that agricultural systems have the tools and resources they need to adapt crop and animal production to be resilient to climate change impacts. Crop production must be resilient to drought, temperature extremes, and pests and disease. This includes crop systems based on annuals like corn, soybeans, and wheat; perennial systems like forages and grazed pastures; and larger ecosystems like rangelands. Crop management approaches include developing new crop varieties adapted to climate extremes and pest pressures, implementing crop rotations that reduce pest cycles and are less dependent on inputs, and managing rangeland landscapes to resist weed invasion, recover from wildfire, and provide abundant forage. Animal production must be resilient to temperature extremes and pest and disease pressures. Animal management approaches include promoting breeds adapted to production environments and developing tools so animals are resistant to new pest and disease pressures brought on by weather extremes, like more frequent flooding. Agricultural production must also explore new, more climate resilient approaches to food and animal feed production. A promising, innovative opportunity to diversify our feed production systems is to increase the applicability and impact of insect rearing to provide novel, nutritious livestock feeds while also potentially treating or utilizing certain waste streams. Such new agricultural opportunities hold promise for increasing the sustainability, resilience and adaptability of feed and livestock production systems. Because climate is changing rapidly and often in unanticipated ways, fully realizing crop and animal production resilience requires further innovation to optimize technologies and system integration. A robust new research and development effort would strengthen the American agriculture industry, ensure the stability of food production, and creating new initiatives for farm enterprises and rural development.

*Means to Achieve Change*

- Crop and rangeland resilience to drought, temperature extremes, and invasive weeds (\$1,250,000). ARS will:
  - Conserve and utilize plant genetic resources to adapt crops to drought and high temperatures

*Partnership and Collaborations*

Funding will create nationwide coordination among crop, animal, and insect research projects in ARS, and opportunities for collaboration with USDA Climate Hubs, USFS, NRCS, APHIS, and NIFA, as well as with BLM, and Tribal Nations. Through these partnerships, ARS will lead the way for conducting research to safeguard the most resilient production systems in the world.

***Food Safety***

(4) An increase of \$14,044,000 and 21 staff years for Food Safety research (\$115,690,000 and 678 staff years available in 2022 annualized CR).

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. The research supports many of USDA's Strategic Goals.

The funding change is requested for the following items:

- A) An increase of \$2,062,000 which includes \$1,404,000 for pay inflation and \$658,000 for FERS for 2022 Pay and FERS.

This increase supports the pay increase which went into effect January 1, 2022, of a 2.7 percent Cost of Living pay increases for civilian employees, and a 1.1 percent increase to cover the expenses for the mandated increase of USDA's contribution to FERS.

Funding for pay and retirement benefit costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Elimination of the pay and retirement benefit costs would require ARS to absorb these costs and reduce planned hiring levels, eroding USDA's ability to meet key Administration priorities.

- B) An increase of \$3,402,000 for 2023 Pay.

This increase will support the annualization of the 2022 2.7 percent Cost of Living pay increase and the 2023 4.6 percent Cost of Living pay increase.

Funding for pay costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Elimination of the pay costs would require ARS to absorb these costs and reduce planned hiring levels, eroding USDA's ability to meet key Administration priorities.

- C) An increase of \$80,000 for Department's Working Capital Fund and Shared Costs.

This includes \$75,000 for the Working Capital Fund and \$5,000 for Department-Wide Shared Cost Programs. Elimination of these costs would require ARS to absorb these costs and erode USDA's ability to meet key Administration priorities.

- D) An increase of \$109,000,000 for Climate Science of which \$8,000,000 is for ARS' Food Safety Program.

The urgency of the global climate crisis is growing. Nearly every aspect of the nation's agricultural enterprise is increasingly called on to contribute to climate change mitigation by reducing GHG emissions, sequestering

carbon (C) to reduce atmospheric carbon dioxide (CO<sub>2</sub>), and developing agriculturally based approaches for generating energy as alternatives to fossil fuels. Agriculture is also faced with adapting quickly to unprecedented climate changes and weather extremes with minimal interruptions in production. These enormous challenges call for innovative research supported by bold, trans-disciplinary collaborations. USDA-ARS has research projects and scientific expertise that address many topics related to climate change mitigation and adaptation. This existing infrastructure positions ARS to enable these advancements by establishing new research efforts and collaborations described below to support agriculture's response to the climate crisis.

#### *Means to Achieve Change*

- Mitigate the Impact of Mycotoxins to the Food and Feed Supply (\$3,000,000). ARS will:
  - Determine the genetic basis for enhanced resistance to Fusarium mycotoxin contamination of cereal crops such as wheat, barley, oats, and corn.
  - Use bioinformatic resources to identify novel sources of resistance resources so that breeders can develop climate resistant varieties.
  - Delineate the molecular basis of Aspergillus flavus resistance in corn.
  - Identify novel regulatory genes and gene networks that play key roles in host plant resistance against the fungus to contribute in marker-assisted breeding.
  - Apply functional genomics and bioinformatic resources to identify metabolic pathways that contribute to resistance to Aspergillus flavus and aflatoxin production.
  - Develop transgenic corn lines for cereal production expressing antifungal capacities that inhibit Aspergillus flavus contamination.
- Mitigate Climate-Driven Food Safety Risks Caused by Food and Waterborne Pathogens (\$5,000,000). ARS will:
  - Use high-throughput genomic technologies and bioinformatics to identify current and emerging parasites responsible for foodborne illnesses from a range of complex environments affected by climate change.
  - Use mathematical modeling and artificial intelligence to assess complexities of climate and infection interactions that allow testing of adaption or mitigation measures to counteract the negative impacts of climate change on agricultural systems, food safety and public health.
  - Use genomic and advanced bioinformatic analytical tools to determine how climate-related stressors cause functional shifts in the broiler chicken gut microbiome and changes in enteric neurochemistry.

#### *Partnership and Collaborations*

External partners with ARS on this effort are extensive and will include those whose missions and needs contribute to Climate Science advances. These include USDA agencies such as ERS, NASS, NIFA, NRCS, Forest Service; other non-USDA federal agencies, such as EPA, DOE, NASA, NOAA, USGS, Health and Human Services; state and regional government agencies focused on climate science and its beneficial outcomes; a wide spectrum of Land Grant Universities, their faculty, students, and extension teams; ecosystem service market quantifiers and brokers; NGOs and industry, including but not limited to: Soil Health communities; Conservation Districts; The Nature Conservancy; Field to Market, and other private industries involved with animal and plant breeding, germplasm development, animal welfare, and with sustainability commitments that depend on improved Climate Science.

- E) An increase of \$18,000,000 for Climate Adaptation and Resilience Activities for which \$500,000 is for Food Safety.

President Joe Biden on January 27, 2021 signed the "[Executive Order on Tackling the Climate Crisis at Home and Abroad](#)" which directed federal agencies to develop plans to bolster adaptation and increase resilience to the impacts of climate change. It is critical to national security that agricultural systems have the tools and resources they need to adapt crop and animal production to be resilient to climate change impacts. Crop production must be resilient to drought, temperature extremes, and pests and disease. This includes crop systems based on annuals like corn, soybeans, and wheat; perennial systems like forages and grazed pastures; and larger ecosystems like rangelands. Crop management approaches include developing new crop varieties adapted to climate extremes and pest pressures, implementing crop rotations that reduce pest cycles and are less dependent on inputs, and managing rangeland landscapes to resist weed invasion, recover from wildfire, and provide abundant forage. Animal production must be resilient to temperature extremes and pest and disease pressures. Animal management approaches include promoting breeds adapted to production environments and developing tools so animals are resistant to new pest and disease pressures brought on by weather extremes, like more frequent flooding. Agricultural production must also explore new, more climate resilient approaches to food and animal feed production. A promising, innovative opportunity to diversify our feed production systems is to increase the applicability and impact of insect rearing to provide novel, nutritious livestock feeds while also potentially treating or utilizing certain waste streams. Such new agricultural opportunities hold promise for increasing the sustainability, resilience and adaptability of feed and livestock production systems. Because climate is changing rapidly and often in unanticipated ways, fully realizing crop and animal production resilience requires further innovation to optimize technologies and system integration. A robust new research and development effort would strengthen the American agriculture industry, ensure the stability of food production, and creating new initiatives for farm enterprises and rural development.

#### *Means to Achieve Change*

- Innovating novel, resilient, high-protein feed production (\$500,000). ARS will:
  - Explore insect rearing as an opportunity to convert mycotoxin-contaminated grain into nutritious livestock feed

#### *Partnership and Collaborations*

Funding will create nationwide coordination among crop, animal, and insect research projects in ARS, and opportunities for collaboration with USDA Climate Hubs, USFS, NRCS, APHIS, and NIFA, as well as with BLM, and Tribal Nations. Through these partnerships, ARS will lead the way for conducting research to safeguard the most resilient production systems in the world.

#### ***Livestock Protection***

- (5) An increase of \$32,689,000 and 60 staff years for Livestock Protection research (\$127,376,000 and 460 staff years available in 2022 annualized CR).

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. The research supports many of USDA's Strategic Goals.

The funding change is requested for the following items:

- A) An increase of \$1,400,000 which includes \$953,000 for pay inflation and \$447,000 for FERS for 2022 Pay and FERS.

This increase will support a 2.7 percent Cost of Living pay increases for civilian employees, and a 1.1 percent increase to cover the expenses for the mandated increase of USDA's contribution to FERS.

Funding for pay and retirement benefit costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Elimination of the pay and retirement benefit costs would require ARS to absorb these costs and reduce planned hiring levels, eroding USDA's ability to meet key Administration priorities.

- B) An increase of \$2,382,000 for 2023 Pay.

This increase will support the annualization of the 2022 2.7 percent Cost of Living pay increase and the 2023 4.6 percent Cost of Living pay increase.

Funding for pay costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Elimination of the pay costs would require ARS to absorb these costs and reduce planned hiring levels, eroding USDA's ability to meet key Administration priorities.

- C) An increase of \$57,000 for Department's Working Capital Fund and Shared Costs.

This includes \$53,000 for the Department's Working Capital Fund and \$4,000 for Department-Wide Shared Cost Programs. Elimination of these costs would require ARS to absorb these costs and erode USDA's ability to meet key Administration priorities.

D) An increase of \$109,000,000 for Climate Science of which \$5,500,000 is for ARS' Livestock Protection Program.

The urgency of the global climate crisis is growing. Nearly every aspect of the nation's agricultural enterprise is increasingly called on to contribute to climate change mitigation by reducing GHG emissions, sequestering carbon (C) to reduce atmospheric carbon dioxide (CO<sub>2</sub>), and developing agriculturally based approaches for generating energy as alternatives to fossil fuels. Agriculture is also faced with adapting quickly to unprecedented climate changes and weather extremes with minimal interruptions in production. These enormous challenges call for innovative research supported by bold, trans-disciplinary collaborations. USDA-ARS has research projects and scientific expertise that address many topics related to climate change mitigation and adaptation. This existing infrastructure positions ARS to enable these advancements by establishing new research efforts and collaborations described below to support agriculture's response to the climate crisis.

*Means to Achieve Change*

- Develop methods to reduce and mitigate the impacts of climate change on pests and pathogens of livestock, poultry, and aquaculture. (\$5,500,000). ARS will:
  - Implement strategies for reducing or eliminating the on-farm impacts of Vesicular Stomatitis Virus and stable flies resulting from climate change.
  - Develop countermeasures to Orbivirus of livestock, including bluetongue and epizootic Hemorrhagic Fever.
  - Predict and control Vesicular Stomatitis Virus (VSV) in North America.
  - Develop Detection and Control Strategies for tick transmitted Bovine Babesiosis and anaplasmosis.

*Partnership and Collaborations*

External partners with ARS on this effort are extensive and will include those whose missions and needs contribute to Climate Science advances. These include USDA agencies such as ERS, NASS, NIFA, NRCS, Forest Service; other non-USDA federal agencies, such as EPA, DOE, NASA, NOAA, USGS, Health and Human Services; state and regional government agencies focused on climate science and its beneficial outcomes; a wide spectrum of Land Grant Universities, their faculty, students, and extension teams; ecosystem service market quantifiers and brokers; NGOs and industry, including but not limited to: Soil Health communities; Conservation Districts; The Nature Conservancy; Field to Market, and other private industries involved with animal and plant breeding, germplasm development, animal welfare, and with sustainability commitments that depend on improved Climate Science.

E) An increase of \$11,600,000 for the National Bio and Agro-Defense Facility—Research.

The National Bio- and Agro-Defense Facility (NBAF), located in Manhattan, Kansas, will be a state-of-the-art biocontainment facility for the study of foreign, emerging, and zoonotic animal diseases that pose a threat to United States animal agriculture and public health. The facility will serve as a "One Health" national and international resource, offering capabilities for training, research and development, surveillance, prevention, and response to emerging infectious diseases. NBAF will provide the first U.S large animal biosafety level-4 (BSL-4) facilities to house livestock infected with zoonotic agents within the highest biocontainment envelope, a critical capability that is currently lacking in the U.S. NBAF will also house a Biologics Development Module that will provide small scale production of standardized biological reagents needed for basic and applied research, and biological test materials for supporting proof-of-concept studies and early phase veterinary medical countermeasures development.

*Means to Achieve Change*

- NBAF Research Programs for Rift Valley Fever, Japanese encephalitis, Crimean-Congo Hemorrhagic Fever, and Nipah virus (\$8,300,000). ARS will:
  - Develop new medical countermeasures to recover from Rift Valley Fever virus outbreaks with the development of next generation vaccines and diagnostics engineered to differentiate vaccinated from infected animals.
  - Identify molecular determinants responsible for the evolution of new genotypes of Japanese encephalitis viruses and their impact on viral pathogenesis and maintenance in mosquito vectors and animal hosts.
  - Determine the role of other animal species in the epidemiological cycle of Japanese encephalitis virus in areas where densities of pigs are low.
  - Determine the transmission cycle of Crimean-Congo Hemorrhagic Fever virus from animals to humans, including the viral infectious dose, the period of time infected animals shed the virus, and whether domestic ruminants can shed the virus in milk.
  - Determine the competence of U.S hard ticks for Crimean-Congo Hemorrhagic Fever virus.
  - Identify geographical areas of risk for the establishment of the Crimean-Congo Hemorrhagic Fever virus vectors taking into consideration climatic and ecological conditions.
  - Determine if antibodies in cattle infected with Crimean-Congo-Hemorrhagic Fever are protective.
  - Develop vaccines for Crimean-Congo Hemorrhagic Fever virus reservoir animals to avoid tick-based infection and transmission.
  - Determine the extent of henipavirus species and strains circulating in Pteropus bats and assess their potential for causing disease in domestic animals.
  - Determine innate defense mechanisms responsible for limiting Nipah virus replication in bats.
  - Identify determinants of Nipah virus virulence in domestic pigs.
  - Determine correlates of Nipah virus protective immunity in pigs.
  - Determine the effectiveness of available Nipah virus vaccine platforms in pigs.
- NBAF Partnerships and Innovation (\$1,000,000). ARS will:
  - Provide the framework by which NBAF will enhance America's agricultural biosecurity by forming strategic partnerships to support the NBAF Strategic Plan and National Biodefense Strategy.
- NBAF Biologics Development Module (\$2,300,000). ARS will:
  - Create dedicated space for the early stage development of veterinary medical countermeasures and enable their transfer to commercial partners for full development.
  - Accelerate the development of platform technologies and medical countermeasures through the early development stage to a development ready.
  - Produce master seeds and cells for viral vaccine production.
  - Produce recombinant proteins, monoclonal antibodies, and diagnostic reagents to support the development of point-of-care diagnostics.

- Support biologics development activities including process development and scale up.

#### *Partnership and Collaborations*

External partners include but are not limited to: National Cattleman’s Beef Association; National Pork Board; Animal and Plant Health Inspection Service; Department of Health and Human Services: CDC, NIH, BARDA; DoD; DHS; Animal Health Institute; STAR-IDAZ (International Collaboration on Research on Animal and Emerging Zoonotic Diseases); United States Animal Health Association (USAHA); Kansas State University; American Association of Veterinary Medical Colleges (AAVMC); and the American Veterinary Medical Association (AVMA).

- F) An increase of \$5,500,000 for FY 2023 for the research and development of veterinary medical countermeasures at the NBAF.

Current facilities at the Plum Island Animal Disease Center (PIADC) do not have the dedicated specialized space needed to support the early development and technology transfer of veterinary medical countermeasures (MCM). This is a major gap as the incentive for pharmaceutical companies to develop and manufacture MCM for foreign animal diseases (FAD) is limited as there is a very limited market for these products in the United States. There is therefore a critical need to mitigate the risks associated with developing MCM to incentivize pharmaceutical companies to invest in their development, registration, stockpiling, and distribution. The construction of new facilities at the NBAF provides this opportunity to enhance USDA’s ability in this realm.

These capabilities will ensure that our nation has the capacity to develop promising bio and agro-defense countermeasures, assess their safety and effectiveness, expedite their development, and provide test and evaluation capacity to support rapid licensure. The plan has been for NBAF and the Biologics Development Module (BDM) to possess the capability to rapidly produce experimental biologicals, diagnostics, and vaccine-related products for potential use by USDA in an outbreak of an emerging animal disease. The facility mission will therefore directly support and accelerate technology transfer to commercial veterinary biologic manufacturers (e.g., vaccines, diagnostics, veterinary medical countermeasures [MCMs], and biotherapeutics).

Funding this Initiative addresses draft Department’s Strategic Goal, Families Have Plenty of Safe, Nutritious Food to Eat. Work at NBAF and the BDM is intended to enable rapid scaling of ideas to test at greater volumes and industry relevant methodologies. These funds will provide the necessary resources to realize that capacity.

Partnerships and technology transfer are intrinsic components of the NBAF and BDM missions. Technology transfer relies on partnerships to make the information and technologies developed through research available for broad adoption. NBAF and the BDM will use the whole range of technology transfer mechanisms, from publication to patents and licensing. However, the BDM will largely focus on establishing cooperative research agreements with various pharmaceutical industry partners in order to develop fully deployable medical countermeasures from candidates identified thorough NBAF research programs. Working Cap, Climate Science, Clean Energy, Improving Specialty Crop and Animal Production, Mitigating the Impact of Extreme Weather, ARS Bio Innovation, Adaptation and Resilience Working Cap, Climate Science, Clean Energy, Improving Specialty Crop and Animal Production, Mitigating the Impact of Extreme Weather, ARS Bio Innovation, Adaptation and Resilience Working Cap, Climate Science, Clean Energy, Improving Specialty Crop and Animal Production, Mitigating the Impact of Extreme Weather, ARS Bio Innovation, Adaptation and Resilience

Industry partners at NBAF and the BDM will leverage the ideas, creativity, and expertise of ARS research scientists and BDM experts throughout discovery and early development to create the best possible candidate countermeasure for transfer. Additionally, a dedicated, experienced team in the BDM will “de-risk” early development and optimize small-scale processes to transform candidate veterinary medical countermeasures into more mature products, ready for transfer to industry partners.



These funds will enhance ARS' ability to conduct the critical, scalable and practical research for advanced development of technologies, equipment and products leading to effective veterinary medical countermeasures (MCM). This investment will enhance and expedite the transition from research to commercially viable countermeasures and place NBAF at the nexus of the biodefense and agro-defense domains and establish NBAF as a leader among biocontainment laboratories.

#### *Means to Achieve Change*

- NBAF Research Programs for Veterinary Medical Countermeasures (\$5,500,000). ARS will:
  - Find new solutions to prevent economic losses from foreign animal diseases in agricultural and wild-life species;
  - Discover effective countermeasures to prevent and eliminate the threat of zoonotic diseases in agricultural and wild-life species;
  - Provide scientific information to enable the establishment of on-farm practices to maximize biosecurity from naturally or intentionally introduced pathogens that will increase food security, farm productivity, and secure trade and exports;
  - Establish methods to detect, analyze and respond to new and emerging agricultural pathogens;
  - Find solutions to maintain barriers to pathogens at the domestic-wildlife interface;
  - Build an integrated research program to discover host genetic variations associated with disease susceptibility and resistance;
  - Develop 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;
  - Develop quick and cost-effective sampling and detection methodologies;
  - Develop integrated predictive modeling capability for emerging and/or intentionally released infectious diseases of animals and the collection of data to support these models;
  - Exploit recent advances in biotechnology to develop novel detection systems and broad-spectrum vaccines and biotherapeutics to counter the threat of emerging diseases or engineered biological weapons.

#### *Partnership and Collaborations*

External partners include but are not limited to land grant universities (e.g. Kansas State University; Iowa State University; Penn State University, University of Georgia). Federal partners such as Department of Health and Human Services - CDC, NIH, APHIS, DHS, DoD, USGS, and Department of State. Foreign collaborations with countries where the critical diseases are endemic, industry scientists from large and small bio-pharmaceutical companies and animal health and medical countermeasure providers, including those working in the Kansas City Animal Health Corridor.

- G) An increase of \$16,000,000 for USDA-ARS biotechnology innovation for which \$4,750,000 is for Livestock Protection.

Biotechnology is providing transformative solutions to many of our Nation's greatest challenges, including human disease and pandemic threats (e.g. SARS-Cov-2) and biomanufacturing (e.g. new foods and industrial feedstocks). Biotechnology can provide the same for our Nation's greatest agricultural challenges, including climate change, invasive pests and disease, food supply inequality, and provide novel opportunities to grow the U.S. economy and workforce. The USDA-ARS biotechnology innovation plan (BI) will provide strategic

research planning, organization, resource development, and coordination, to meet these challenges, and accelerate the development and commercialization of new breakthroughs in biotechnology.

The USDA-ARS BI mission is ***to accelerate biotechnology innovation and development, product regulatory approval, and transfer to stakeholders and partners*** for agricultural products grown across the United States, including areas historically left behind by technological innovations. BI will leverage ARS infrastructure, existing projects, and biotechnology expertise to create a “hub-and-spokes” platform for biotechnology discovery, product development, and technology transfer—analogue to crop and animal breeding.

#### *Means to Achieve Change*

- To prevent and reduce animal losses and resulting economic devastation due to emerging pathogens and diseases USDA-ARS BI will develop, assemble, field validate, and gain regulatory approval for a new rapid biotechnology-based Animal Biotechnology Development Pipeline (\$4,000,000). ARS will:
  - Develop a new rapid biotechnology-based Animal Veterinary Medical Countermeasures Development Pipeline; includes diagnostics, vaccines and biotherapeutics for the early detection, prevention, and treatment of animal diseases.
  - Develop a new rapid trait innovation pipeline that utilizes next generation sequencing, metabolomics, prediction models, genome editing, synthetic biology, and artificial intelligence and machine learning to address stakeholder priorities, including reduced production costs, reduced mortality and waste, reduced use of medically important antibiotics, and enhanced resistance to environmental stress.
- To reduce losses and resulting economic devastation due to arthropod pests of crops and animals (includes insects, ticks and mites), the USDA-ARS BI will develop, assemble, validate, and gain regulatory approval for a new rapid Pest Control Biotechnology Development Pipeline that includes SIT (sterile insect technology), gene drives, gene-editing, and PIP (plant incorporated protectant) technologies (\$750,000). ARS will:
  - Develop SIT and gene drive technologies for arthropods suitable for eradication.
  - Develop gene-editing (e.g. CRISPR) and PIP technologies for management of established pests.

#### *Partnerships and Collaborations*

Internal government collaborators will include action and regulatory agencies such as the Animal and Plant Health Inspection Service. External partners include but are not limited to: Department of Health and Human Services: CDC, NIH, BARDA; DoD; DHS; Animal Health Institute; STAR-IDAZ (International Collaboration on Research on Animal and Emerging Zoonotic Diseases); United States Animal Health Association (USAHA); American Association of Veterinary Medical Colleges (AAVMC); and the American Veterinary Medical Association (AVMA).

- H) An increase of \$18,000,000 for Climate Adaptation and Resilience to which \$1,500,000 is for Livestock Protection.

President Joe Biden on January 27, 2021 signed the "[Executive Order on Tackling the Climate Crisis at Home and Abroad](#)" which directed federal agencies to develop plans to bolster adaptation and increase resilience to the impacts of climate change. It is critical to national security that agricultural systems have the tools and resources they need to adapt crop and animal production to be resilient to climate change impacts. Crop production must be resilient to drought, temperature extremes, and pests and disease. This includes crop systems based on annuals like corn, soybeans, and wheat; perennial systems like forages and grazed pastures; and larger ecosystems like rangelands. Crop management approaches include developing new crop varieties adapted to climate extremes and pest pressures, implementing crop rotations that reduce pest cycles and are less dependent on inputs, and managing rangeland landscapes to resist weed invasion, recover from wildfire, and provide abundant forage.

Animal production must be resilient to temperature extremes and pest and disease pressures. Animal management approaches include promoting breeds adapted to production environments and developing tools so animals are resistant to new pest and disease pressures brought on by weather extremes, like more frequent flooding. Agricultural production must also explore new, more climate resilient approaches to food and animal feed production. A promising, innovative opportunity to diversify our feed production systems is to increase the applicability and impact of insect rearing to provide novel, nutritious livestock feeds while also potentially treating or utilizing certain waste streams. Such new agricultural opportunities hold promise for increasing the sustainability, resilience and adaptability of feed and livestock production systems. Because climate is changing rapidly and often in unanticipated ways, fully realizing crop and animal production resilience requires further innovation to optimize technologies and system integration. A robust new research and development effort would strengthen the American agriculture industry, ensure the stability of food production, and creating new initiatives for farm enterprises and rural development.

#### *Means to Achieve Change*

- Enhancing resilience of crop and animal production to pest and disease pressure caused by changing climate (\$1,500,000). ARS will:
  - Develop strategies for invasive pests such as ticks and ants, whose impact is expanding due to climate change.
  - Minimize bacterial zoonotic disease threat (leptospirosis) associated with severe weather events and flooding.

#### *Partnership and Collaborations*

Funding will create nationwide coordination among crop, animal, and insect research projects in ARS, and opportunities for collaboration with USDA Climate Hubs, USFS, NRCS, APHIS, and NIFA, as well as with BLM, and Tribal Nations. Through these partnerships, ARS will lead the way for conducting research to safeguard the most resilient production systems in the world.

#### ***Crop Protection***

- (6) An increase of \$25,525,000 and 99 staff years for Crop Protection research (\$223,267,000 and 864 staff years available in 2022 annualized CR).

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. The research supports many of USDA's Strategic Goals.

The funding change is requested for the following items:

- A) An increase of \$2,627,000 which includes \$1,789,000 for pay inflation and \$838,000 for FERS for 2022 Pay and FERS.

This increase will support a 2.7 percent Cost of Living pay increases for civilian employees, and a 1.1 percent increase to cover the expenses for the mandated increase of USDA's contribution to FERS.

Funding for pay and retirement benefit costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Elimination of the pay and retirement benefit costs would require ARS to absorb these costs and reduce planned hiring levels, eroding USDA's ability to meet key Administration priorities.

- B) An increase of \$4,471,000 for 2023 Pay.

This increase will support the annualization of the 2022 2.7 percent Cost of Living pay increase and the 2023 4.6 percent Cost of Living pay increase.

Funding for pay costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Elimination of the pay costs would require ARS to absorb these costs and reduce planned hiring levels, eroding USDA's ability to meet key Administration priorities.

- C) An increase of \$105,000 for Department's Working Capital Fund and Shared Costs.

This includes \$98,000 for the Department's Working Capital Fund and \$7,000 for Department-Wide Shared Cost Programs. Elimination of these costs would require ARS to absorb these costs and erode USDA's ability to meet key Administration priorities.

- D) An increase of \$101,000,000 for Clean Energy of which \$500,000 is for ARS' Crop Protection Program.

President Joe Biden on January 27, 2021 signed the "[Executive Order on Tackling the Climate Crisis at Home and Abroad](#)" which ordered federal agencies to develop clean energy technologies and accelerate clean energy generation projects that stimulates clean energy industries and benefits rural economies. The change to clean energy, and away from fossil-based energy, works by producing power without the negative environmental impacts such as greenhouse gases, like carbon dioxide and methane. And is generated from renewable, zero emission sources that do not pollute the atmosphere, as well as energy saved by energy efficiency measures. The various sources of clean energy are wind, solar, tidal, geothermal, nuclear, hydrogen, and agriculturally based, renewable biomass feedstocks. The need for clean energy is multi-purposed: 1. it's important for future generations, as clean energy sources are inexhaustible and adapt well to natural cycles and do not emit greenhouse gases. 2. Clean Energy gives local economies an advantage by reducing the cycle of economic losses from a dependence on fossil fuels, to relying on locally produced renewable energy sources found everywhere and readily available for ensuring energy sustainability. 3. Clean Energy is becoming more affordable, with costs trending at a declining rate and becoming more competitive with natural gas, coal, and oil. And 4. Clean Energy is a benefit to local economies due to creating locally produced new jobs in the generation of energy. But research and development must happen faster to make clean energy solutions viable. Therefore, although, clean energy already makes good business sense, fully realizing its potential, however, requires further innovation to optimize technologies and system integration. A robust new research and development effort would strengthen and ensure global leadership of the American agriculture industry as well as creating new initiatives for rural development through generation of Bioenergy.

*Means to Achieve Change*

- Biowaste-stream to Bioenergy (\$500,000). ARS will:
  - Use existing low-value agricultural waste products to create a renewable flex-use biomethane gas or synthesis gas (a mixture of methane, hydrogen, and carbon oxides).

*Partnership and Collaborations*

External partners include but are not limited to DOE and other federal agencies, universities, and commercial stakeholders.

E) An increase of \$109,000,000 for Climate Science of which \$9,950,000 is for ARS' Crop Protection Program.

The urgency of the global climate crisis is growing. Nearly every aspect of the nation's agricultural enterprise is increasingly called on to contribute to climate change mitigation by reducing GHG emissions, sequestering carbon (C) to reduce atmospheric carbon dioxide (CO<sub>2</sub>), and developing agriculturally based approaches for generating energy as alternatives to fossil fuels. Agriculture is also faced with adapting quickly to unprecedented climate changes and weather extremes with minimal interruptions in production. These enormous challenges call for innovative research supported by bold, trans-disciplinary collaborations. USDA-ARS has research projects and scientific expertise that address many topics related to climate change mitigation and adaptation. This existing infrastructure positions ARS to enable these advancements by establishing new research efforts and collaborations described below to support agriculture's response to the climate crisis.

*Means to Achieve Change*

- Mitigate climate change in crop production to develop crops with reduced greenhouse gas emissions and increased capacity for carbon banking (\$1,000,000). ARS will:
  - Improve the capture and storage of carbon in woody, perennial, and cover crops.
  - Develop carbon monitoring, measuring, and storage technologies in both above- and below-ground agricultural production.
- Protect pollinators from the damages of climate change (\$700,000). ARS will:
  - Develop methods for bee population modeling and new strategies for protecting bees.
- Understand climate change effects on the invasion biology of emerging and invasive pests (\$2,750,000). ARS will:
  - Evaluate the unpredictability in weather patterns associated with early seasonal warmth and increased rainfall or drought to see how they affect pest populations, their movement in the environment, and their impact on crops and natural ecosystems.
  - Determine how the competition between a crop and weeds, pests, and pathogens changes with the environment to minimize the likelihood that invasive species gain advantage due to their greater ability to adapt to new hosts and environments caused by climate change.
- Rapid response research infrastructure to manage pests, pathogens, and weeds in a changing environment (\$3,000,000). ARS will:
  - Develop innovative solutions to monitor, rapidly and accurately detect, and predict potential new habitats of pathogens, pests and weeds.

- Evaluate the potential of innovative technologies to detect pests, such as plant-embedded sensors developed by DARPA in the Advanced Plant Biotechnologies program, or Artificial Intelligence/Machine Learning facilitated systems and canines for rapid pathogen sensing and identification.
- Apply biotechnological solutions to implement resistance to pests in breeding programs.
- Develop effective tools to manage pests, pathogens, and weeds in a changing environment. (\$2,500,000). ARS will:
  - Develop an understanding of how climate change affects competition that is predicted to intensify between weeds and crops with increasing CO<sub>2</sub>.
  - Determine how pathogen abundance and distribution will change with increasing variation in temperatures.
  - Evaluate the impacts of seasonal weather pattern changes on the movement of insects in crop fields and forest systems.

#### *Partnership and Collaborations*

External partners with ARS on this effort are extensive and will include those whose missions and needs contribute to Climate Science advances. These include USDA agencies such as ERS, NASS, NIFA, NRCS, Forest Service; other non-USDA federal agencies, such as EPA, DOE, NASA, NOAA, USGS, Health and Human Services; state and regional government agencies focused on climate science and its beneficial outcomes; a wide spectrum of Land Grant Universities, their faculty, students, and extension teams; ecosystem service market quantifiers and brokers; NGOs and industry, including but not limited to: Soil Health communities; Conservation Districts; The Nature Conservancy; Field to Market, and other private industries involved with animal and plant breeding, germplasm development, animal welfare, and with sustainability commitments that depend on improved Climate Science.

#### F) An increase of \$15,000,000 for Improving Specialty Crop and Animal Production for Small Farm Profitability for which \$5,350,000 is for Crop Protection.

There are currently 671,000 growers managing small acreage farms, which includes Native American farmers on tribal lands and other minority-serving farmers and communities. They need highly profitable, climate-resilient crop and animal production to support a robust rural economy, and to meet their cultural and nutritional needs. Small farms represent 90 percent of all farms and more than half of all U.S. farmland. Small farms produced nearly half of U.S. food in 1991, but only 25 percent today. This is because some small farms grow relatively low volumes of lower-value commodities that are vulnerable to market drops, regulatory costs, and climate change impacts. Most specialty crops are grown on large farms that can afford investments in labor and inputs. Therefore, new ARS varieties for small farms must have traits for low input farming and dramatically reduced labor needs that are aligned with small farm management practices. Furthermore, the traditional cultivars of specialty crops are integral to meeting the economy, cultural, and nutritional needs of Native American, Black, and Hispanic populations. Each region of the U.S. produces unique specialty crops and animals adapted to that environment, so ARS needs to improve and identify a diverse portfolio of crops and animals that are regionally-important for small farms.

#### *Means to Achieve Change*

- Precision production systems that utilize AI and machine learning decision support tools (\$500,000). ARS will:

- Develop small farm decision support tools for plant stress, disease incidence, insect monitoring, and crop development using continuous and real-time measurements from low-cost sensors such as cell phone cameras.
- Disease, insect pest, and weed management practices for diversified small farm production of specialty crops and animals, especially under high-value or organic production systems (\$4,850,000). ARS will:
  - Area-wide insect, disease, and weed monitoring networks for distributed, coordinated pest management.
  - Innovative technology for disease and insect management and immunity and weed management, using in planta techniques and biocontrol innovations.
  - Low-cost, integrated insect, weed, and disease management systems that are suitable for organic or conventional production of specialty crops and animals, including intercropping, cover cropping, and multi-species cropping.

#### *Partnership and Collaborations*

Funding will create nationwide coordination among specialty crop growers, animal producers, and small farm research projects in ARS, and opportunities for collaboration with NASS, NIFA, ERS, FS, APHIS, USDA Climate Hubs and NRCS, as well as with NSF, BLM, NOAA, USGS and Tribal Nations. Through these partnerships, ARS will lead the way for conducting research to safeguard the most efficient and safest food production systems in the world.

#### G) An increase of \$16,000,000 for USDA-ARS biotechnology innovation to which 2,750,000 is for Crop Protection.

Biotechnology is providing transformative solutions to many of our Nation’s greatest challenges, including human disease and pandemic threats (e.g. SARS-Cov-2) and biomanufacturing (e.g. new foods and industrial feedstocks). Biotechnology can provide the same for our Nation’s greatest agricultural challenges, including climate change, invasive pests and disease, food supply inequality, and provide novel opportunities to grow the U.S. economy and workforce. The USDA-ARS biotechnology innovation plan (BI) will provide strategic research planning, organization, resource development, and coordination, to meet these challenges, and accelerate the development and commercialization of new breakthroughs in biotechnology.

The USDA-ARS BI mission is ***to accelerate biotechnology innovation and development, product regulatory approval, and transfer to stakeholders and partners*** for agricultural products grown across the United States, including areas historically left behind by technological innovations. BI will leverage ARS infrastructure, existing projects, and biotechnology expertise to create a “hub-and-spokes” platform for biotechnology discovery, product development, and technology transfer—analogue to crop and animal breeding.

#### *Means to Achieve Change*

- To reduce losses and resulting economic devastation due to arthropod pests of crops, the USDA-ARS BI will develop, assemble, validate, and gain regulatory approval for a new rapid Pest Control Biotechnology Development Pipeline that includes SIT (sterile insect technology), gene drives, gene-editing, and PIP (plant incorporated protectant) technologies (\$2,750,000). ARS will:
  - Develop gene-editing (e.g. CRISPR) and PIP technologies for management of established pests.

#### *Partnerships and Collaborations*

Internal government collaborators will include action and regulatory agencies such as the Animal and Plant Health Inspection Service. External partners include but are not limited to: Department of Health and Human

Services: CDC, NIH, BARDA; DoD; DHS; Animal Health Institute; STAR-IDAZ (International Collaboration on Research on Animal and Emerging Zoonotic Diseases); United States Animal Health Association (USAHA); American Association of Veterinary Medical Colleges (AAVMC); and the American Veterinary Medical Association (AVMA).

- H) An increase of \$18,000,000 for Climate Adaptation and Resilience to ensure agricultural production system sustainability for which \$2,000,000 is for Crop Protection.

President Joe Biden on January 27, 2021 signed the "[Executive Order on Tackling the Climate Crisis at Home and Abroad](#)" which directed federal agencies to develop plans to bolster adaptation and increase resilience to the impacts of climate change. It is critical to national security that agricultural systems have the tools and resources they need to adapt crop and animal production to be resilient to climate change impacts. Crop production must be resilient to drought, temperature extremes, and pests and disease. This includes crop systems based on annuals like corn, soybeans, and wheat; perennial systems like forages and grazed pastures; and larger ecosystems like rangelands. Crop management approaches include developing new crop varieties adapted to climate extremes and pest pressures, implementing crop rotations that reduce pest cycles and are less dependent on inputs, and managing rangeland landscapes to resist weed invasion, recover from wildfire, and provide abundant forage. Animal production must be resilient to temperature extremes and pest and disease pressures. Animal management approaches include promoting breeds adapted to production environments and developing tools so animals are resistant to new pest and disease pressures brought on by weather extremes, like more frequent flooding. Agricultural production must also explore new, more climate resilient approaches to food and animal feed production. A promising, innovative opportunity to diversify our feed production systems is to increase the applicability and impact of insect rearing to provide novel, nutritious livestock feeds while also potentially treating or utilizing certain waste streams. Such new agricultural opportunities hold promise for increasing the sustainability, resilience and adaptability of feed and livestock production systems. Because climate is changing rapidly and often in unanticipated ways, fully realizing crop and animal production resilience requires further innovation to optimize technologies and system integration. A robust new research and development effort would strengthen the American agriculture industry, ensure the stability of food production, and creating new initiatives for farm enterprises and rural development.

#### *Means to Achieve Change*

- Enhancing resilience of crop and animal production to pest and disease pressure caused by changing climate (\$2,000,000). ARS will:
  - Develop tools to control emerging and endemic plant pathogens which are becoming more severe in a changing climate
  - Develop strategies for invasive pests such as ticks and ants, whose impact is expanding due to climate change

#### *Partnership and Collaborations*

Funding will create nationwide coordination among crop, animal, and insect research projects in ARS, and opportunities for collaboration with USDA Climate Hubs, USFS, NRCS, APHIS, and NIFA, as well as with BLM, and Tribal Nations. Through these partnerships, ARS will lead the way for conducting research to safeguard the most resilient production systems in the world.

- I) A decrease of \$2,228,000 for Office of Chief Scientist Funding.

ARS along with the other REE agencies have historically provided direct funding to the Office of the Chief Scientist. In FY 2023, OCS is proposing to receive a direct appropriation which would no longer require annual agency transfers to support OCS. ARS, ERS, NASS, and NIFA are all proposing offsets to support the direct appropriation to OCS totaling \$4.95 million.



***Human Nutrition***

- (7) An increase of \$2,539,000 and no staff years for Human Nutrition research (\$99,144,000 and 316 staff years available in 2022 annualized CR).

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. The research supports many of USDA's Strategic Goals.

The funding change is requested for the following items:

- A) An increase of \$960,000 which includes \$653,000 for pay inflation and \$307,000 for FERS for 2022 Pay and FERS.

This increase will support a 2.7 percent Cost of Living pay increases for civilian employees, and a 1.1 percent increase to cover the expenses for the mandated increase of USDA's contribution to FERS.

Funding for pay and retirement benefit costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Elimination of the pay and retirement benefit costs would require ARS to absorb these costs and reduce planned hiring levels, eroding USDA's ability to meet key Administration priorities.

- B) An increase of \$1,543,000 for 2023 Pay.

This increase will support the annualization of the 2022 2.7 percent Cost of Living pay increase and the 2023 4.6 percent Cost of Living pay increase.

Funding for pay costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Elimination of the pay costs would require ARS to absorb these costs and reduce planned hiring levels, eroding USDA's ability to meet key Administration priorities.

- C) An increase of \$36,000 for Department's Working Capital Fund and Shared Costs.

This includes \$34,000 for the Department’s Working Capital Fund and \$2,000 for Department-Wide Shared Cost Programs. Elimination of these costs would require ARS to absorb these costs and erode USDA’s ability to meet key Administration priorities.

### *Environmental Stewardship*

- (8) An increase of \$103,321,000 and 369 staff years for Environmental Stewardship research (\$251,675,000 and 1,185 staff years available in 2022 annualized CR).

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. The research supports many of USDA’s Strategic Goals.

The funding change is requested for the following items:

- A) An increase of \$3,603,000 which includes \$2,452,000 for pay inflation and \$1,151,000 for FERS for 2022 Pay and FERS.

This increase will support a 2.7 percent Cost of Living pay increases for civilian employees, and a 1.1 percent increase to cover the expenses for the mandated increase of USDA’s contribution to FERS.

Funding for pay and retirement benefit costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS’ mission. Elimination of the pay and retirement benefit costs would require ARS to absorb these costs and reduce planned hiring levels, eroding USDA’s ability to meet key Administration priorities.

B) An increase of \$6,859,000 for 2023 Pay.

This increase will support the annualization of the 2022 2.7 percent Cost of Living pay increase and the 2023 4.6 percent Cost of Living pay increase.

Funding for pay costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Elimination of the pay costs would require ARS to absorb these costs and reduce planned hiring levels, eroding USDA's ability to meet key Administration priorities.

C) An increase of \$159,000 for Department's Working Capital Fund and Shared Costs.

This includes \$150,000 for the Department's Working Capital Fund and \$9,000 for Department-Wide Shared Cost Programs. Elimination of these costs would require ARS to absorb these costs and erode USDA's ability to meet key Administration priorities.

D) An increase of \$101,000,000 for Clean Energy for which \$10,200,000 is for ARS' Environmental Stewardship Program.

President Joe Biden on January 27, 2021 signed the "[Executive Order on Tackling the Climate Crisis at Home and Abroad](#)" which ordered federal agencies to develop clean energy technologies and accelerate clean energy generation projects that stimulates clean energy industries and benefits rural economies. The change to clean energy, and away from fossil-based energy, works by producing power without the negative environmental impacts such as greenhouse gases, like carbon dioxide and methane. And is generated from renewable, zero emission sources that do not pollute the atmosphere, as well as energy saved by energy efficiency measures. The various sources of clean energy are wind, solar, tidal, geothermal, nuclear, hydrogen, and agriculturally based, renewable biomass feedstocks. The need for clean energy is multi-purposed: 1. it's important for future generations, as clean energy sources are inexhaustible and adapt well to natural cycles and do not emit greenhouse gases. 2. Clean Energy gives local economies an advantage by reducing the cycle of economic losses from a dependence on fossil fuels, to relying on locally produced renewable energy sources found everywhere and readily available for ensuring energy sustainability. 3. Clean Energy is becoming more affordable, with costs trending at a declining rate and becoming more competitive with natural gas, coal, and oil. And 4. Clean Energy is a benefit to local economies due to creating locally produced new jobs in the generation of energy. But research and development must happen faster to make clean energy solutions viable. Therefore, although, clean energy already makes good business sense, fully realizing its potential, however, requires further innovation to optimize technologies and system integration.

*Means to Achieve Change*

- Clean Energy Feedstocks (\$10,200,000). ARS will:
  - Determine through innovative cellulosic feedstocks and cropping systems for the U.S. that overcome current barriers to clean energy bioconversion, including increasing biomass per acre for non-crop plants and crop residues, reducing inputs required for feedstock production, and improving soil health and other ecosystems services.

*Partnership and Collaborations*

External partners include but are not limited to DOE and other federal agencies, universities, and commercial stakeholders.

E) An increase of \$5,000,000 for Climate Hubs.

The urgency of the global climate crisis is growing, as is the need for experts and new career scientists who can provide tools to the agricultural community to develop and implement climate-smart production systems. The USDA-ARS climate hubs have been successful, but demand to ensure ARS research and engagement extends across all Climate Hubs, including those led by the Forest Service, outpaces what can be accomplished by current staff. A strategic approach to address these needs is to use the USDA-ARS Climate Hub Fellows program to attract early career experts in needed domains. The fellows nature of the program will also provide strategic, on-the-ground expert training to the needed Civilian Climate Corps. Ultimately, USDA ARS Fellows will be exemplary candidates for jobs in the agricultural sector, industry, academia, and NGOs, to support the pressing need for experts to address climate change impacts on agriculture and society.

#### *Means to Achieve Change*

- Enhancing Climate Hub Impact by establishing a vital Fellowship Program that actively supports climate hub research, communication, and impact and that integrates with the establishment of a highly skilled Civilian Climate Corps (\$5,000,000). ARS will:
  - Establish a Fellows program for the Climate Hubs that supports a total of nineteen fellows positioned across current and proposed new Climate Hub locations to expand and enhance each Hub's research and communication capacity. Fellows will work at individual Hubs but be coordinated across the entire Hub network.

#### *Partnership and Collaborations*

The Hubs customer and stakeholder community is regionally and nationally diverse and the Climate Hub Fellows will collaborate with USDA action agencies such as the Natural Resources Conservation Service (NRCS), Rural Development (RD), and others. Other Federal agencies (e.g., BLM, USGS, NOAA, NASA and NASA), land grant universities, university extension, producers, producer groups, NGOs, and technical service providers will also be collaborators on the Climate Hub Fellows effort.

#### F) An increase of \$109,000,000 for Climate Science of which \$42,500,000 is for ARS' Environmental Stewardship Program.

The urgency of the global climate crisis is growing. Nearly every aspect of the nation's agricultural enterprise is increasingly called on to contribute to climate change mitigation by reducing GHG emissions, sequestering carbon (C) to reduce atmospheric carbon dioxide (CO<sub>2</sub>), and developing agriculturally based approaches for generating energy as alternatives to fossil fuels. Agriculture is also faced with adapting quickly to unprecedented climate changes and weather extremes with minimal interruptions in production. These enormous challenges call for innovative research supported by bold, trans-disciplinary collaborations. USDA-ARS has research projects and scientific expertise that address many topics related to climate change mitigation and adaptation. This existing infrastructure positions ARS to enable these advancements by establishing new research efforts and collaborations described below to support agriculture's response to the climate crisis.

#### *Means to Achieve Change*

- Establish the USDA ARS Comprehensive Climate Change "center of excellence" (\$6,900,000). ARS will:
  - Create an ARS center of excellence focused on climate change adaptation and mitigation modeling, data management and tool development to strengthen research across ARS and regional engagement of the Climate Hubs.
  - Catalyze a data-driven and precision agriculture focus on climate change adaptation and mitigation.
  - Develop approaches to support and enhance precision agriculture efforts already underway at ARS as

well as at new precision livestock management efforts at other locations.

- Increase focus on climate-smart practices, data, tools and technologies that are relevant both regionally and nationally, and that can lead to GHG mitigation, producer participation in carbon and ecosystem markets, resilience to weather extremes, and adaptation to future climate.
- Establish ARS Advanced Climate Change Research Teams at each core ARS Climate Hub location to support regionally relevant locations and expand Hub impact. (\$15,000,000). ARS will:
  - Establish critical scientific and climate expertise at ARS sites within each region of the ARS Climate Hubs to research field-level climate change impacts.
  - Increase capacity on practices to reduce methane and other GHG emissions from beef and dairy open feedlots.
  - Assess manure as a biochar feedstock and as an agronomically viable soil additive for grazing lands.
  - Modernize the current wind and water erosion science and assessment with the most current climate science and future change scenarios to quantify how weather extremes may affect environmental quality and to incorporate risk assessment that can be used to plan response and remediation strategies.
- Enhance the LTAR Network to focus on climate change (\$15,600,000). ARS will:
  - Create a coordinated climate change adaptation and mitigation focus within the LTAR network that builds on the current collaborations and common research framework to increase adoption of climate smart practices that can lead to GHG mitigation, producer participation in carbon and ecosystem markets, resilience to weather extremes, and adaptation to future climate.
  - Establish a LTAR program in California that will create a four-pronged network that includes the two primary agricultural regions of California (the Central Valley and the Imperial Valley), the extensive network of California livestock grazing rangelands, and watersheds that supply much of the water for irrigated farmland.
- Enhanced the power of the USDA ARS Climate Hub engagement with their regions (\$5,000,000). ARS will:
  - Expand engagement with producers, including indigenous and underserved farmers and ranchers, across Alaska and Hawaii and Affiliated Pacific Islands by creating two new Climate hub locations.
  - Enhance Climate Hub direct activities by strategic engagement of critical needs of each regional hub.
  - Provide resources to promote and integrate climate hub programming and communication and synthesis needs.

#### *Partnership and Collaborations*

External partners with ARS on this effort are extensive and will include those whose missions and needs contribute to Climate Science advances. These include USDA agencies such as ERS, NASS, NIFA, NRCS, Forest Service; other non-USDA federal agencies, such as EPA, DOE, NASA, NOAA, USGS, Health and Human Services; state and regional government agencies focused on climate science and its beneficial outcomes; a wide spectrum of Land Grant Universities, their faculty, students, and extension teams; ecosystem service market quantifiers and brokers; NGOs and industry, including but not limited to: Soil Health communities; Conservation Districts; The Nature Conservancy; Field to Market, and other private industries involved with animal and plant breeding, germplasm development, animal welfare, and with sustainability commitments that depend on improved Climate Science.

- G) An increase of \$15,000,000 for Improving Specialty Crop and Animal Production for Small Farm Profitability for which \$1,250,000 is for Environmental Stewardship.

There are currently 671,000 growers managing small acreage farms, which includes Native American farmers on tribal lands and other minority-serving farmers and communities. They need highly profitable, climate-resilient crop and animal production to support a robust rural economy, and to meet their cultural and nutritional needs. Small farms represent 90 percent of all farms and more than half of all U.S. farmland. Small farms produced nearly half of U.S. food in 1991, but only 25 percent today. This is because some small farms grow relatively low volumes of lower-value commodities that are vulnerable to market drops, regulatory costs, and climate change impacts. Most specialty crops are grown on large farms that can afford investments in labor and inputs. Therefore, new ARS varieties for small farms must have traits for low input farming and dramatically reduced labor needs that are aligned with small farm management practices. Furthermore, the traditional cultivars of specialty crops are integral to meeting the economy, cultural, and nutritional needs of Native American, Black, and Hispanic populations. Each region of the U.S. produces unique specialty crops and animals adapted to that environment, so ARS needs to improve and identify a diverse portfolio of crops and animals that are regionally-important for small farms.

#### *Means to Achieve Change*

- Improved specialty crop cultivars and animal germplasm for small farm production (\$1,000,000). ARS will:
  - Implement coordinated on-farm trials of new specialty crop cultivars and animal (sheep and goat) lines or breeds using assisted reproductive technologies under small farm management practices.
- Disease, insect pest, and weed management practices for diversified small farm production of specialty crops and animals, especially under high-value or organic production systems (\$250,000). ARS will:
  - Small-farm modeling for disease, insect, and weed risks in specialty crop and animal production systems

#### *Partnership and Collaborations*

Funding will create nationwide coordination among specialty crop growers, animal producers, and small farm research projects in ARS, and opportunities for collaboration with NASS, NIFA, ERS, FS, APHIS, USDA Climate Hubs and NRCS, as well as with NSF, BLM, NOAA, USGS and Tribal Nations. Through these partnerships, ARS will lead the way for conducting research to safeguard the most efficient and safest food production systems in the world.

#### H) An increase of \$14,000,000 Mitigating the Impact of Extreme Weather Events to Ensure Production System Sustainability to which \$10,000,000 is for Environment Stewardship.

The incidence of extreme weather events is increasing, and climate change is accelerating the rate of incidence. As of June 2021, 98 percent of the U.S. western states are experiencing some level of drought. Recent landslides in California were initiated by drought, then wind-enhanced wildfire, and finally storm runoff on burned areas without vegetative protection. Historic flooding in the Midwest in 2019 prevented farmers from planting 19.6 million acres and resulted in more than \$2 billion in crop losses and damage in Iowa alone. All these events were caused by a sequence of climate and weather extremes. Advanced informatics and data analytics technologies are needed to model and predict the impacts of these extreme events, advance the precision of surface and groundwater best management practices, and increase the ability of soils to absorb and hold water. These advances will improve the economic and environmental sustainability of food, fiber, and biofuels production, develop irrigation practices to optimize water use, and aide groundwater recharge and sustain surface water storage at different scales. Beyond crop and animal production losses, extreme weather events can lead to devastating soil loss through water erosion from flooding and wind erosion of excessively dry, bare soils. Once lost, soil resources are effectively gone for centuries. Advancing informatics and data analytics to better predict, model, and mitigate basic wind and water erosion processes through novel and optimized best management practices will improve the economic and environmental sustainability of agricultural production.

#### *Means to Achieve Change*

- Water and soil management for both drought and excess water (\$6,000,000). ARS will:
  - Expand water supply forecasting and drought modelling and impact prediction.
  - Develop new irrigation technologies that reduce water use for optimum crop production.
  - Develop cropping systems and management strategies that increase soil health to mitigate the impacts of excessive water.
  - Deliver scientific support for small dam management in the USDA Small Watershed Program through the development of standardized design, specialized engineering tools, and dam breach analysis software.
- Soil erosion modeling and mitigation (4,000,000). ARS will:
  - Advance erosion prediction models and decision support tools.
  - Develop cropping systems and management strategies that minimize wind and water erosion.

#### *Partnership and Collaborations*

Funding will create nationwide coordination among crop and livestock producers and water and erosion research projects in ARS, and opportunities for collaboration with NRCS, USFS, BLM, USGS, NOAA, NASA, NIFA, USDA Climate Hubs, U.S. Army Corp of Engineers, U.S. Bureau of Reclamation, and FEMA. Through these partnerships, ARS will lead the way for conducting research to safeguard the most efficient food production systems in the world.

#### I) An increase of \$10,000,000 for Prioritizing Sustainable & Resilient Small Farm Production Systems.

Small farms have different needs from large-scale agricultural systems. Small farms often include specialty crops, animals, and/or trees in an integrated production system and often with a focus on the function of the entire agricultural system, rather than its components. Organic production systems tend to have smaller farm size but can be highly profitable due to price premiums that consumers pay for organic products. Small farm managers, both conventional and organic, have special needs for integrated support for system decision-making. Improvements in data and innovation of new tools relevant to small farms will be especially important to underserved communities as their engagement in agriculture grows. This added research support targeted to small-scale producers and land managers has been a concern and is a growing need.

#### *Means to Achieve Change*

- Develop a New England Region small-farm, local-market long-term agroecosystem research (LTAR) site for integrated crop-livestock systems (\$1,500,000). ARS will:
  - Initiate LTAR site led by the ARS unit in Burlington, VT.
  - Design innovative and sustainable production systems (including agroforestry) for small-farm specialty crops and animals that are marketed as part of the local-regional food system and linked to human nutrition and health.
  - Develop small-farm systems resilient to extreme weather (including drought, heavy rainfall events, and severe winds) that can also participate in emerging ecosystem service markets (through carbon storage, lower greenhouse gas emissions, and improvements in water quality).
- Enhancing small farm sustainability through scale-appropriate precision agriculture (\$3,200,000). ARS will:
  - Develop automated data collection systems relevant to small-farm management needs, including for agroforestry and specialty crop and animal systems.

- Develop precision equipment for implementing sustainable management practices in small-farm systems, including organic production systems.
- Create data analysis and decision support tools targeted for small-farm crop and livestock producers using the data capture and management structure of the ARS Partnerships for Data Innovation (PDI).
- Improving soil health in small-farm production systems, including organic systems (\$1,200,000). ARS will:
  - Improve small-farm productivity and resilience to climate change through innovative soil health management options.
  - Improve small-farm opportunities to participate in ecosystem service markets through system design and quantifying the benefits of soil health on carbon storage, greenhouse gas mitigation, water quality, and water quantity.
- Supporting small farm producers (including Tribal and beginning farmers) to ensure climate resilience (\$4,100,000). ARS will:
  - Assess the specific needs of small-farm, beginning, historically underserved, and indigenous producers in different regions of the U.S. (aligned with the Climate Hubs) as they adapt to a changing climate, bringing social sciences to bear on the development of relevant tools and technologies through the co-production of knowledge.
  - Design targeted data tools to improve usability of USDA data resources for small-farm, beginning, historically underserved, and indigenous producers, with the support of ARS Partnership for Data Innovations.

#### *Partnerships and Collaborations*

Funding will create nationwide coordination among producers in small-farm agricultural systems and among the researchers that support them, including 1890's land grant institutions (Tuskegee University, Langston University, Lincoln University and 1994 land grant institutions (Southwestern Indian Polytechnic Institute, Dine College and Navajo Technical University in NM, United Tribes Technical College in ND, Oglala Lakota College in SD). There will be opportunities for collaboration with NASS, NIFA, ERS, FS, APHIS, USDA Climate Hubs and NRCS, as well as with NSF, BLM, NOAA and USGS. Through these partnerships, ARS will lead the way for conducting research to safeguard the most efficient, sustainable, and safest food production systems in the world.

#### J) An increase of \$18,000,000 Climate Adaptation and Resilience Activities for which \$2,750,000 is for Environmental Stewardship.

President Joe Biden on January 27, 2021 signed the "[Executive Order on Tackling the Climate Crisis at Home and Abroad](#)" which directed federal agencies to develop plans to bolster adaptation and increase resilience to the impacts of climate change. It is critical to national security that agricultural systems have the tools and resources they need to adapt crop and animal production to be resilient to climate change impacts. Crop production must be resilient to drought, temperature extremes, and pests and disease. This includes crop systems based on annuals like corn, soybeans, and wheat; perennial systems like forages and grazed pastures; and larger ecosystems like rangelands. Crop management approaches include developing new crop varieties adapted to climate extremes and pest pressures, implementing crop rotations that reduce pest cycles and are less dependent on inputs, and managing rangeland landscapes to resist weed invasion, recover from wildfire, and provide abundant forage. Animal production must be resilient to temperature extremes and pest and disease pressures. Animal management approaches include promoting breeds adapted to production environments and developing tools so animals are resistant to new pest and disease pressures brought on by weather extremes, like more frequent flooding. Agricultural production must also explore new, more climate resilient approaches to food and animal feed production. A promising, innovative opportunity to diversify our feed production systems is to increase the applicability and impact of insect rearing to provide novel, nutritious livestock feeds while also potentially



treating or utilizing certain waste streams. Such new agricultural opportunities hold promise for increasing the sustainability, resilience and adaptability of feed and livestock production systems. Because climate is changing rapidly and often in unanticipated ways, fully realizing crop and animal production resilience requires further innovation to optimize technologies and system integration. A robust new research and development effort would strengthen the American agriculture industry, ensure the stability of food production, and creating new initiatives for farm enterprises and rural development.

#### *Means to Achieve Change*

- Crop and rangeland resilience to drought, temperature extremes, and invasive weeds (\$2,750,000). ARS will:
  - Conserve and utilize plant genetic resources to adapt crops to drought and high temperatures.
  - Develop precision animal grazing strategies to combat invasive annual grasses and wildfire intensity on rangelands.
  - Develop comprehensive ecological management strategies to increase resilience and productivity of Great Basin rangelands.

#### *Partnership and Collaborations*

Funding will create nationwide coordination among crop, animal, and insect research projects in ARS, and opportunities for collaboration with USDA Climate Hubs, USFS, NRCS, APHIS, and NIFA, as well as with BLM, and Tribal Nations. Through these partnerships, ARS will lead the way for conducting research to safeguard the most resilient production systems in the world.

- K) An increase of \$11,000,000 for *Greenhouse Gas (GHG) Measurement and Monitoring* research to enable agricultural production to become a net zero contributor to climate change.

President Joe Biden on January 27, 2021 signed the "[Executive Order on Tackling the Climate Crisis at Home and Abroad](#)" which affirmed this administration's priority to place the climate crisis at the forefront of this Nation's foreign policy and national security planning, which included being leaders who promote ambitious approaches to meet the climate challenge. ARS has been a highly visible national and global leader for more than two decades in advancing the quantification and modeling of greenhouse gas (GHG) emissions and soil carbon storage in agricultural systems. Priorities have included developing key decision support tools that inform land and livestock managers about practices that can reduce GHG emissions and increase soil carbon storage, and by providing critical science and data for the National Greenhouse Gas Inventory. The current need will enable ARS to make critical advances in the measurement, models and monitoring tools. ARS will conduct innovative research to improve the sensitivity, durability and accessibility of real time sensors and monitors; create automated data collection tools for GHG phenomena - such as those that currently exist for monitoring weather conditions; and develop and leverage new AI and other Big Data analytics tools to increase the capability, power and accuracy of our GHG monitoring, measurement, and inventory. A key outcome of these efforts will be to increase our capacity to quantify and/or predict the GHG impact of changing management strategies or developing new production technologies that are GHG neutral and that are climate smart.

Taken together, ARS will conduct critical research to address the climate challenge to enable U.S. production systems to be more adaptive and climate smart while also providing the tools needed to quantify and account for the benefits to the environment and society. The research will fill a critical need to improve our ability to accurately measure and monitor the agricultural contributors to GHG emissions and climate change (e.g., advanced approaches to provide more and better data for GHG emissions) and opportunities for the sector to reduce net emissions and become net neutral (e.g., practices that sequester carbon or that reduce GHG promoting chemicals, such as emissions of carbon dioxide, methane, or nitrous oxide). It is critical to our agricultural enterprise and to our national security that we have the tools and resources to better understand and measure

GHG emissions and remediation approaches, as well as to better monitor them (and the effectiveness of our efforts to reduce them) so that GHG concerns can be adeptly addressed.

These new funds will allow ARS to establish a new research initiative developing the next generation of highly automated, Internet of Things (IoT) enabled GHG sensor design and deployment and the Big Data and AI tools needed to integrate and analyze that data in support of the national research community. This constitutes the next generation advancement of existing ARS instrumentation and research networks such as GRACEnet and Livestock GRACEnet. Developing advanced data pipelines capable of moving standardized salient data from the field to an appropriate and diverse set of end users including researchers, policymakers and producer decision support communities to fully understand the utility and impact of agricultural GHG mitigation options. The overarching goal of this funding is enable: (1) advanced sensors and measurement approaches for addressing all critical aspects of GHG emissions, and (2) optimized measurement and monitoring of these and related processes to address climate change. This will include development and optimization of sensors that measure and monitor outcomes of processes that seek to lower or abate emissions (e.g., via carbon sequestration, optimized nitrogen fertilization to combat nitrous oxide emissions, and others). It will also include research that seeks to make these sensors both more sensitive/accurate and less expensive, so that they can be widely deployed and used. Finally, this effort will include development and deployment of advanced data pipelines and end user applications such as geospatial decision support tools and GHG flux quantifiers. The outcome will be improved understanding of GHG fluxes and related processes, improved decision support tools and apps for a variety of end user communities, more accurate National GHG Inventory reporting, and ultimately a more resilient and climate smart agricultural sector producing ample food, feed, fiber, fuels and environmental services.

#### *Means to Achieve Change*

- Establish an ARS Agricultural Measurement and Monitoring Innovation Lab with a focus on sensor design and deployment and data integration across the ARS field network (\$4,000,000). ARS will:
  - Upgrade and expand current instrumentation and develop new instruments and low-cost sensor technologies, distributed initially to LTAR, GRACEnet and Livestock GRACEnet partner locations.
  - Leverage the historical power of GRACEnet, LTAR and other GHG efforts, and develop powerful tools for enhancing these via development of next generation Internet of Things (IoT), AI and Big Data capabilities and tools.
- Improve local, regional and national scale models and tools for quantifying GHG emissions and carbon storage resulting in new apps, tools and models adapted to the needs of a variety of public and industry stakeholders including producer decision support (\$1,500,000). ARS will:
  - Enhance the historically powerful GRACEnet network to lead in GHG assessment and modeling efforts and enable additional engagement with the measurement and monitoring data for facile data handling, storage and access via development of next generation IoT and Big Data capabilities and tools.
  - Develop effective data pipelines and data standardization protocols to ensure maximum impact, functionality and accessibility of GHG measurement and monitoring data.
- Catalyze the innovation of soil carbon measurement and GHG emissions quantification through deployment of new sensor and data tools, improved data management and standardization, and tools for data sharing (\$1,500,000). ARS will:
  - Improve local, regional and national scale GHG monitoring data standardization and connectivity through enhancement of existing protocols and standards (e.g., LTAR and GRACEnet and PDI) and establishment of new efforts to streamline data delivery and increase impact. This will ensure network connectivity for widespread GHG measurement and monitoring coherence that further enables GHG assessment accuracy.
  - Enhance the LTAR network system for highly sensitive GHG measurement and monitoring that provides more accurate, regionally relevant outcomes from different practices seeking to mitigate GHG emissions, with a focus on advanced GHG sensor development and deployment, leveraging advances in the IoT.

- Enhance GHG measurement network data acquisition and processing by enabling leadership in Eddy Covariance (EC) system and other IoT instrumented data collection, assessment, and tool development for automated data processing (\$1,500,000). ARS will:
  - Establish the *ARS Agricultural EddyFlux Network* of high speed and IoT and Artificial Intelligence (AI) enabled EC measurement sensors and technologies for enhanced data collection, handling, assessment – all within a common and scientifically valid standardization environment. This will enable more rapid and powerful analysis from EC towers and the Eddyflux network for better assessments of GHG mitigating practices and effects on emissions.
- Conduct systems-level data collection and analyses on livestock enteric methane, grazinglands soil carbon storage, and manure management emissions mitigation by creating a new GRACEnet site at the Meat Animal Research Center. (\$1,500,000). ARS will:
  - Establish a new GRACEnet partner site with a focus on beef production systems and evaluating opportunities to monitor and measure emissions and carbon storage across the livestock system and exploring opportunities to adapt the system to optimize productivity while shifting toward net neutrality with regards to GHG emissions.
  - Enable sensor developments that better assess and that enhance animal welfare for 1) respiratory exhaled methane and 2) digestive system emitted methane, and that seek to 3) measure and assess the entire livestock (initially cattle) digestive system for determining opportunities to reduce all livestock methane production and subsequent emissions.
- Develop or enhance technologies for methane measurement in livestock production systems (instrumented sites/animal sensors) resulting in forage and animal management strategies that mitigate GHG emissions and optimize carbon capture and storage across livestock, rangeland, pasture, feedlot and manure management systems. (\$1,000,000). ARS will:
  - Leverage sensor development to address animal in pasture and rangeland grazing systems and engage with GRACEnet Livestock network to implement robust sensor systems for these settings.

#### *Partnership and Collaborations*

Funding will create nationwide coordination among projects in ARS, and opportunities for collaboration with USDA Climate Hubs, USFS, NRCS, APHIS, and NIFA, as well as with BLM, NASA, Land Grant Universities (including 1890 and 1994 LGUs), and Tribal Nations. Through these partnerships, ARS will lead the way for conducting research to measure, monitor, and safeguard the most resilient production systems in the world.

#### *Library and Information Services*

- (9) An increase of \$6,327,000 and 21 staff years for Library and Information Services (\$28,884,000) and 92 staff years available in 2022 annualized CR).

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) An increase of \$280,000 which includes \$190,000 for pay inflation and \$90,000 for FERS for 2022 Pay and FERS.

This increase will support a 2.7 percent Cost of Living pay increases for civilian employees, and a 1.1 percent increase to cover the expenses for the mandated increase of USDA's contribution to FERS.

Funding for pay and retirement benefit costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Elimination of the pay and retirement benefit costs would require ARS to absorb these costs and reduce planned hiring levels, eroding USDA's ability to meet key Administration priorities.

- B) An increase of \$537,000 for 2023 Pay.

This increase will support the annualization of the 2022 2.7 percent Cost of Living pay increase and the 2023 4.6 percent Cost of Living pay increase.

Funding for pay costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Elimination of the pay costs would require ARS to absorb these costs and reduce planned hiring levels, eroding USDA's ability to meet key Administration priorities.

- C) An increase of \$12,000 for Department's Working Capital Fund and Shared Costs.

This includes \$11,500 for the Department's Working Capital Fund and \$500 for Department-Wide Shared Cost Programs. Elimination of these costs would require ARS to absorb these costs and erode USDA's ability to meet key Administration priorities.

- D) An increase of \$101,000,000 for Clean Energy of which \$998,000 is for Library and Information Services.

President Joe Biden on January 27, 2021 signed the "[Executive Order on Tackling the Climate Crisis at Home and Abroad](#)" which ordered federal agencies to develop clean energy technologies and accelerate clean energy generation projects that stimulates clean energy industries and benefits rural economies. The change to clean energy, and away from fossil-based energy, works by producing power without the negative environmental impacts such as greenhouse gases, like carbon dioxide and methane. And is generated from renewable, zero emission sources that do not pollute the atmosphere, as well as energy saved by energy efficiency measures. The various sources of clean energy are wind, solar, tidal, geothermal, nuclear, hydrogen, and agriculturally based, renewable biomass feedstocks. The need for clean energy is multi-purposed: 1. it's important for future generations, as clean energy sources are inexhaustible and adapt well to natural cycles and do not emit greenhouse gases. 2. Clean Energy gives local economies an advantage by reducing the cycle of economic losses from a dependence on fossil fuels, to relying on locally produced renewable energy sources found everywhere and readily available for ensuring energy sustainability. 3. Clean Energy is becoming more affordable, with costs trending at a declining rate and becoming more competitive

with natural gas, coal, and oil. And 4. Clean Energy is a benefit to local economies due to creating locally produced new jobs in the generation of energy. But research and development must happen faster to make clean energy solutions viable. Therefore, although, clean energy already makes good business sense, fully realizing its potential, however, requires further innovation to optimize technologies and system integration.

#### *Means to Achieve Change*

- Sustainable Clean Energy (\$998,000). ARS will:
  - Enhance NAL capacity for Life Cycle-Assessment (LCA) and knowledge management support.

#### *Partnership and Collaborations*

External partners include but are not limited to DOE and other federal agencies, universities, and commercial stakeholders.

#### E) An increase of \$109,000,000 for Climate Science of which \$4,000,000 is for Library and Information Services.

The urgency of the global climate crisis is growing. Nearly every aspect of the nation's agricultural enterprise is increasingly called on to contribute to climate change mitigation by reducing GHG emissions, sequestering carbon (C) to reduce atmospheric carbon dioxide (CO<sub>2</sub>), and developing agriculturally based approaches for generating energy as alternatives to fossil fuels. Agriculture is also faced with adapting quickly to unprecedented climate changes and weather extremes with minimal interruptions in production. These enormous challenges call for innovative research supported by bold, trans-disciplinary collaborations. USDA-ARS has research projects and scientific expertise that address many topics related to climate change mitigation and adaptation. This existing infrastructure positions ARS to enable these advancements by establishing new research efforts and collaborations described below to support agriculture's response to the climate crisis.

#### *Means to Achieve Change*

- National Agricultural Library Support for Climate Science Research (\$4,000,000). ARS will:
  - Build capacity to improve Life-Cycle Assessment (LCA) in the agricultural economy and lead cross-government efforts to standardize LCA methods and data.
  - Align ARS research capacity with LCA assessment methods to support development of Environmental Product Declarations (EPDs).
  - Enhance existing NAL platforms to provide preservation and access to digital objects (i.e., data sets, literature, models, etc., and their associated metadata) to support climate research, including the Federal LCA program.
  - Support ARS scientists and USDA decision makers with systematic reviews and meta-analyses that provide deep insight and synthesis of scientific literature and other resources in support of climate research.

#### *Partnership and Collaborations*

External partners with ARS on this effort are extensive and will include those whose missions and needs contribute to Climate Science advances. These include USDA agencies such as ERS, NASS, NIFA, NRCS, Forest Service; other non-USDA federal agencies, such as EPA, DOE, NASA, NOAA, USGS, Health and Human Services; state and regional government agencies focused on climate science and its beneficial outcomes;

a wide spectrum of Land Grant Universities, their faculty, students, and extension teams; ecosystem service market quantifiers and brokers; NGOs and industry, including but not limited to: Soil Health communities; Conservation Districts; The Nature Conservancy; Field to Market, and other private industries involved with animal and plant breeding, germplasm development, animal welfare, and with sustainability commitments that depend on improved Climate Science.

- F) An increase of \$16,000,000 for USDA-ARS biotechnology innovation to which \$500,000 is for Library and Information Services.

Biotechnology is providing transformative solutions to many of our Nation’s greatest challenges, including human disease and pandemic threats (e.g., SARS-Cov-2) and biomanufacturing (e.g., new foods and industrial feedstocks). Biotechnology can provide the same for our Nation’s greatest agricultural challenges, including climate change, invasive pests and disease, food supply inequality, and provide novel opportunities to grow the U.S. economy and workforce. The USDA-ARS biotechnology innovation plan (BI) will provide strategic research planning, organization, resource development, and coordination, to meet these challenges, and accelerate the development and commercialization of new breakthroughs in biotechnology.

The USDA-ARS BI mission is ***to accelerate biotechnology innovation and development, product regulatory approval, and transfer to stakeholders and partners*** for agricultural products grown across the United States, including areas historically left behind by technological innovations. BI will leverage ARS infrastructure, existing projects, and biotechnology expertise to create a “hub-and-spokes” platform for biotechnology discovery, product development, and technology transfer—analogueous to crop and animal breeding.

#### *Means to Achieve Change*

- To enhance crop, animal, and microbial productivity the USDA-ARS BI will develop, assemble, field validate, and gain regulatory approval for a new rapid Microbial Bioengineering Pipeline, including genome editing, synthetic biology, nanotechnology, and microbiome engineering (\$3,000,000). ARS will:
  - Expand bioinformatic support to identify and curate gene variation for potential genome editing applications.

#### *Partnerships and Collaborations*

External partners include but are not limited to:; Department of Health and Human Services: CDC, NIH, BARDA; DoD; DHS; Animal Health Institute; STAR-IDAZ (International Collaboration on Research on Animal and Emerging Zoonotic Diseases); United States Animal Health Association (USAHA); American Association of Veterinary Medical Colleges (AAVMC); and the American Veterinary Medical Association (AVMA).

#### ***National Bio and Agro-Defense Facility - Operations and Maintenance***

- (10) An increase of \$31,060,000 and no staff years for the National Bio and Agro-Defense Facility Operations and Maintenance (\$81,056,000 and 82 staff years available in 2022 annualized CR).

The funding change is requested for the following items:

- A) An increase of \$249,000 which includes \$170,000 for pay inflation and \$79,000 for FERS for 2022 Pay and FERS.

This increase will support a 2.7 percent Cost of Living pay increases for civilian employees, and a 1.1 percent increase to cover the expenses for the mandated increase of USDA’s contribution to FERS.

Funding for pay and retirement benefit costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Elimination of the pay and retirement benefit costs would require ARS to absorb these costs and reduce planned hiring levels, eroding USDA's ability to meet key Administration priorities.

B) An increase of \$401,000 for 2023 Pay.

This increase will support the annualization of the 2022 2.7 percent Cost of Living pay increase and the 2023 4.6 percent Cost of Living pay increase.

Funding for pay costs is critical for recruiting and retaining top level scientists and staff, conducting viable research programs, and carrying out ARS' mission. Elimination of the pay costs would require ARS to absorb these costs and reduce planned hiring levels, eroding USDA's ability to meet key Administration priorities.

C) An increase of \$10,000 for Department's Working Capital Fund and Shared Costs.

This includes \$9,500 for the Department's Working Capital Fund and \$500 for Department-Wide Shared Cost Programs. Elimination of these costs would require ARS to absorb these costs and erode USDA's ability to meet key Administration priorities.

D) An increase of \$37,400,000 for the National Bio and Agro-Defense Facility -- Operations and Maintenance.

The new National Bio and Agro-Defense Facility (NBAF) in Manhattan, Kansas will replace the outdated and inadequate Plum Island Animal Diseases Center (PIADC) in New York. NBAF will be a state-of-the-art biocontainment facility for the study of high consequence foreign, emerging, and zoonotic animal diseases that pose a threat to U.S. animal agriculture and to public health. NBAF will include the first Biosafety Level-4 biocontainment facility for large livestock in the United States.

ARS is working closely with the Department of Homeland Security and APHIS to ensure a smooth transition of operations from PIADC to NBAF. Once the transition is complete, both ARS and APHIS will share responsibility for NBAF's operations.

*Means to Achieve Change*

- NBAF Operations and Maintenance. (\$37,400,000). ARS will use additional funds for increased costs associated with:
  - Utility costs associated with full operation of the facility.
  - Contracts and Services associated with facility operations.
  - Building modifications and Specialized equipment.

*Partnership and Collaborations*

This initiative requires contributions from ARS scientists working within the Animal Health National Program.

External partners include but are not limited to: National Cattleman's Beef Association; National Pork Board; Animal and Plant Health Inspection Service; Department of Health and Human Services: CDC, NIH, BARDA; DoD; DHS; Animal Health Institute; STAR-IDAZ (International Collaboration on Research on Animal and Emerging Zoonotic Diseases); United States Animal Health Association (USAHA); Kansas State University;

American Association of Veterinary Medical Colleges (AAVMC); and the American Veterinary Medical Association (AVMA).

E) A decrease of \$7,000,000 for NBAF -- Operations and Maintenance.

The new NBAF in Manhattan, Kansas will replace the outdated and inadequate Plum Island Animal Diseases Center (PIADC) in New York. NBAF will be a state-of-the-art biocontainment facility for the study of high consequence foreign, emerging, and zoonotic animal diseases that pose a threat to U.S. animal agriculture and to public health. NBAF will include the first Biosafety Level-4 biocontainment facility for large livestock in the United States.

ARS is working closely with the Department of Homeland Security and APHIS to ensure a smooth transition of operations from PIADC to NBAF. Once the transition is complete, both ARS and APHIS will share responsibility for NBAF's operations.

A proposed reduction of \$7,000,000 in NBAF operations and maintenance resources is associated with the reduction in NBAF stand-up support services contract.



**PROPOSED LEGISLATION**

**Agricultural Research**

*Annual Appropriations for Salaries and Expenses*

ARS proposes to amend the agency’s limitation used for two buildings to be constructed at a cost not to exceed \$3,000,000 each in the annual appropriations for the Salaries and Expenses account. ARS proposes to increase the number of buildings per year from 2 to 4 and dollar limitation on the authority from \$3,000,00 to \$5,000,000.

This small building authority limitation provides the agency flexibility to replace worn out, decrepit facilities with new, more efficient same size/purpose facilities. This authority is used only where repair of existing structures/systems does not make sense and is not cost effective. In recent years, construction and building costs have increased substantially. The current limitations are no longer sufficient.

The goal is to provide the most cost-effective program for the construction, alteration, and repair of ARS’ buildings. With the proposed change to the small building authority limitation, ARS will provide significant cost savings. For example, under the current limitations on small buildings, ARS recently upgraded its Clay Center swine facilities by constructing four small buildings. Only three larger buildings would have been constructed if the proposed increased limitations or the new authority had been in effect. The construction of fewer buildings, therefore less infrastructure (i.e., less mechanical/electrical/plumbing systems) with reduced operating and maintenance costs, results in significant cost savings to the government. Consolidating facilities also has the added advantage of reducing the footprint of Federal facilities.

***Table ARS-13. Change in Funding Due to Additional Private Investment (thousands of dollars)***

Item	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	10 Year Total
Budget Authority	0	0	0	0	0	0	0	0	0	0	0
Outlays	0	0	0	0	0	0	0	0	0	0	0

**GEOGRAPHIC BREAKDOWN OF OBLIGATIONS AND FTE****Table ARS-14. Geographic Breakdown of Obligations and FTE (thousands of dollars, FTE)**

State/Territory/Country	2020 Actual	FTE	2021 Actual	FTE	2022 Estimated	FTE	2023 Estimated	FTE
Alabama								
Auburn.....	\$14,522	34	\$18,962	39	\$20,447	46	\$20,805	46
Total.....	14,522	34	18,962	39	20,447	46	20,805	46
Arizona								
Maricopa .....	10,644	56	10,021	62	11,001	56	17,782	83
Tucson .....	6,641	45	6,717	47	6,485	45	9,085	54
Total.....	17,285	101	16,738	109	17,486	101	26,867	137
Arkansas								
Booneville.....	4,814	22	3,912	26	3,953	22	6,329	35
Fayetteville .....	2,181	14	1,995	15	1,882	14	4,331	20
Jonesboro.....	1,212	8	1,326	9	1,435	8	3,387	18
Little Rock.....	8,618	-	9,504	-	9,999	3	10,023	3
Stuttgart .....	7,785	52	9,330	55	7,972	52	10,178	61
Total.....	24,610	96	26,067	105	25,241	99	34,248	137
California								
Albany .....	41,897	171	38,177	162	40,077	174	56,583	229
Davis.....	13,876	72	17,762	77	16,904	72	23,495	100
Parlier .....	11,382	80	12,449	81	12,779	83	15,765	96
Riverside.....	5,681	26	5,364	28	5,908	26	6,111	26
Salinas.....	7,186	45	7,503	49	7,100	45	11,051	64
Total.....	80,022	394	81,255	397	82,768	400	113,005	515
Colorado								
Akron.....	1,663	12	1,808	12	1,992	12	2,085	12
Fort Collins .....	21,975	122	22,127	151	21,035	125	29,885	159
Total.....	23,638	134	23,935	163	23,027	137	31,970	171
Delaware								
Newark .....	1,940	16	2,207	14	2,024	16	2,598	19
Total.....	1,940	16	2,207	14	2,024	16	2,598	19
District of Columbia								
National Arboretum .....	12,807	49	14,843	59	14,215	49	14,597	49
Headquarters Federal Administration <sup>3</sup> .....	149,480	549	169,767	469	165,276	1,179	172,062	1,200
Total.....	162,287	598	184,610	528	179,491	1,228	186,659	1,249
Florida								
Canal Point .....	3,037	26	3,685	28	3,854	26	4,057	26
Fort Lauderdale.....	2,388	27	3,346	28	2,474	27	2,909	27
Fort Pierce.....	19,595	93	18,281	95	17,460	93	24,484	118
Gainesville.....	11,481	76	11,665	80	12,141	76	13,813	83
Miami .....	5,061	25	5,537	27	5,962	25	6,157	25
Total.....	41,562	247	42,514	258	41,891	247	51,420	279
Georgia								
Athens.....	29,209	127	30,525	141	32,165	127	39,455	161
Byron.....	3,433	28	4,773	31	5,288	31	5,529	31
Dawson.....	3,172	22	4,665	26	5,051	25	5,246	25
Griffin.....	2,465	13	2,429	15	2,435	13	2,986	13
Tifton.....	10,326	66	10,361	76	10,741	66	16,431	90
Total.....	48,605	256	52,753	289	55,680	262	69,647	320
Hawaii								

<sup>3</sup> Federal Administration contains supplemental funding for kelp and seagrass in FY 2021.

State/Territory/Country	2020		2021		2022		2023	
	Actual	FTE	Actual	FTE	Estimated	FTE	Estimated	FTE
Hilo.....	12,431	49	13,009	54	13,478	52	15,346	52
Total.....	12,431	49	13,009	54	13,478	52	15,346	52
Idaho								
Aberdeen.....	7,030	33	7,567	36	7,931	33	10,438	43
Boise.....	2,821	27	2,751	28	2,902	27	5,903	40
Dubois.....	1,997	10	2,557	10	2,605	13	3,156	16
Kimberly.....	5,445	36	5,457	41	5,637	36	5,917	36
Total.....	17,293	106	18,332	115	19,075	109	25,414	135
Illinois								
Peoria.....	32,430	154	32,095	157	33,274	154	64,848	273
Urbana.....	5,565	27	5,738	34	5,615	27	7,401	36
Total.....	37,995	181	37,833	191	38,889	181	72,249	309
Indiana								
West Lafayette.....	7,560	52	7,820	55	7,851	52	10,371	61
Total.....	7,560	52	7,820	55	7,851	52	10,371	61
Iowa								
Ames.....	55,590	304	53,895	328	57,441	304	67,685	344
Total.....	55,590	304	53,895	328	57,441	304	67,685	344
Kansas								
Manhattan.....	83,193	146	109,552	221	114,650	176	160,546	206
Total.....	83,193	146	109,552	221	114,650	176	160,546	206
Kentucky								
Bowling Green.....	2,662	14	2,671	16	2,646	14	2,755	14
Lexington.....	2,669	10	4,257	11	3,625	10	3,703	10
Total.....	5,331	24	6,928	27	6,271	24	6,458	24
Louisiana								
Baton Rouge.....	3,079	22	2,810	22	3,117	22	3,558	22
Houma.....	4,881	39	5,285	39	5,359	39	6,113	42
New Orleans.....	19,612	94	20,906	100	21,854	94	39,312	161
Total.....	27,572	155	29,001	161	30,330	155	48,983	225
Maine								
Orono.....	4,802	16	5,703	20	5,876	19	8,229	32
Total.....	4,802	16	5,703	20	5,876	19	8,229	32
Maryland								
Beltsville.....	119,064	491	122,340	517	123,880	497	138,868	532
National Ag Library.....	29,551	62	31,721	74	27,839	62	29,670	83
Frederick.....	5,945	26	5,898	29	6,493	26	7,371	29
Total.....	154,560	579	159,959	620	158,212	585	175,909	644
Massachusetts								
Boston.....	16,341	7	16,352	8	15,690	7	15,745	7
Total.....	16,341	7	16,352	8	15,690	7	15,745	7
Michigan								
East Lansing.....	1,616	7	2,292	8	2,137	10	2,214	10
Total.....	1,616	7	2,292	8	2,137	10	2,214	10
Minnesota								
Morris.....	2,571	15	2,701	16	3,003	18	5,303	28
St. Paul.....	10,384	44	11,250	51	11,202	44	12,355	48
Total.....	12,955	59	13,951	67	14,205	62	17,658	76
Mississippi								
Mississippi State.....	15,209	54	17,131	62	18,290	60	19,658	72
Oxford.....	14,796	55	14,107	61	15,446	55	17,315	61
Poplarville.....	5,828	27	5,737	29	5,943	27	6,153	27
Stoneville.....	46,261	183	50,508	208	53,787	186	56,406	197
Total.....	82,094	319	87,483	360	93,466	328	99,532	357

State/Territory/Country	2020		2021		2022		2023	
	Actual	FTE	Actual	FTE	Estimated	FTE	Estimated	FTE
Missouri								
Columbia .....	9,877	49	11,029	55	11,440	52	13,285	58
Total.....	9,877	49	11,029	55	11,440	52	13,285	58
Montana								
Miles City .....	3,575	23	4,786	25	4,685	23	4,864	23
Sidney .....	5,131	36	4,991	41	5,315	36	9,511	42
Total.....	8,706	59	9,777	66	10,000	59	14,375	65
Nebraska								
Clay Center .....	23,150	104	23,089	105	23,805	104	30,510	130
Lincoln.....	6,856	47	7,571	51	7,861	47	23,483	109
Total.....	30,006	151	30,660	156	31,666	151	53,993	239
Nevada								
Reno.....	2,363	11	2,422	13	2,298	11	4,139	22
Total.....	2,363	11	2,422	13	2,298	11	4,139	22
New Mexico								
Las Cruces .....	7,788	40	7,399	41	7,579	40	12,886	62
Total.....	7,788	40	7,399	41	7,579	40	12,886	62
New York								
Geneva.....	4,239	24	5,569	29	5,726	27	6,837	30
Greenport.....	8,922	18	8,483	23	5,981	18	14,433	55
Ithaca .....	21,889	49	18,739	51	12,927	49	6,121	18
Total.....	35,050	91	32,791	103	24,634	94	27,391	103
North Carolina								
Raleigh.....	12,496	76	12,384	76	12,307	76	13,574	79
Total.....	12,496	76	12,384	76	12,307	76	13,574	79
North Dakota								
Fargo.....	24,385	84	27,652	99	29,360	99	31,032	105
Grand Forks .....	9,108	30	8,914	33	9,758	30	9,992	30
Mandan .....	4,581	32	6,090	33	5,997	38	7,463	44
Total.....	38,074	146	42,656	165	45,115	167	48,487	179
Ohio								
Columbus.....	2,031	14	1,902	17	1,924	14	2,753	17
Wooster.....	9,119	39	9,859	49	8,012	39	8,766	42
Total.....	11,150	53	11,761	66	9,936	53	11,519	59
Oklahoma								
El Reno .....	6,629	40	6,530	40	6,990	40	11,397	58
Stillwater.....	4,534	25	5,502	26	4,745	28	6,133	31
Woodward .....	9,576	14	2,475	16	2,238	14	3,247	17
Total.....	20,739	79	14,507	82	13,973	82	20,777	106
Oregon								
Burns.....	4,049	22	4,762	27	5,339	22	5,511	22
Corvallis .....	22,929	82	24,466	95	21,748	88	24,234	101
Pendleton .....	3,337	12	4,734	14	5,066	15	5,183	15
Total.....	30,315	116	33,962	136	32,153	125	34,928	138
Pennsylvania								
University Park .....	6,629	32	7,624	35	6,720	32	7,689	35
Wyndmoor.....	30,574	118	31,425	129	33,143	118	44,263	155
Total.....	37,203	150	39,049	164	39,863	150	51,952	190
South Carolina								
Charleston.....	8,640	29	9,946	35	9,855	32	11,454	41
Florence .....	4,180	22	3,959	25	4,053	22	4,225	22
Total.....	12,820	51	13,905	60	13,908	54	15,679	63
South Dakota								
Brookings .....	3,054	18	3,126	22	3,353	18	4,124	21

State/Territory/Country	2020		2021		2022		2023	
	Actual	FTE	Actual	FTE	Estimated	FTE	Estimated	FTE
Total.....	3,054	18	3,126	22	3,353	18	4,124	21
Texas								
Bushland.....	6,824	32	6,983	35	7,390	32	8,719	38
College Station <sup>4</sup> .....	12,980	67	30,980	71	29,211	70	32,206	73
Houston.....	19,113	6	16,389	7	15,997	9	16,068	9
Kerrville.....	10,633	30	10,323	36	11,955	30	13,314	33
Lubbock.....	9,324	64	10,037	66	10,150	64	11,368	67
Temple.....	4,403	30	4,746	32	4,701	30	5,655	33
Total.....	63,277	229	79,458	247	79,404	235	87,330	253
Utah								
Logan.....	9,728	61	10,050	70	10,322	61	11,248	64
Total.....	9,728	61	10,050	70	10,322	61	11,248	64
Vermont								
Burlington.....	-	-	9,664	1	9,900	6	10,847	9
Total.....	-	-	9,664	1	9,900	6	10,847	9
Washington								
Pullman.....	22,946	103	23,140	115	24,465	103	30,600	118
Wapato.....	6,664	45	6,871	46	5,933	45	8,264	57
Wenatchee.....	3,209	17	2,898	15	3,403	17	3,536	17
Total.....	32,819	165	32,909	176	33,801	165	42,400	192
West Virginia								
Kearneysville.....	9,994	39	9,609	40	9,393	39	11,497	52
Leetown.....	8,556	29	8,859	30	9,441	32	10,590	38
Total.....	18,550	68	18,468	70	18,834	71	22,087	90
Wisconsin								
Madison.....	21,339	98	21,707	106	22,834	101	26,051	110
Total.....	21,339	98	21,707	106	22,834	101	26,051	110
Puerto Rico								
Mayaguez.....	3,347	33	3,306	33	3,406	33	3,663	33
Total.....	3,347	33	3,306	33	3,406	33	3,663	33
Other Countries								
France, Montpelier.....	3,551	1	3,967	1	3,204	1	4,382	1
Total.....	3,551	1	3,967	1	3,204	1	4,382	1
Extramural & Funds								
Administered.....	57,329	-	34,151	-	113,050	-	58,760	-
Repair & Maintenance of Facilities.....	20,144	-	20,144	-	20,144	-	20,144	-
Obligations.....	1,423,529	5,625	1,510,403	6,045	1,599,050	6,405	1,877,579	7,491
Lapsing Balances.....	2,508	-	3,530	-	-	-	-	-
Bal. Available, EOY.....	74,418	-	88,406	-	-	-	-	-
Total, Available.....	1,500,455	5,625	1,602,339	6,045	1,599,050	6,405	1,877,579	7,491

<sup>4</sup> Human Nutrition funding of \$20m is reflected in the FY 2021, 2022 and 2023 columns.

**CLASSIFICATION BY OBJECTS****Table ARS-15. Classification by Objects (thousands of dollars)**

Item No.	Item	2020 Actual	2021 Actual <sup>5</sup>	2022 Estimated <sup>7</sup>	2023 Estimated <sup>8</sup>
	Personnel Compensation:				
	Washington D.C. ....	\$35,871	\$37,579	\$37,579	\$41,383
	Personnel Compensation, Field.....	444,075	465,218	465,218	512,310
11	Total personnel compensation.....	479,946	502,797	502,797	553,693
12	Personal benefits .....	181,147	195,352	195,747	203,889
13.0	Benefits for former personnel.....	511	395	-	-
	Total, personnel comp. and benefits.....	661,605	698,544	698,544	757,582
	Other Objects:				
21.0	Travel and transportation of persons .....	5,320	793	880	1,094
22.0	Transportation of things .....	631	821	911	1,132
23.1	Rental payments to GSA .....	4,982	4,717	4,717	4,717
23.2	Rental payments to others .....	1,868	2,067	2,293	2,852
23.3	Communications, utilities, and misc. charges.....	40,214	42,192	46,943	59,661
24.0	Printing and reproduction .....	736	3,592	3,984	4,956
25.1	Advisory and assistance services.....	1,021	1,315	1,458	1,814
25.2	Other services from non-Federal sources .....	21,127	24,043	26,668	33,168
25.3	Other goods and services from Federal sources .....	1,562	6,196	6,872	8,547
25.4	Operation and maintenance of facilities .....	40,830	50,577	56,099	69,773
25.5	Research and development contracts.....	349,789	391,501	434,621	540,429
25.6	Medical care .....	206	204	226	281
25.7	Operation and maintenance of equipment .....	52,509	31,058	34,449	42,846
25.8	Subsistence and support of persons .....	11	1	1	1
26.0	Supplies and materials.....	93,605	85,347	94,666	117,740
31.0	Equipment .....	83,834	85,026	94,310	117,297
32.0	Land and Structures.....	29,024	37,437	41,525	51,647
41.0	Grants, subsidies, and contributions .....	34,654	44,972	49,883	62,041
	Total, Other Objects .....	761,924	811,859	900,506	1,119,997
99.9	Total, new obligations .....	1,423,529	1,510,403	1,599,050	1,877,579
	DHS Building Security Payments (included in 25.3).....	\$175	\$184	\$184	\$184
	Information Technology Investments:				
25.2	Mission Area Non-Major Investment Totals.....	36,580	45,601	43,161	43,161
	Mission Area Standard Investment Totals.....	22,808	12,008	13,008	13,008
25.3	Mission Area WCF Transfers.....	20,521	33,342	35,643	35,990
	Position Data:				
	Average Salary (dollars), ES Position .....	\$250,818	\$148,868	\$141,033	\$131,150
	Average Salary (dollars), GS Position.....	\$78,810	\$77,202	\$72,861	\$68,609

<sup>5</sup> NOAA Working Group on Kelp and Seagrass funding is reflected in the FY 2021 column.<sup>6</sup> Human Nutrition funding of \$20m is reflected in the FY 2021 columns<sup>7</sup> Human Nutrition funding of \$20m is reflected in the FY 2022 columns<sup>8</sup> Human Nutrition funding of \$20m is reflected in the FY 2023 columns

Average Grade, GS Position.....	9.8	9.9	10.2	10.0
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**ADVERTISING EXPENDITURES**

***Table ARS-16. Advertising Expenditures (thousands of dollars)***

<b>Item</b>	<b>2021</b>		<b>2022</b>		<b>2023</b>	
	<b>Number of Contracts</b>	<b>Dollars Obligated</b>	<b>Number of Contracts</b>	<b>Dollars Obligated</b>	<b>Number of Contracts</b>	<b>2023 Dollars Obligated</b>
Total Contracts for Advertising Services .....	15	\$1,316	13	\$1,250	16	\$1,480
Contracts for Advertising Services to Socially and Economically Disadvantaged Small Businesses.....	4	335	3	295	4	360
Contracts for Advertising Services to Women-Owned and Minority-Owned Small Businesses.....	-	-	-	-	-	-



## **STATUS OF PROGRAMS**

The Agricultural Research Service (ARS) is the U.S. Department of Agriculture's chief scientific in-house research agency. Our mission is to deliver scientific solutions to national and global agricultural challenges. ARS' major research programs -- New Products/Product Quality/Value Added; Livestock/Crop Production; Food Safety; Livestock/Crop Protection; Human Nutrition; and Environmental Stewardship -- address the Department's goals and priorities. A brief summary of the agency's selected FY 2021 accomplishments and current activities, including the National Agricultural Library, are detailed below.

### ***Program Evaluations***

In FY 2021, ARS conducted retrospective reviews of its Plant Genetic Resources, Genomics, and Genetic Improvement research program; and Food Animal Production research program. Overall, the programs were found to have had high impact (i.e., significant benefit or influence). The programs were evaluated by 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. 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.

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

Germ-fighting, durable, nano-enhanced cotton. Current methods to make fabrics with germ-fighting properties rely on surface coatings, but these surface coatings typically have poor durability and lose their functionality after only a few uses. ARS scientists in New Orleans, Louisiana, developed a new technology to produce permanent antimicrobial cotton products by synthesizing inexpensive copper oxide nanoparticles, which are powerful antimicrobial agents, within the cotton fiber. This process does not require the use of harsh chemicals. It is the first known development of a nano-enhanced cotton having long-lasting antimicrobial performance (50 laundering cycles) that is easily transferrable to large-scale manufacturing. It is anticipated that these active fabrics will have a market value reaching \$1.1 billion by 2026.

Green jet fuel from yeast now at commercial scale. U.S. airlines have committed to reducing carbon dioxide emissions by 50 percent in 2050, which has generated significant demand for renewable jet fuel that can be used to replace the 23 billion gallons of fossil fuel currently supplying the jet fuel market. ARS scientists in Peoria, Illinois, assembled a collection of yeasts that convert agriculture waste into bio-oil, which is then easily converted into biodiesel or renewable jet fuel. One of these yeasts (*Rhodosporidium toruloides*) was used in a pilot demonstration at a commercial development center to convert sugarcane bagasse into bio-oil. The yeast produced 18 grams of bio-oil/100 grams of agricultural waste, demonstrating that it is robust enough to produce bio-oil in a commercial, large-scale operation. This accomplishment supports President Biden's mandate to reduce fossil fuels and convert underutilized agricultural residues into value-added, green biofuels that support rural economies.

### **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. This is accomplished 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:*

Rapid eye temperature measurement to evaluate animal health. Rapid temperature measurement using forehead thermometers has become normal practice for humans, but current practices in cattle rely on obtaining rectal temperatures which is time-consuming. ARS scientists in Lubbock, Texas, and university collaborators studied infrared ocular thermography, measuring the temperature of the eye, to detect fever in cattle. Results indicate that infrared ocular thermography can detect fever in cattle in less than 30 seconds and that eye temperature is highly correlated with rectal temperature. Adopting this rapid method for detecting fever in cattle allows high-throughput measurement in production facilities that will improve cattle management and sickness identification practices, improve cattle well-being and productivity, and reduce production costs.

Farm Genotype-Tissue Expression (FarmGTEx) Consortium and the Cattle Gene Atlas. Understanding the regulation of livestock gene expression underpins the study of biological mechanisms that contribute to economically important traits and animal improvement through selective breeding. FarmGTEx is an international collaboration focused on the development of a comprehensive atlas of tissue-specific gene expression and genetic regulation in farm animals. Co-led by ARS scientists in Beltsville, Maryland, and researchers at the University of Edinburgh, Scotland and 20 other universities and institutes around the world, FarmGTEx built a Cattle Gene Atlas using approximately 12,000 publicly available RNA-sequence datasets that represented more than 100 tissues and cell types from more than 40 cattle breeds. The atlas describes the landscape of RNA expression in the genome and across tissues, and identifies variation in gene expression and protein isoform variants for 24 major tissues and 43 economically important traits in cattle. This data portal allows researchers to query gene expression, alternative splicing, and DNA regions associated with economically important traits in an easy, uniform way. FarmGTEx serves as the primary international reference source for cattle genomics, breeding, adaptive evolution, comparative genomics, and veterinary medicine. This research directly addresses the collective quest to enhance efficiency in cattle production and contributes to improvements in the environment, sustainable systems, and consumer expectations of beef and dairy products.

Improved fillet yield and body weight in rainbow trout. The proportion of edible meat (fillet yield) on a carcass is of major economic importance and breeding animals with superior fillet yield can improve production efficiency and profitability. Animals must be slaughtered to measure fillet yield directly, so it cannot be measured in breeding animals. However, developing genetic gains for fillet yield are possible using information, including genome information, from siblings of fish that are potential breeders. ARS researchers in Leetown, West Virginia, compared the accuracy of genetic merit predictions for fillet yield between the family-based selective breeding—which used information about family relationships—and genomic selection, which used information about family relationships and genomic information. The genomic selection model increased the accuracy of genetic merit predictions for fillet yield by 50 percent, indicating that the use of genomic selection can enhance genetic improvement for the fillet yield trait and further enhance the efficiency and sustainability of rainbow trout aquaculture.

## **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, aids in detection/identification, and increases control through tactics that restore habitats and biological diversity.

*Selected Examples of Recent Progress:*

‘Yorizane’, a new self-fertile almond cultivar. Eighty percent of the world’s almonds are grown in California, and the majority of the 1.5 million acres are planted with cultivars that require bees to transfer pollen between different trees to produce nuts. Self-fertile varieties require fewer pollinators in the orchard because the pollen moves only a short distance within the flower or within the tree to produce nuts. The California almond industry wants new self-fertile cultivars to reduce the need for honeybees and pollinators. ARS researchers in Parlier, California, developed the new self-fertile ‘Yorizane’ cultivar, which yielded well in regional trials throughout the San Joaquin Valley for five commercial harvests. Yorizane nuts have been rated highly by the almond industry in marketing potential and kernel appearance and it has great potential for adoption by almond growers.

Winter oilseed cover crops suppress early-season weeds. ARS researchers and university partners in Morris, Minnesota, are developing Midwest U.S. crop production systems that use winter camelina and pennycress as an oilseed cash cover crop that can also suppress the growth of weeds. They found pennycress, as an overwintering crop, reduced spring and early summer weed growth from 97 to 100 percent, while winter camelina suppressed weeds from 85 to 87 percent. When used as cash cover crops, these oilseeds can reduce herbicide use and help control herbicide resistant weeds. These findings have been shared via a refereed publication and will greatly benefit farmers, agronomists, extension educators, and others interested in adopting this new cropping practice.

Universal intelligent spray control system as a retrofit for conventional sprayers commercialized. An intelligent spray technology developed by ARS researchers in Wooster, OH, effectively controls pest insects and diseases with significant reductions in pesticide waste to the environment; however, to ensure that growers use this technology economically, it must be adaptable to conventional sprayers. To address this challenge, the researchers developed a universal intelligent spray system as a retrofit unit for conventional orchard sprayers. The retrofit unit was tested in 15 commercial nurseries, fruit and nut orchards, and vineyards in California, Ohio, Oregon, South Carolina, Tennessee, Texas, and Australia. Field tests demonstrate this new technology can provide pest and disease control that is as effective as conventional spray systems while reducing spray drift by up to 87 percent and ground loss by 90 percent. In addition, pesticide use was reduced by up to 85 percent, resulting in an annual chemical cost saving of \$812 per acre, depending on crop type. This cost reduction does not include reductions in labor and fuel costs. The technology was transferred to a commercial partner and a commercial product, “Intelligent Spray Control System” by Smart Guided Systems, LLC, was released to the market. Citrus, apple, grape, nursery, and pecan growers in the United States and other countries have started to upgrade their sprayers with the commercial product. The use of a new laser-guided intelligent spraying system is beneficial to the environment and saves growers money. The ability to retrofit conventional sprayers offers a sustainable and environmentally responsible approach to protecting crops.

## **Food Safety**

### **Current Activities:**

ARS’ Food Safety research program is designed to yield science-based knowledge on the safe production, storage, processing, and handling of plant and animal products, and on the detection and control of pathogenic bacteria and fungi, parasites, chemical contaminants, and plant toxins. All of ARS’ research activities involve a high degree of cooperation and collaboration with USDA’s Research, Education, and Economics agencies, as well as with the FSIS, APHIS, FDA, CDC, DHS, and the 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.

*Selected Examples of Recent Progress:*

Semicarbazide during poultry processing. To ensure food is safe from chemical contaminants, detection technologies should be accurate and reliable. Semicarbazide (SEM) is an indicator compound used by national and international organizations to infer the use of nitrofurazone, a banned antibiotic, in animal production. Recently, the detection of SEM by a significant importer of U.S. poultry resulted in an import ban for products from specific processing plants. The validity of using SEM as an indicator for nitrofurazone has been questioned in recent years. Strong evidence has emerged that sanitizers used in processing facilities to decontaminate meat may chemically create SEM from biological molecules in the complete absence of nitrofurazone use. Studies conducted by ARS researchers in Athens, Georgia, support this unintentional production of SEM on poultry meat. An extensive survey of poultry processing plants indicated that the use of certain antiseptic chemicals, in combination with pH, can react with meat tissue to produce detectable levels of SEM. These data confirm that incidental production of the chemical can occur in processing facilities; therefore, SEM is not a reliable indicator of nitrofurazone, and alternative indicators of nitrofurazone use should be developed. This data has been transferred to food safety regulatory agencies, industry, and trade organizations to ensure and avoid inaccurate contamination reports, and to eliminate economic loss and potential trade issues.

Deep learning approach for classifying contamination levels. Mercury (Hg) and arsenic (As) ions have been recognized as chemical threats to human health and can be present in foods in trace amounts. A critical issue recognized by the Food and Drug Administration and other organizations is the difficulty detecting low contamination levels in the parts per billion range. This remains challenging due to the small number of available data samples and significant intra-class variance. ARS researchers and colleagues at Purdue University's Center for Food Safety Engineering explored techniques for synthesizing realistic colorimetric images and proposed a Convolutional Neural Network (CNN) classifier. The system was trained and evaluated on a dataset of 126 images captured with a cell phone camera representing 5 contamination levels. The system accurately classified 88.1 percent of the contaminated images and classified contamination levels with a precision level of 91.9 percent. Using this system would allow regulators, processors, and consumers to use cell phone cameras to capture images that can estimate heavy metal contamination levels and advance the protection of the food supply.

## **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. ARS' animal research program includes: 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:*

Discovery of continuous cell line to detect African swine fever virus infectious field isolates. African swine fever virus (ASFV) field isolates only replicate in primary cultures of swine white blood cells (macrophages), which are time consuming to prepare and require a herd of healthy donor pigs. These factors make swine macrophage cultures inaccessible for most diagnostic laboratories trying to identify infections in suspect field samples. ARS scientists in Greenport, New York, discovered that a cell line of monkey origin, Ma-104, was highly susceptible to infection with field isolates of ASFV. Results showed Ma-104 cells can be readily infected by all ASFV isolates tested. Furthermore, ARS researchers discovered the detection sensitivity was just below that of primary swine macrophage cultures and above the sensitivity of conventional real-time PCR methods. This discovery is of paramount importance for ASFV diagnostics as it will enable diagnostic laboratories worldwide to perform detection of ASFV infectious particles using a readily available cell line that is easy to grow. A patent covering the use of Ma-104 cells for ASFV diagnostic was filed by the ARS Office of Technology Transfer.

A swine-origin H3N2 influenza virus closely related to human H3N2v demonstrated transmission from swine to ferrets. The transmission of influenza A viruses (IAV) from swine to humans occurs sporadically and is often associated with U.S. agricultural fairs. IAVs from swine that are detected in humans are called "variant" to differentiate from human seasonal IAV. During the 2016-2017 influenza season, 61 H3N2 variant (H3N2v) cases were reported. ARS scientists in Ames, Iowa, compared the genomes of human H3N2v viruses and swine H3N2 viruses collected at the same 2017 state fair in Ohio, where ferrets were also directly infected with the H3N2 virus. In the study, pigs were infected with the virus and placed in an enclosure close to caged ferrets, which were chosen to test the spread of H3N2 because IAV transmission and infection in ferrets serves as model for human IAV transmission and infection. Results demonstrated that the swine H3N2 replicated in both pigs and ferrets exposed to the respiratory aerosols of infected pigs, showing potential transmission from pigs to susceptible ferrets. These results are the first to show a transmission model from swine to ferrets without modification to the virus, and highlight the need to reduce swine IAV at animal exhibits. This study also demonstrates the importance of continued surveillance, research, and collaboration on swine and human IAV.

Attractant-impregnated adhesive stable fly tape. Stable flies are one of the most important arthropod pests of livestock. Stable flies reduce cattle weight gain and milk production, which leads to an annual economic loss of more than \$2 billion to the U.S. cattle industry. ARS scientists in Lincoln, Nebraska, have identified attractant compounds that can be used with mass trapping techniques to reduce stable fly attacks on cattle. These attractants have been developed with adhesive technologies for stable fly control in feedlots to help cattle producers reduce stable fly infestation levels. A U.S. patent and an international patent application have been filed. A developed prototype product has been tested in the field, resulting in improved cattle protection against biting flies and an 80 percent reduction in cattle stress.

**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:*

Managing tomato brown rugose fruit virus. Tomato brown rugose fruit virus (ToBRFV), an emerging and economically important plant virus, has caused serious disease outbreaks on greenhouse tomatoes around the world in recent years. This seed-borne and mechanically transmitted virus poses a serious threat to the \$2.5 billion tomato and pepper industries in the United States. Recently, ARS researchers in Charleston, South Carolina, reported an outbreak of ToBRFV on tomato for the first time in the United States. Based on this report, USDA-APHIS issued a federal order to inspect all imported tomatoes and peppers for ToBRFV infection to prevent potential devastation to the U.S. tomato industry. Also, the researchers conducted molecular and biological characterizations of ToBRFV isolates in the United States and developed a highly sensitive real-time PCR detection system for the virus that can also be used for seed health testing. Additionally, several disinfectants that kill the virus and prevent the disease from spreading have been identified and recommended to growers. Furthermore, the researchers screened available tomato germplasm and identified new sources of resistance that are being used in breeding to develop plants that are resistant to the virus. These research findings will provide fundamental knowledge and practical solutions to prevent and protect tomato and pepper crops in the United States and around the world from potential devastation by this emerging and economically important plant pathogen.

New viruses passed on by whiteflies threaten cucurbit crops in California's Central Valley. In the U.S. Southwestern low desert, two yellowing viruses are known to impact summer and fall cucurbit production. These two viruses had not been previously known to infect plants in the Central Valley of California, where more than half of U.S. cantaloupe production occurs. During the fall of 2020, ARS scientists in Salinas, California, identified both viruses from melon plants in Fresno County, California, using a virus detection system developed by the ARS laboratory. These first reports were published in the journal *Plant Disease*. The viruses have the potential to cause severe losses, and it is important for the cucurbit industry that continued monitoring occur to determine prevalence and to develop strategies to reduce the impact of the virus.

**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 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.

*Selected Examples of Recent Progress:*

Lean beef in a Mediterranean diet pattern reduces heart disease risk. Eating red meat has a reputation for being bad for the heart, but when consumed as part of a healthy diet, it might reduce heart disease risk factors such as bad cholesterol. ARS researchers in Beltsville, Maryland, and Pennsylvania State University colleagues conducted a dietary intervention study to determine how much lean beef can be included in a Mediterranean diet pattern to promote heart health. Volunteers daily consumed either 0.5, 2.5, or 5.5 ounces of lean beef as part of a healthy Mediterranean diet pattern or 2.5 ounces as part of a typical American diet. The researchers determined that a Mediterranean diet pattern that included lean beef consumption at all three levels reduced bad cholesterol and other risk factors for heart disease. While the traditional Mediterranean diet is low in lean beef, this study demonstrates how people can incorporate lean beef into a healthy diet and benefit further from beef's other key nutrients.

Adolescents with prediabetes or type 2 diabetes have impaired metabolic flexibility. Metabolic flexibility refers to the ability to utilize different nutrients (fats and sugars) and to transition between them while fasting and after a meal. Impaired metabolic flexibility can lead to metabolic disease, but it is not clear whether metabolic flexibility is impaired in obese youth. ARS-funded researchers in Houston, Texas, found that adolescents with prediabetes and type 2 diabetes

have a defect in metabolic flexibility and are not able to change fuel use as easily as normal weight individuals or obese individuals who maintain normal sugar levels. The impairment results from severe insulin resistance that in turn impairs the appropriate use of available fuels. These results highlight the need for additional studies to investigate which changes in diet or physical activity could improve how the body utilizes these nutrients and help mitigate the risk of type 2 diabetes.

## **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:***

The ARS root-zone soil moisture technique improves drought early warning systems. The Soil Moisture Active Passive (SMAP) satellite is an effective method for monitoring soil moisture content at a coarse resolution (36-km grid). It is possible to refine this gridding to 9 km, but this is still too coarse for many agricultural applications. ARS scientists in Beltsville, Maryland, developed a new technique to produce 1-km soil moisture estimates, called the root-zone soil moisture technique. With these new high-resolution techniques, drought monitor systems can now be designed to optimally merge soil moisture information from multiple sources (including ground-based observations) and maximize the probability of early drought detection. The root-zone soil moisture technique enables USDA-Foreign Agricultural Service (FAS) to better monitor the impact of agricultural drought on global agricultural productivity. FAS formally integrated this SMAP-based technique into their Crop Explorer system and their analysts are actively using it to improve their international commodity crop production forecasts. Early drought detection is critical to U.S. food security and for adaptive management. Global application of the ARS root-zone soil moisture technique is enhancing our global food security and national security.

Improved methods for measuring soil carbon lower costs and increase accuracy. Two limitations to building credible soil carbon sequestration programs are the high cost and variability in soil carbon measurements. Part of the measurement variability is caused by small plant materials that cannot be removed by hand. ARS researchers in Pendleton, Oregon, developed a rapid way to remove large and small particulates using an electrostatically charged surface, which made the organic matter measurements more consistent. They also assessed a low-cost non-destructive spectroscopy technique to accurately detect small changes in soil carbon. To further increase the power of these approaches in soil carbon monitoring, they teamed with ARS researchers in Beltsville, Maryland; Lincoln, Nebraska; Mandan, North Dakota; Fort Collins, Colorado; and researchers at the Woodwell Climate Research Center and Rodale Institute. This team used soil samples from long-term research trials to show that this spectroscopy technique, when used in context of a USDA-NRCS laboratory spectral library, can be a reliable way to estimate soil carbon compared to traditional, more expensive lab methods. These improvements in measurement consistency and low-cost analytical techniques for soil carbon can be used by farmers seeking to improve soil management and benefit from ecosystem service markets.

Targeted cattle grazing prevents megafires. Rangeland megafires (>100,000 acres) are becoming increasingly common in the western United States, account for much of the \$1-3 billion spent annually on wildfire suppression, and critically threaten human life, property, and natural resources. Targeted livestock grazing offers an efficient and effective means of curbing wildfire size and reducing damage by creating and maintaining fuel breaks strategically positioned between fire-prone landscapes, such as those dominated by highly-flammable, invasive annual grasses like cheatgrass. In partnership with the Bureau of Land Management, ARS researchers in Boise, Idaho, used targeted cattle grazing to create fuel breaks at project sites in Idaho, Nevada, and Oregon. Intensive and carefully managed cattle grazing reduced vegetative fuel height, loading, and connectivity while avoiding adverse impacts to environment health within the fuel break areas. Targeted grazing fuel breaks have already reduced fire intensity and expansion in three wildfires at the Nevada project site, saving millions of dollars in property damages, fire suppression, and subsequent landscape restoration. This allowed wildland firefighters to make more timely arrivals and apply better initial control options to contain the fires to smaller acreages. Targeted grazing provides a unique opportunity for agricultural producers, private landowners, and public land managers to strategically reduce fine fuels and wildfire size and severity with a tool that is already in place and at a scope needed for the annual grass-wildfire problem.

Vegetable growers receive increased nitrogen credits for growing cover crops. Winter cover cropping is a best management practice for reducing nitrogen leaching into ground water in high-input vegetable systems, but only about 5 percent of irrigated land in the Central Coast region of California is cover cropped during the winter. To address the issue of ground water pollution from agriculture, a new regulation, known as Ag Order 4.0, was adopted in California. During the development of the regulation, an ARS researcher in Salinas, California, used long-term cover cropping data to justify increasing the nitrogen credit farmers would receive when they grow winter cover crops. This change improves the regulation to the benefit of both farmers and the environment and will incentivize cover cropping on 540,000 acres of irrigated land in this important vegetable production region of California.

## **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.

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

Expanding public access to data outcomes from USDA-funded research through Ag Data Commons. The Ag Data Commons is a Federal scientific research data catalog and repository that helps the agricultural research community share and discover research data funded by USDA. In FY 2020, NAL’s Ag Data Commons team worked with the ARS Agricultural Collaborative Research Outcomes System (AgCROS) team to develop a workflow to create and apply Digital Object Identifiers (DOIs) for data deposited in AgCROS. The result of improved platform interfaces and other customer service improvements in FY 2020 was a 20 percent increase in individual data submitters, as well as an increase in the number of cataloged datasets and dataset downloads.

Increasing USDA full-text publications and peer-reviewed citations in PubAg. PubAg is the NAL search system for USDA-funded scholarly agricultural literature. In FY 2020, NAL created a new workflow that added more than 1,200 manuscripts. PubAg now contains more than 3 million citations for peer-reviewed, agriculture-related scientific articles, an increase of more than 350,000 citations from FY 2019.



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

**APPROPRIATIONS LANGUAGE**

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, \$45,405,000 to remain available until expended.

**LEAD-OFF TABULAR STATEMENT***Table ARS-17. Lead-Off Tabular Statement (In dollars)*

<b>Item</b>	<b>Amount</b>
Estimate, 2022	\$35,700,000
Change in Appropriation	+9,705,000
Budget Estimate, 2023	<u>45,405,000</u>

**PROJECT STATEMENT APPROPRIATIONS**

*Table ARS-18. Project Statement (thousands of dollars)*

Item	2020 Actual	2021 Actual	2022 Estimated	2023 Estimated	Inc. or Dec.
Discretionary Appropriations:					
<u>Buildings and Facilities</u>					
Buildings and Facilities	\$25,800	\$24,500	\$24,500	\$45,405	+\$20,905
ARS Co-Located Facilities	166,900	11,200	11,200	-	-11,200
Subtotal .....	192,700	35,700	35,700	45,405	+9,705
Total Appropriation.....	192,700	35,700	35,700	45,405	+9,705
Recoveries, Other.....	69	906	-	-	-
Bal. Available, SOY.....	697,006	109,368	100,449	127,316	+26,867
Total Available.....	889,775	145,974	136,149	172,721	+36,572
Bal. Available, EOY .....	-109,368	-100,449	-127,316	-168,459	-41,143
Total Obligations <sup>9</sup> .....	780,407	45,525	8,833	4,262	-4,571

<sup>9</sup> Emergency Hurricane Supplemental funds were appropriated in FY18 and are not displayed on the Project Statement Appropriations exhibit. The funds are still being obligated through FY23 and are reflected on the Project Statement Obligations exhibit

**FUNDING DETAIL APPROPRIATIONS****Table ARS-19. Funding Detail (thousands of dollars)**

<u>Allocations</u>	<b>2020</b> <u>Actual</u> <b>B.A.</b>	<b>2021</b> <u>Actual</u> <b>B.A.</b>	<b>2022</b> <u>Estimated</u> <b>B.A.</b>	<b>2023</b> <u>Budget</u> <b>Request</b> <b>B.A.</b>	<b>Change from</b> <b>2022</b> <u>Estimate</u> <b>B.A.</b>
<b>Buildings and Facilities</b>					
Beltsville, MD, Beltsville Area Research Center, Buildings 002, 005 and 308 .....	\$12,300	-	-	-	-
Beltsville, MD, Beltsville Area Research Center, Building 002 .....	-	\$24,500	\$24,500	-	-\$24,500
Beltsville, MD, Beltsville Area Research Center, Building 005 .....	-	-	-	\$34,805	+34,805
Corvallis, OR, National Clonal Germplasm Repository .....	13,500	-	-	-	-
Manhattan, KS, National Bio and Agro-Defense Facility .....	-	-	-	10,600	+10,600
<b>Subtotal .....</b>	<b>25,800</b>	<b>24,500</b>	<b>24,500</b>	<b>45,405</b>	<b>+20,905</b>
<b>ARS Co-Located Facilities</b>					
Columbia, MO, University of Missouri .....	24,800	-	-	-	-
Davis, CA, University of California .....	76,200	-	-	-	-
Lexington, KY, University of Kentucky .....	65,900	-	-	-	-
Lincoln, NE, University of Nebraska .....	-	11,200	11,200	-	-11,200
<b>Subtotal .....</b>	<b>166,900</b>	<b>11,200</b>	11,200	-	-11,200
<b>Total .....</b>	<b>192,700</b>	<b>35,700</b>	<b>35,700</b>	<b>45,405</b>	<b>+9,705</b>

**PROJECT STATEMENT OBLIGATIONS****Table ARS-20. Project Statement (thousands of dollars)**

Item	2020 Actual	2021 Actual	2022 Estimated	2023 Estimated	Inc. or Dec.
Discretionary Obligations:					
<u>Buildings and Facilities</u>					
Buildings and Facilities ARS Co-Located	\$413,969	\$14,347	\$1,833	\$2,662	+\$829
Facilities	364,058	26,620	-	-	-
Subtotal	778,027	40,967	1,833	2,662	+829
Supplemental Obligations:					
Emergency Supplemental <sup>10</sup>	2,380	4,558	7,000	1,600	-5,400
Subtotal	2,380	4,558	7,000	1,600	-5,400
Total Obligations	780,407	45,525	8,833	4,262	-4,571
Balances Available, EOY	109,368	100,449	127,316	168,459	+41,143
Total Available	889,775	145,974	136,149	172,721	+36,572
Recoveries, Other	-69	-906	-	-	-
Bal. Available, SOY	-697,006	-109,368	-100,449	-127,316	-26,867
Total Appropriation	192,700	35,700	35,700	45,405	+9,705

<sup>10</sup> Emergency Hurricane Supplemental funds were appropriated in FY18 and are not displayed on the Project Statement Appropriations exhibit. The funds are still being obligated through FY23 and are reflected on the Project Statement Obligations exhibit.

**FUNDING DETAIL OBLIGATIONS****Table ARS-21. Funding Detail (thousands of dollars)**

<u>Allocations</u>	<u>2020</u> <u>Actual</u> <u>B.A.</u>	<u>2021</u> <u>Actual</u> <u>B.A.</u>	<u>2022</u> <u>Estimated</u> <u>B.A.</u>	<u>2023</u> <u>Budget</u> <u>Request</u> <u>B.A.</u>	<u>Change</u> <u>from</u> <u>2022</u> <u>Estimate</u> <u>B.A.</u>
<b>Buildings and Facilities</b>					
Athens, GA, Southeast Poultry Research Laboratory .....	\$284	\$599	\$200	\$1,833	+\$1,633
Ames, IA, National Laboratory for Agricultural and the Environment.....	445	-	-	-	-
Beltsville, MD, Beltsville Area Research Center, Buildings 002, 005 and 308.....	7,736	-	-	-	-
Beltsville, MD, Beltsville Area Research Center, Building 307 .....	31,984	1,650	-	-	-
Corvallis, OR, National Clonal Germplasm Repository .....	13,472	-	-	-	-
Frederick, MD, Foreign Disease-Weed Science Research Laboratory .....	65,472	-	-	-	-
Houston, TX, Children's Nutrition Research Center .....	28,258	-	-	-	-
Kerrville, TX, Knipling Bushland Research Center .....	50,176	24	-	-	-
Prairie du Sac, WI, Dairy Forage Agriculture Research Center.....	56,500	-	-	-	-
Salinas, CA, U.S. Agricultural Research Station .....	90,149	3,568	1,000	829	-171
Temple, TX, Grassland, Soil and Water Research Laboratory .....	17,004	286	633	-	-633
Tifton, GA, Southeast Watershed Research Laboratory .....	32,400	7,500	-	-	-
Tucson, AZ, Southwest Watershed Research Laboratory .....	-	718	-	-	-
University Park, PA, U.S. Pasture Laboratory.....	20,089	1,808	-	-	-
<b>Subtotal .....</b>	<b>413,969</b>	<b>16,153</b>	<b>1,833</b>	<b>2,662</b>	<b>+829</b>
<b>ARS Co-Located Facilities</b>					
Auburn, AL, National Soil Dynamics Laboratory.....	42,068	-	-	-	-
Columbia, MO, University of Missouri .....	24,028	-	-	-	-
Davis, CA, University of California .....	75,092	14	-	-	-
Geneva, NY, Grape Genetics Research Center.....	54,300	13,600	-	-	-
Lexington, KY, University of Kentucky....	55,478	-	-	-	-
Lincoln, NE, University of Nebraska.....	-	11,200	-	-	-
Pullman, WA, Pullman ARS Research Laboratory.....	82,700	-	-	-	-
Raleigh, NC, Raleigh Research Laboratory .....	30,392	-	-	-	-
<b>Subtotal .....</b>	<b>364,058</b>	<b>24,814</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>Emergency Hurricane Supplemental</b>					
<b>Subtotal .....</b>	<b>2,380</b>	<b>4,558</b>	<b>7,000</b>	<b>1,600</b>	<b>-5,400</b>
<b>Total.....</b>	<b>780,407</b>	<b>45,525</b>	<b>8,833</b>	<b>4,262</b>	<b>-4,571</b>

## JUSTIFICATIONS OF INCREASES/DECREASES

### *Buildings and Facilities*

ARS operates laboratories and facilities that have a capitalization value of \$5 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.

In 2012, ARS completed an extensive review of its laboratory portfolio and developed a plan for future capital investments. The report, known as the “Capital Investment Strategy (CIS),” highlighted ARS’ aging infrastructure, noting that approximately \$200,000,000 in capital investments was needed on a regular and recurring basis. Since 2012, modernization or replacement has begun on 24 of ARS’ priority facilities.

ARS has updated its 2012 CIS to identify its highest priority facilities in need of modernization or replacement. Funding is requested below to address one of the highest priority facilities.

- (1) An increase of \$34,805,000 for renovation/construction of the Beltsville Agricultural Research Center (BARC), Beltsville, Maryland, Building 005, and its supporting utilities and infrastructure.

BARC is one of the largest agricultural research centers in the world, in terms of program scope and number of scientists (over 200) and support staff (over 500). It has long had a worldwide reputation because of its prominent scientists, quality of research, and contributions to agriculture. BARC’s programs include hundreds of research projects related to: food animal production; animal health; veterinary, medical, and urban entomology; food safety; human nutrition; water availability and watershed management; grass, forage, and rangeland agroecosystems; sustainable agricultural systems; plant genetic resources, genomics, and genetic improvement; plant diseases; crop protection and quarantine; crop production; and product quality and new uses.

Building 005 is a laboratory/office building on BARC-West in need of major renovations to meet current research needs. The facility does not meet state-of-the-art research requirements for high quality scientific research. This renovation will continue the consolidation of BARC’s campus, moving the Invasive Insect Biocontrol and Behavior Lab, Soybean Genomics and Improvement Lab and the Hydrology and Remote Sensing Lab into the BARC-West cluster of buildings that face the main thoroughfare traversing Beltsville. Building 005 is in the historic district of Beltsville and must comply with State Historical Society requirements.

In FY 2020, ARS received \$4,300,000 for the programming and design for the renovation of Building 005.

- (2) An increase of \$10,600,000 for capital improvement and maintenance at the National Bio and Agro-Defense Facility.

The National Bio and Agro-Defense Facility (NBAF) is a \$1.25 billion facility that is being constructed by the Department of Homeland Security in Manhattan, Kansas. USDA will operate the facility upon completion of construction. The high containment facility is extraordinarily complex and requires sophisticated air handling system to protect the people, animals, and the environment. NBAF science programs will be located within a 574,000 square-foot high-containment laboratory facility. Several ancillary facilities will support the main laboratory complex, including the central utility plant (CUP), wastewater treatment plant, trans-shipping facility, and visitor’s center. Including all buildings, NBAF will total 709,000 square feet. Dedicated resources are needed to address ongoing capital improvement and maintenance needs of this critical center charged with the study of highly contagious, emerging, and zoonotic animal diseases that pose a threat to the U.S. agriculture, the food supply, and public health.

USDA began operation of the CUP, wastewater treatment plant, and facility security in 2021.

Capital improvements are needed for the CUP which has been in use for eight years and additional security measures.

**CLASSIFICATION BY OBJECTS**

*Table ARS-22. Classification by Objects (thousands of dollars)*

Item No.	Item	2020 Actual	2021 Actual	2022 Estimated	2023 Estimated
	Other Objects:				
32.0	Land and structures .....	\$780,407	\$45,525	\$8,833	\$4,262
99.9	Total, new obligations.....	780,407	45,525	8,833	4,262



**STATUS OF CONSTRUCTION**

Status of Construction Projects as of December 2021. Status of research facilities authorized or funded in prior years and reported as uncompleted in the 2022 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 percent - or a complete design designated as 100 percent. 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>
Alabama, Auburn National Soil Dynamics Research Laboratory	2019 Design and Construction	\$43,300,000	New funding was provided in 2019. Project transferred to USACE for managing the design and construction. New sites determined at Research Park for Land Swap. Land Swap to be finalized for 2nd Quarter 2022. Program of Requirements (POR) completed in 1st Quarter 2022. Design to be complete in the 1st Quarter 2023. Projected Contract Award for 1st Quarter 2024.
Arizona, Tucson Southwest Watershed Research Center	2016 Design and Construction	\$12,400,000	Design/Programming completed in the 1st Quarter 2018. Construction contract awarded in the 4th Quarter 2018. Construction completion date is scheduled for 1st Quarter 2023.
California, Albany Western Regional Research Center (Research and Development Facility)	2000 Planning and Design 2001 Construction 2002 Construction 2009 ARRA 2015 Rescission	\$2,600,000 4,889,220 3,800,000 15,624,460 (166)	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 in the 1st Quarter 2010. Construction contract award for the final phases 3 thru 6 was awarded for 3rd Quarter 2010 with ARRA funding and was completed in the 3rd quarter 2015.
	Total	26,913,514	
California, Davis Center for Advanced Viticulture and Tree Crop Research	2004 Planning and Design 2005 Construction 2006 Construction 2008 Construction 2009 Construction 2010 Construction 2011 Rescission 2020 Design and Construction	\$2,684,070 2,976,000 3,588,750 1,869,819 2,192,000 3,000,000 (16,062,114) 76,200,000	POR completed in the 2nd Quarter 2007. Lease agreement was not executed. Project transferred to USACE for managing the design and construction. Land purchased for an off-campus site adjacent to UC-Davis should be completed in the 2nd Quarter 2022. Award of A-E contract in 4th Quarter 2021. Design to be completed in 2nd Quarter 2023. Projected Construction Contract Award for 1st Quarter 2024.
	Total	76,448,525	
California, Salinas	2004 Planning and Design	\$4,473,450	Design (100%) completed in the 2nd Quarter 2007. A design update was awarded

<b>Location and Purpose</b>	<b>Year</b>	<b>Amount of Funds Provided</b>	<b>Description</b>
Agricultural Research Station	2005 Planning and Design	2,976,000	1st Quarter 2017 and completed 4th Quarter 2018. Design changed from 3 phases to 2 phases for construction. Contract awarded in 4th Quarter 2020. Construction completion date is scheduled for 4th Quarter 2024.
	2006 Construction	3,588,750	
	2008 Construction	1,869,819	
	2009 Construction	2,192,000	
	2010 Construction	3,654,000	
	2011 Rescission	(14,937,644)	
	2016 Design	1,300,000	
	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		
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. 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 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 2016. Demolition was completed in the 4th Quarter 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	2005 Planning	\$400,000	Draft POR completed 1st Quarter 2007. The POR was awarded in the 3rd Quarter 2015 and completed 4th Quarter 2015. POR/Bridging documents were awarded 4th Quarter 2015 and completed in the 3rd Quarter 2016. Design Build Construction Contract was awarded in the 4th Quarter 2017. Total contract duration from notice to proceed to completion is expected to take 6 1/2 years (all work to be completed by the
	2005 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, Construction	45,000,000	
2016 Construction	113,701,000		

Location and Purpose	Year	Amount of Funds Provided	Description
	Total	159,152,502	3rd Quarter 2024). The Government will take ownership of buildings as they are completed and accepted. The estimated completion by building is as follows:  <ul style="list-style-type: none"> <li>- B43A Hatchery/Brooding - 4th Quarter 2019 (actual)</li> <li>- B47 BLS-3 Animal Holding/Laboratory - 2nd Quarter 2022</li> <li>- B48 SPF Animal Holding - TBD when funded</li> <li>- B45 Laboratory/Office/Administration - 1st Quarter 2022 (actual)</li> <li>- B46 BSL-2 Animal Holding - 2nd Quarter 2024</li> <li>- Finalize Roadways, Sidewalks etc. - 2nd Quarter 2024</li> </ul>
Georgia, Tifton Southeast Watershed Research Laboratory	2019 Design and Construction	\$39,900,000	New Funding provided in 2019. Project transferred to USACE for managing the design and construction. A-E Contract awarded for 4th Quarter 2020. Design complete by 3rd Quarter 2022. Construction award by 1st Quarter 2023. Construction complete by 4th Quarter 2025.
Hawaii, Hilo U.S. Pacific Basin Agricultural Research Center	1999 Planning and Design	\$4,500,000	Design of Phases 1 and 2 is complete.
	2000 Construction	4,500,000	Construction of Phase 1 completed 3rd Quarter 2007. Construction contract for Phase 2 awarded 4th Quarter 2010 and completed 1st Quarter 2012.
	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	31,808,304	
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	

Location and Purpose	Year	Amount of Funds Provided	Description
	2011 Rescission	(2,907,600)	
	Total	313,500	
Illinois, Peoria National Center for Agricultural Utilization Research (Central Wing)	2000 Construction Design	\$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	37,705,239	
Iowa, Ames National Centers for Animal Health	2001 Design and Construction	\$8,980,200	All major components of the modernization are complete.
	2002 Design and Construction	40,000,000	
	2002 Construction	50,000,000	-Phase 1 Lab/Office (APHIS) completed in 2004.
	2002 APHIS Transfers	15,753,000	-Large Animal BSL-3Ag facilities construction completed 2nd Quarter 2007.
	[Supplemental]	[14,081,000]	-Central Utility Plant and Infrastructure, Phase 1 and 2 construction is complete.
	[Other Transfers]	[1,672,000]	Phase 3 construction completed 1st Quarter 2009.
	2002 Construction	25,000,000	-Construction of the Consolidated Laboratory Facility completed 2nd Quarter 2009.
	2003 Construction	32,785,500	
	2003 Construction	110,000,000	-Low Containment Large Animal Facility construction completed 1st Quarter 2009.
	2005 Construction	121,024,000	
	2006 Construction	58,212,000	- Demolition of existing facilities on 1st and 2nd Street completed 3rd Quarter 2012.
	2015 Rescission	(1,108,686)	
	Total	476,399,014	- Buildings 1 and 2 demolition is complete.
Iowa, Ames National Laboratory for Agricultural and the Environment	2016 Design and Construction	\$13,500,000	Design awarded 4th Quarter 2016 and bridging documents were completed 4th Quarter 2017. Construction awarded 4th Quarter 2018 and was completed 4th Quarter 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	

Location and Purpose	Year	Amount of Funds Provided	Description
	2011 Rescission	(5,880,338)	
	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. Project transferred to USACE for managing the design and construction. Project reactivated by FY20. Lease agreement for the new Lab office and Animal Facilities are ongoing. 30% POR completed.
	2006 Construction	3,960,000	
	2008 Construction	2,085,300	
	2009 Construction	1,632,000	
	2010 Construction	2,000,000	
	2011 Rescission	(9,678,689)	
	2020 Construction	65,900,000	
	Total	68,874,611	
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	(100)	
	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 (construct.)]	[20,000,000]	
	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 of Maine 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 Const.	2,684,070	
	2005 Design and Const.	2,976,000	
	2006 Design and Const.	2,475,000	
	2011 Rescission	(2,012,504)	
	Total	20,707,591	

<b>Location and Purpose</b>	<b>Year</b>	<b>Amount of Funds Provided</b>	<b>Description</b>
Maryland, Beltsville Beltsville Agricultural Research Center, (BARC)	1988 Design and Const.	\$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 Const.	6,100,000	
	1990 Design and Const.	9,860,000	
	1991 Design and Const.	15,999,792	
	1992 Design and Const.	16,000,000	
	1993 Design and Const.	13,547,000	
	1994 Design and Const.	19,700,000	
	1995 Design and Const.	3,960,000	
	1996 Design and Const.	8,000,000	
	1997 Design and Const.	4,500,000	
	1998 Design and Const.	3,200,000	
	1999 Design and Const.	2,500,000	
	2000 Design and Const.	13,000,000	
	2001 Design and Const.	13,270,740	
	2002 Design and Const.	3,000,000	
	2003 Design and Const.	4,152,830	
	2004 Design and Const.	2,684,070	
	2005 Design and Const.	2,976,000	
	2006 Design and Const.	3,588,750	
	2009 Design and Const.	2,192,000	
2009 ARRA	21,513,046		
2010 Construction	3,000,000		
2011 Rescission	(9,831,954)		
Total	168,662,274		
Renovate Building 307	2016 Design and Const.	\$37,100,000	Preparation of design bridging documents for Building 307 was awarded for 4th Quarter 2016 and completed in the 1st Quarter 2018. Construction was awarded in the 1st Quarter 2020 with completion in the 2nd Quarter 2022.
Renovate Buildings 002, 005, and 308	2020 Design	\$12,300,000	Design awarded for Building 002 was awarded for 4th Quarter 2020 and was completed in the 4th Quarter 2021. Construction award planned for 2nd Quarter 2022. Design awarded for Building 005 was awarded 4th Quarter 2020 and is scheduled for completion in the 3rd Quarter 2022. Award for 35% design of Building 308 executed in 4th Quarter 2020 and was completed in the 4th Quarter 2021.
Renovate Building 002	2021 Construction	\$24,500,000	

Location and Purpose	Year	Amount of Funds Provided	Description
Maryland, Beltsville National Agricultural Library	1998 Design and Const.	\$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 façade, and replacement of the plumbing system awarded for 1st Quarter 2010 using ARRA funding and completed in the 3rd Quarter 2012.
	1999 Design and Const.	1,200,000	
	2001 Design and Const.	1,766,106	
	2002 Construction	1,800,000	
	2003 Design and Const.	1,490,250	
	2004 Design and Const.	894,690	
	2009 ARRA	6,357,422	
	2011 Rescission	(115,175)	
	Total	15,893,293	
Maryland, Frederick (Fort Detrick) Foreign Disease-Weed Science Research Laboratory	2016 Design	\$4,900,000	Design/Programming awarded for the 4th Quarter 2016 and completed 2nd Quarter 2018. Project transferred to USACE for managing the design and construction. Construction was scheduled to be awarded in the 4th Quarter 2021 but funding was insufficient for award. The project team is working on a plan to redesign within funding. Redesign completion planned for 1st Quarter 2023. Construction completion planned for 4th Quarter 2025.
	2017 Construction	64,300,000	
	Total	69,200,000	
Michigan, East Lansing Avian Disease and Oncology Laboratory	1992 Planning	\$250,000	Design (100%) for this multi-phased facility modernization is complete.
	1993 Planning	212,000	
	1998 Planning and Design	1,800,000	
	2011 Rescission	(63,193)	
	Total	2,198,807	
Mississippi, Lorman Biotechnology Laboratory Alcorn State University	2006 Planning and Design	\$1,980,000	A lease agreement with Alcorn State University for the new facility 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	(5,798,055)	
	Total	248,145	
Mississippi, Poplarville Thad Cochran Southern Horticulture Laboratory	2002 Design	\$800,000	Construction of the Headhouse/Greenhouse awarded for 4th Quarter 2007 and completed in the 1st Quarter 2008.
	2003 Construction	9,140,200	
	2006 Supplemental	4,300,000	

Location and Purpose	Year	Amount of Funds Provided	Description
	2011 Rescission	(9,178)	
	Total	14,231,022	
Mississippi, Starkville Poultry Science Research Facility	2005 Planning and Design	\$2,976,000	Lease agreement is in place. Design (100%) completed in the 1st Quarter 2008.
	2006 Construction	4,950,000	
	2008 Construction	1,390,200	
	2009 Construction	3,177,000	
	2011 Rescission	(10,345,645)	
	Total	2,147,555	
Mississippi, Stoneville Jamie Whitten Delta States Research Center	2004 Construction	\$4,831,326	Design (100%) 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 for 3rd Quarter 2010. Phase 2 and 3 completed in the 1st Quarter 2013, Phase 4 completed in the 2nd Quarter 2015, and Phase 5 completed in the 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	2004 Planning and Design	\$2,415,663	Design (100%) completed in the 4th Quarter 2008. Project transferred to USACE
National Plant and Genetics Security Center	2005 Construction	4,960,000	for managing the design and construction. A-E contract awarded in the
	2006 Construction	3,687,750	3rd Quarter 2021. Design to be complete 3rd Quarter 2022.
	2008 Construction	2,085,300	Projected Contract Award for 1st Quarter 2023.
	2009 Construction	1,633,000	
	2010 Construction	3,500,000	
	2011 Rescission	(15,590,075)	
	2020 Design and Construction	24,800,000	
	Total	27,491,638	
Montana, Bozeman Animal Bioscience Facility	2005 Planning and Design	\$1,984,000	Lease agreement in place. Conceptual Design (35%) completed in the 3rd Quarter 2008.
	2006 Construction	3,960,000	
	2008 Construction	1,869,819	
	2009 Construction	2,192,000	
	2010 Construction	3,654,000	



<b>Location and Purpose</b>	<b>Year</b>	<b>Amount of Funds Provided</b>	<b>Description</b>
	2011 Rescission	(12,720,879)	
	Total	938,940	
Montana, Sidney Northern Plains Agricultural	1998 Planning and Design	\$606,000	Construction of Phase 1 (Lab/Office Building) completed 2003 and Phase 2 (Quarantine Lab) completed in the 4th Quarter 2008.
	1999 Construction	7,300,000	
Research Laboratory	2004 Design and Const.	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 in the 3rd Quarter 2011.
	2009 Planning and Design	1,088,000	
	2010 Construction	3,760,000	
	2011 Rescission	(5,782,528)	
	Total	455,672	
Nebraska, Lincoln University of Nebraska National Center for Resilient Precision Agri	2021 Design	\$11,200,000	Project transferred to USACE for managing the design and construction. Lease should be finalized by 3rd Quarter 2022. A-E contract awarded for 2nd Quarter 2022. Design to be completed in the 3rd Quarter 2023.
New York, Geneva	2004 Planning and Design	\$2,415,663	Design (100%) completed in the 4th Quarter 2007. Project transferred to USACE for managing the design and construction. A-E contract awarded in 4th
Grape Genetics Research Center	2005 Construction	2,976,000	
	2006 Construction	3,588,750	Quarter 2020. Design to be completed 1st Quarter 2023. Projected contract
	2008 Construction	1,869,819	award in the 2nd Quarter 2023.
	2009 Construction	2,192,000	
	2010 Construction	3,654,000	
	2011 Rescission	(14,806,870)	
	2019 Design and Construction	68,900,000	
	Total	70,789,362	
New York, Ithaca	2004 Planning and Design	\$3,847,167	Design (100%) completed in the 2nd Quarter 2008.
Crop-based Health Genomics	2005 Construction	2,976,000	
	2006 Construction	3,588,750	
	2011 Rescission	(7,314,491)	
	Total	3,097,426	

Location and Purpose	Year	Amount of Funds Provided	Description
North Carolina, Raleigh Plant Science Research	2019 Design and Construction	\$30,600,000	New funding was provided in 2019. Project transferred to USACE for managing the design and construction. NCSU has reserved a 15-acre parcel at the Lake Wheeler site for ARS; once the ARS project has been designed and a premises established, a lease agreement can be executed. A-E contract awarded in 2nd Quarter 2021. Design to be completed in 2nd Quarter 2022. Anticipated construction contract award for 1st Quarter 2023.
Ohio, Toledo University of Toledo	2005 Planning and Design	\$1,984,000	Design (100%) completed in the 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	(9,356,845)	
	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	(152,556)	
	Total	12,271,444	
Oregon, Corvallis National Clonal Germplasm Repository	2020 Design and Construction	\$13,500,000	Project transferred to USACE for managing the design and construction. A-E Task Order Awarded for 3rd Quarter 2021. Anticipate design complete by 3rd Quarter 2022. Anticipated construction contract award in 2nd Quarter 2023.
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 in 4th Quarter 2010 with ARRA funding and completed in the 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	(2)	
	Total	36,784,484	
Pennsylvania, University Park Pasture Systems & Watershed	2019 Design and Construction	\$21,900,000	New funding was provided in 2019. Project transferred to USACE for managing the design and construction. Design started in 1st Quarter 2021. Anticipated design completion for 2nd Quarter 2022.

Location and Purpose	Year	Amount of Funds Provided	Description
Management Research			Anticipated Contract Award for 4th Quarter 2022.
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. Reprogrammed from Horticultural Crop and Water Management Research Laboratory, Parlier, CA.
	1990 Planning and Construction	1,135,000	
	1994 Construction	909,000	
	1995 Construction	5,544,000	
	1996 Construction	3,000,000	
	1997 Construction	3,000,000	
	1998 Construction	4,824,000	
	2000 Construction	1,000,000	
	2002 Construction	4,500,000	
	2003 Design	1,390,900	
	2004 Construction	3,131,415	
	2005 Construction	2,976,000	
	2006 Construction	1,980,000	
	2011 Rescission	(517)	
	Total	33,439,798	
Texas, Houston Children's Nutrition Research Center	2016 Design and Construction	\$29,200,000	Design (bridging documents stage) awarded for 4th Quarter 2016 and completed in the 4th Quarter 2017. Project transferred to USACE for managing the design and construction. Project re-started in 4th Quarter 2020. Anticipated design complete in 2nd Quarter 2022. Anticipate contract award in 3rd Quarter 2022. Construction completion date projected for 4th Quarter 2025.
Texas, Kerrville	2008 Planning and Design	\$1,390,200	POR completed 2nd Quarter 2010 for a new site. Project transferred to USACE
Knippling Bushland Laboratory	2009 Planning and Design	1,957,000	for managing the design and construction. The design was awarded for 1st Quarter
	2011 Rescission	(2,768,214)	2019 and planned to be complete in the 2 <sup>nd</sup>
	2017 Planning and Design	3,700,000	Quarter 2021. Construction awarded in 4th Quarter 2021. Construction completion planned for 1st Quarter 2024.
	2018 Construction	50,700,000	
	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. The
	2018 Construction	18,700,000	

Location and Purpose	Year	Amount of Funds Provided	Description
	Total	20,100,000	POR and Investigative Study was awarded for 1st Quarter 2018. Additional funding provided in 2018 for construction. Design was completed in the 4th Quarter 2019. Construction awarded in the 4th Quarter 2020. Construction completion is planned for 2nd Quarter 2023.
Utah, Logan Agricultural Research Center	2008 Planning and Design	\$5,560,800	Lease completed 3rd Quarter 2010. POR completed in the 4th Quarter 2010.
	2009 Design and Construction	4,351,000	
	2010 Construction	4,527,000	
	2011 Rescission	(13,839,929)	
	Total	598,871	
Washington, Pullman Pullman ARS Research Laboratory	2004 Planning and Design	\$3,936,636	Lease agreement with Washington State University in place. Conceptual Design (35%) completed. New funding was provided in 2019. The previous design, completed to 35% cannot be used. Project transferred to USACE for managing the design and construction. A-E awarded for 4th Quarter 2020 and is planned to be complete in 2nd Quarter of 2022. Anticipated contract award in 4th Quarter 2022.
	2005 Construction	2,976,000	
	2006 Construction	3,588,750	
	2008 Construction	1,869,819	
	2009 Construction	2,192,000	
	2010 Construction	3,740,000	
	2011 Rescission	(17,240,830)	
	2019 Design and Construction	104,900,000	
	Total	105,962,375	
	West Virginia, Kearneysville Appalachian Fruit Laboratory	2003 Planning and Design	
2004 Construction		1,789,380	
2005 Construction		3,608,896	
2006 Construction		2,024,550	
2008 Planning and Design		1,529,220	
2009 Planning and Design		783,000	
2010 Construction		2,000,000	
2011 Rescission		(3,430,725)	
Total		8,776,234	

<b>Location and Purpose</b>	<b>Year</b>	<b>Amount of Funds Provided</b>	<b>Description</b>
West Virginia, Leetown National Center for Cool and Cold Water Aquaculture (Broodstock Facility)	2002 Design and Construction	\$2,200,000	Construction completed in the 3rd Quarter 2008.
	2006 Construction	891,000	
	2011 Rescission	(4,717)	
	<b>Total</b>	<b>3,086,283</b>	
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 in the 4th Quarter 2008. Phase 2 construction (Animal Holding Facility) awarded for 4th Quarter 2007. Phase 2 construction completed in the 1st Quarter 2010.
	2004 Construction	3,668,229	
	2005 Construction	4,860,800	
	2006 Construction	7,920,000	
	2011 Rescission	(18,229)	
	<b>Total</b>	<b>19,411,300</b>	
Wisconsin, Prairie du Sac Dairy Forage Agriculture Research Center	2008 Planning and Design	\$2,502,360	POR completed 3rd Quarter 2011. New funding was provided in 2019. Funds have been transferred to the USACE to manage design and construction of this project. A-E awarded in 3rd Quarter 2021. Design completion in the 4th Quarter of 2022. Anticipated contract award for 2nd Quarter 2023.
	2009 Construction	2,002,000	
	2010 Construction	4,000,000	
	2011 Rescission	(7,675,381)	
	2019 Design and Construction	71,700,000	
	<b>Total</b>	<b>72,528,979</b>	
Emergency Hurricane Supplemental Funding	2018 Planning, Design and Construction	\$22,000,000	The majority of the awarded funds in 2021 were for a major greenhouse/quarantine facility renovation project. In 2022, there are two major electrical distribution projects that are anticipated to be awarded.