



**USAID**  
FROM THE AMERICAN PEOPLE

# U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT RESEARCH AND DEVELOPMENT PROGRESS REPORT FY 2015



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**Front Cover Photo:** USAID's science and technology programs create accessible solutions to global development challenges.  
Photo: Zahur Ramji, AKDN.

## PREFACE

Dear Friends and Colleagues,

I am delighted to present USAID's 2015 Research and Development Progress Report. Since President Obama signed the Presidential Policy Directive on Global Development in 2010, we have answered his call by strengthening our investments in science, technology, innovation and partnership across the Agency. With a modernized approach to development, we are ensuring that our work is as effective, efficient, and impactful as it can be.

In 2015, we invested \$425 million in research and development (R&D), and joined forces with partners to tackle some of the biggest challenges ahead of us — from ending preventable child deaths to rooting out hunger. By scaling solutions like the ones highlighted in this report, we can go beyond incremental progress and achieve transformative change in sectors such as agriculture, health, environment, and governance. When we invest in R&D, we can unlock force multipliers for our work and identify solutions not just for today's challenges, but for the challenges of the future. We can help eliminate the causes and effects of global poverty and respond to emerging threats posed by a growing population and a changing climate. We can save and improve lives, contribute to economic growth, enhance stability, and help build stronger families, communities, and nations.

USAID's R&D investments will continue to pay dividends well into the future, making important contributions toward advancing our national security, promoting our economic interests, and reaffirming U.S. leadership on the international stage. Through a strong R&D enterprise, USAID will catalyze and scale innovations by leveraging domestic and international research efforts, filling knowledge gaps, and strengthening thought leadership in international development.

At USAID, we know that research and development matter. And when matched with dedication and powered by partnership, smart investments in R&D can change people's lives, and even change the world. That is why we are committed to continuing our work with partners across the globe to unleash the potential of science and technology in service of human dignity and prosperity everywhere.



Gayle Smith

Administrator, U.S. Agency for International Development

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## ACRONYMS AND ABBREVIATIONS

ACCA	Association for the Conservation of the Amazon Basin
BFS	Bureau for Food Security
CDC	U.S. Centers for Disease Control and Prevention
CIFOR	Center for International Forestry Research
CIMMYT	International Maize and Wheat Improvement Center
DCHA	Bureau for Democracy, Conflict, and Humanitarian Assistance
DIV	Development Innovation Ventures
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
E3	Bureau for Economic Growth, Education, and Environment
FDA	U.S. Food and Drug Administration
FEWS NET	Famine Early Warning Systems Network
HESN	Higher Education Solutions Network
Lab	U.S. Global Development Lab
LAC	Bureau for Latin America and the Caribbean
LMIC	Lower-Middle-Income Countries
MENA NWC	Middle East and North Africa Network of Water Centers of Excellence
MERC	Middle East Regional Cooperation Program
NASA	National Aeronautics and Space Administration
NGOs	Non-Governmental Organizations
NIH	National Institutes of Health
NIFA	National Institute of Food and Agriculture
NOAA	National Oceanic and Atmospheric Administration
NSF	National Science Foundation
PEER	Partnerships for Enhanced Engagement in Research
PPE	Personal Protective Equipment
R&D	Research and Development
RAN	Resilient Africa Network
Sida	Swedish International Development Cooperation Agency
SMART	Spatial Monitoring and Reporting Tool
STIP	Science, Technology, Innovation, and Partnerships
TAPS	Synchronized Pruning and Fertilization Technique
TB	Tuberculosis
UN	United Nations
UNICEF	United Nations Children's Fund
USAID	U.S. Agency for International Development
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
VDAP	Volcano Disaster Assistance Program
WASH	Water, Sanitation, and Hygiene
WHO	World Health Organization



A Liberian nurse prepares to go inside an Ebola patient ward to draw blood from confirmed patients for testing in Bong County, October 2014. Photo: Morgana Wingard, USAID.

## EXECUTIVE SUMMARY

For more than 50 years, the U.S. Agency for International Development (USAID) and its partners have taken on the world's most important development challenges. We increasingly use science, technology, and innovation to advance sustainable development and improve the lives of those most in need. USAID initiatives—including Feed the Future, Global Health, Global Climate Change, and Power Africa—target the symptoms of and pathways out of extreme poverty. We lead crosscutting projects essential to building resilience, including in economic growth, democracy and governance, empowering women and girls, and mitigating and adapting to climate change.

Research and development (R&D) is central to helping USAID and its partners understand complex challenges, produce innovative solutions, and bring solutions to scale. This report demonstrates how USAID's investments in R&D produce and apply science, technology, and innovation toward solutions that make an impact.

USAID invested approximately \$425 million in R&D in Fiscal Year 2015. Of this, 88 percent was implemented by Global Health, Food Security, and the U.S. Global Development Lab.

In the health sector, for example, investments have deepened understanding of how nutritional supplementation affects the “1,000 days” between pregnancy and a child's second birthday. We have

decreased abuse and disrespect in the maternity process, thereby encouraging pregnant women to visit health facilities. USAID's research on tax reform and resource mobilization has built understanding of how fiscal reform affects governments' investments in health.

USAID R&D investments contribute to food security in some of the most food insecure communities in the world. Notably, research led to the development of a bio-pest control for the papaya mealybug in India and Indonesia, with the resulting benefits estimated to have a value of more than \$1 billion over five years. R&D investments also led to the development of fertilizer blends that boosted yields for staple crops in Ethiopia, even in previously nonresponsive soils.

USAID established the U.S. Global Development Lab (Lab) in 2014 as a hub for broadening and intensifying collaboration within USAID and with new partners, such as the private sector, academics, entrepreneurs, and inventors—anyone willing to contribute. The goal: generate breakthroughs for USAID and its projects by sourcing, testing, and scaling new ideas, tools, and potential solutions. The Lab prioritizes its R&D investments by supporting projects tied to USAID programs or policy outcomes and by building capacity for science in developing countries.

Please consider the following points of emphasis in this report:

**First**, USAID's coordinated and integrated approach welcomes and mobilizes contributions by others. Responses to the most complex global challenges

in poverty, hunger, and health need to draw from all available capabilities and partnerships. USAID aims to draw on knowledge and expertise that reside in other federal and state agencies, multilateral organizations, nongovernmental organizations (NGOs), the private sector, and elsewhere. For example, the Higher Education Solutions Network (HESN) opens up development to academic institutions and their fresh ideas and research. HESN's Development Labs increases our impact and influence by linking students in the United States and developing countries, leveraging external donors, partnering with research institutions, and working with the private sector, foundations, NGOs, social entrepreneurs, and other development agencies.

**Second,** USAID's research included attention to market policies and decision-making tools. USAID is investing in powerful new analytical tools to identify effective approaches to policy change, governance, and decision-making that support development priorities in health, food security, and other areas.

**Third,** USAID focused on developing low-cost solutions. For example, USAID's Development Innovation Ventures supported Swasth India Services Private Limited in developing a model that provides access to high quality primary healthcare services for 32 million of India's urban poor at half the market rates.

**Fourth,** USAID enhanced the capacity of local organizations worldwide. Through the Partnerships for Enhanced Engagement in Research (PEER) program, scientists and engineers from developing countries partner with American scientists to address global development challenges. The Middle East Regional Cooperation Program convenes scientists and technologists from Israel and neighboring Arab states through joint applied research projects to address common development problems. Through HESN, the Social Entrepreneurship Accelerator at Duke (SEAD) identifies growth-stage nonprofit and for-profit enterprises with operations in East Africa and India to develop potentially transformative ways

to address challenges in global health. SEAD provides a three-year, peer-based engagement, delivering virtual and in-person content focusing on commonly-shared challenges related to scaling impact. Topics include refining scaling strategies, understanding behavior change, forming cross-sector strategic partnerships, managing organizational growth, accessing funding, and assessing performance.

**Fifth,** USAID R&D investments focused on scaling up development interventions. Through the Grand Challenges for Development initiative, USAID calls on the global community to discover, test, and accelerate innovative science and technology solutions around specific global challenges. One such call is the Saving Lives at Birth Grand Challenge. In this partnership between USAID, the Government of Norway, Bill & Melinda Gates Foundation, Grand Challenges Canada, U.K. Department for International Development, and Korea International Cooperation Agency, \$80 million was provided by donors that elicited a robust pipeline of 94 potentially game-changing innovations from across the world. These innovations have reached more than 1.5 million women and newborns and saved over 10,000 lives.

**Finally,** USAID supported the development of advanced analytical tools. For example, in Cambodia, USAID provided technical assistance to 155 government and community rangers and monthly oversight of the Spatial Monitoring and Reporting Tool toward conserving forests and wildlife. At the College of William & Mary, the AidData Center for Development Policy pioneered a high-tech method to evaluate the effectiveness of development programs: geospatial impact evaluation. By mapping the locations of aid projects and using data from satellites and household and census surveys, this method promises to be thorough, quick, and lower in cost than traditional evaluation methods. AidData is performing geospatial impact evaluations for USAID in conflict-affected areas of Colombia, for an e-democracy platform in the Republic of Georgia, and for government responsiveness in Niger.

## INTRODUCTION

In consecutive State of the Union addresses, President Obama affirmed the belief of many by asserting that a world without extreme poverty is within reach. This view reflects the global consensus expressed in the 2030 Agenda for Sustainable Development, the successor framework to the Millennium Development Goals. The United States is helping lead this concerted international effort, and USAID is committed to helping implement this agenda with our partners.

Optimism for ending extreme poverty arises from the unprecedented progress of recent years: Between 1990 and 2011, the share of the world's population living on less than \$1.25 a day (from 2008-2015, \$1.00 a day from 1990-2008)—the global benchmark measure for extreme poverty—fell by more than 60 percent. Much of this progress stems from extraordinary growth in China, India, and other emerging markets in Asia. Most regions have experienced remarkable improvements, especially in the past decade. Advances in health, education, gender equality, and security reflect rising incomes and broad-based economic and social progress, enabled by more responsive governments, evidence-based policies, and a new generation of leaders taking charge of their countries' development.

Yet, one billion people still live below the international poverty line, disproportionately in low-income countries, conflict-affected states, rural areas, and among children and disadvantaged groups. This shortfall demands the launch of more and new efforts to build on recent momentum and secure and extend these gains. Success will foremost depend on actions by governments and citizens in countries where the extreme poor live, and the United States can support these efforts directly. U.S. leadership can also inspire and mobilize others to do their part. U.S. policies on investment, trade, immigration, climate change, corruption, and other issues beyond our borders can bolster global stability, access to opportunities, and economic growth. U.S. development efforts can build pathways for sustainable escapes from extreme poverty for millions of people.

USAID's mission statement highlights two complementary and intrinsically linked goals: ending extreme poverty and promoting the development of resilient, democratic societies able to pursue their potential. We fundamentally believe that ending extreme poverty requires:

- Enabling inclusive, sustainable economic growth;
- Promoting free, peaceful, and self-reliant societies with effective, legitimate governments;
- Building human capital; and
- Creating social safety nets that reach the poorest and most vulnerable.

USAID's *Vision for Ending Extreme Poverty*, issued earlier this year, lays out USAID's strategic framework to address this challenge.<sup>1</sup>

Since poverty is multidimensional, ending poverty demands a multidimensional approach that addresses hunger and food insecurity, illiteracy and innumeracy, illness and poor health, disempowerment, marginalization, vulnerability, and other conditions. Through Feed the Future, Global Health, Global Climate Change, and Power Africa, USAID targets the causes of and pathways out of poverty. USAID's work on education already reaches millions in extreme poverty. Similarly, our crosscutting efforts in promoting democracy and good governance, empowering women and girls, advancing prosperity, building resilient societies, and mitigating climate change are essential to ending poverty.

Resilient, democratic societies do not simply maintain stability—they are essential to sustaining development progress. Resilient, democratic societies help sustain broad-based economic growth; healthy, well-nourished, and educated populations; and environmental balance. They embrace elections as well as legitimate, inclusive, and accountable institutions that deliver services to all of their people, respect and promote basic rights, and strive to advance freedom, human dignity, and development. These societies can manage conflict, mitigate the impact of natural

<sup>1</sup> Vision for Ending Extreme Poverty, USAID. [https://www.usaid.gov/sites/default/files/documents/1870/Vision-XP\\_508c\\_1.21.16.pdf](https://www.usaid.gov/sites/default/files/documents/1870/Vision-XP_508c_1.21.16.pdf)

## USAID'S MISSION STATEMENT

We partner to end extreme poverty and promote resilient, democratic societies while advancing our security and prosperity.

disasters, and forestall crises that otherwise roll back development gains. They are equipped to ensure that pathways out of poverty are sustained.

As documented in this report, USAID's R&D investments have been crucial to generating results in areas such as global health, agriculture, economic growth, environment, and early warning systems. The results of these investments reflect success in gaining knowledge and applying science, technology, and innovation toward impactful solutions.

The role of science in tackling development challenges is well exemplified by the Green Revolution in South Asia in the 1960s. The speed and scale of bringing about a solution to the food crisis was unprecedented and led by the scientific contributions of Norman Borlaug, whose research on improved cereal varieties, fertilizer, irrigation practices, and pest control measures are credited with saving more than one billion people.

Equally important were efforts toward fostering an "enabling environment" through regulatory and economic reforms that enabled Borlaug's scientific work to be fully applied. These reforms led to improvements to markets and value chains to handle increased production; increased education through agriculture extension services that enabled farmers to use improved (and newly accessible) seeds and fertilizer; and adequate compensation to farmers for their investments. Government policies and reforms also helped smallholder farmers benefit from improvements in the agriculture sector.

Additional actions were needed to address environmental and social consequences and improve engagement with the private sector through public-private partnerships, but the primary takeaway is that science had a critical positive impact—as it does today—in the web of interactions between science, innovation, policy, and the private sector.<sup>2</sup>

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<sup>2</sup> Hazell, Peter B. R., "The Asian Green Revolution," in *Food Security*, Mark W. Rosegrant, ed., SAGE, 2014

While this report focuses on research, USAID also funds activities critical to accelerating innovation. The most appropriate model in understanding the role of science and research is in the "innovation systems" approach,<sup>3</sup> which views science and research as core functions among organizational networks working together to produce potential development solutions. This report presents examples of USAID's R&D activities and accomplishments in support of USAID's science, technology, and innovation objectives for Fiscal Year (FY) 2015. In this period, USAID invested approximately \$425 million in R&D. This report provides an overview of those investments and examples of how they directly contributed toward helping millions of people experience greater stability through improved livelihoods, health, and wellbeing.

To leverage the best experience and know-how for its R&D investments, USAID draws on expertise and resources from other federal agencies via partnerships, including with the National Institutes of Health (NIH), Centers for Disease Control and Prevention (CDC), National Science Foundation (NSF), U.S. Department of Agriculture (USDA), National Aeronautics and Space Administration (NASA), Peace Corps, National Geospatial-Intelligence Agency, and others. This report highlights a number of these partnerships.

In the sections that follow, examples of accomplishments by USAID R&D programs include work performed by USAID Bureaus including Global Health, Food Security, Democracy, Conflict and Humanitarian Assistance, and Economic Growth, Education and Environment; regional bureaus including Africa, Asia, Middle East, and Latin America and the Caribbean; and the Lab. A summary of R&D investments is provided, followed by a concluding section.

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<sup>3</sup> The literature on innovation systems is extensive. For a comprehensive review and analysis, see Don Kash and Robert Rycroft's book, *The Complexity Challenge: Technological Innovation for the 21st Century*, 1999.





GeneXpert® is a revolutionary diagnostic tool that can rapidly detect TB resistance to rifampin, one of the most potent drugs that treats TB. Photo: Michael Tran, USAID.

## RESEARCH AND DEVELOPMENT ACTIVITIES AND ACCOMPLISHMENTS

### RESEARCH AND DEVELOPMENT DEFINED

Throughout this report, research and development activities are described. The definitions of R&D used in this report are consistent with those in other federal agencies,<sup>4</sup> the Office of Management and Budget,<sup>5</sup> and the State Department's Foreign Assistance reporting guidelines. For purposes of this report, the following definitions are used:

**Basic Research:** The systematic study directed toward fuller knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications toward processes or products in mind. One example of basic research is in investigating the genetics of different plant species.

**Applied Research:** The systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met. Applied research is undertaken to determine

possible uses for the findings of basic research or to determine new methods or ways of achieving specific objectives. The results are intended primarily to be valid for possible applications to products, operations, methods, or systems.

**Development Research:** The systematic application of knowledge or understanding directed toward the production of useful materials, devices, and systems or methods including design, development, and improvement of prototypes and new processes to meet specific requirements. One example of development research is supporting the use of chlorhexidine for umbilical cord care to reduce neonatal sepsis, a leading cause of newborn death.

USAID's investments are directed toward applied and development research, and not in basic research, which is the domain of federal science agencies such as the NIH, U.S. Department of Energy (DOE), and others.

In the sections that follow, specific areas of USAID R&D investments are described and a number of accomplishments highlighted.

<sup>4</sup> National Science Foundation, Definitions for Research and Development. <http://www.nsf.gov/statistics/randdef/fedgov.cfm>

<sup>5</sup> Office of Management and Budget, Circular A-11, Section 84, pg. 11 [https://www.whitehouse.gov/sites/default/files/omb/assets/a11\\_current\\_year/a\\_11\\_2012.pdf](https://www.whitehouse.gov/sites/default/files/omb/assets/a11_current_year/a_11_2012.pdf).

## GLOBAL HEALTH

Advances in health research and innovation serve as building blocks for improved public health. USAID uses scientific research to build capacity in health systems around the world to prepare for, identify, and respond to public health emergencies and other public health needs. USAID's research also focuses on developing, testing, and scaling up high-impact practices and innovations to improve the health of the world's poorest and most vulnerable populations. In 2011, USAID's Global Health Bureau introduced a five-year strategy on health-related R&D organized according to the research priorities shown in Appendix A.

### LEVERAGING HEALTH-RELATED R&D WITH OTHER PARTNERS

USAID's health research efforts align closely with those of many other partners, including the CDC, NIH, Department of Defense (DOD), multilateral health organizations, and host country governments. USAID works to strengthen local institutions and support people in developing countries to drive and lead health research. In addition, USAID partners with diverse organizations to apply a rigorous, private-sector approach, investing seed capital in

the most promising ideas to cut the time it takes to transform discoveries in the lab to impact on the ground.

One example is provided by Saving Lives at Birth: A Grand Challenge for Development. Under USAID's partnership with the Government of Norway, Bill & Melinda Gates Foundation, Grand Challenges Canada, U.K. Department for International Development, and Korea International Cooperation Agency, USAID's \$20 million investment is leveraging \$80 million from these partners and has generated at least \$36 million in additional funding from the private sector and other sources. The program has sourced a pipeline of 94 potentially game-changing innovations from across the world with several of these beginning to scale. The most advanced have already reached more than 1.5 million women and newborns and saved nearly 10,000 lives.

A complete review of Global Health-related R&D investments is presented in the Global Health Bureau's 2015 Health-Related Research and Development Progress Report.<sup>6</sup> A few highlights from that report are summarized below.

### SIGNIFICANT ACHIEVEMENTS OF GLOBAL HEALTH R&D

#### Ending Abuse and Disrespect in Health

**Services:** Abuse and disrespect during maternity care have been documented and observed around the world. Women who choose to give birth at home without a skilled health care provider because they have experienced or heard about abuse and disrespect are more likely to suffer complications, as are their newborns. A research study in Kenya, drawing on host-country leadership and parallel advocacy, led to a 35-percent reduction in disrespectful maternity care. It also spurred development of a World Health Organization (WHO) statement on the prevention and elimination of abuse and disrespect during facility-based childbirth. Evidence gathered from these studies is driving scale-up efforts in Tanzania and Kenya, with active engagement and interest from several other countries.



PATH Chlorhexidine staff met this mother and her baby as part of a field trip in Bangladesh. Clean birth practices including use of chlorhexidine, can protect babies such as this one born at home in Kamrangirchar, one of the largest slums in Bangladesh. Photo: Mutsumi Metzler, PATH.

<sup>6</sup> USAID Health-Related Research and Development Progress Report: An Update on the 2011-2015 Health Research Strategy. [https://www.usaid.gov/sites/default/files/documents/1864/Health-Research-Report-2016-508\\_0.pdf](https://www.usaid.gov/sites/default/files/documents/1864/Health-Research-Report-2016-508_0.pdf)





The SILCS diaphragm is a nonhormonal contraceptive developed through a user-centered process to be easy to use and comfortable for both partners. The single-size design makes this reusable barrier simple to supply and provide. SILCS is marketed as the Caya® contoured diaphragm in more than 25 countries; work is underway to bring this new product to low resource settings. Photo: Patrick McKern, PATH.

**Treating Newborns:** Infections in newborns, which can rapidly progress to life-threatening conditions, can be effectively managed with timely treatment with antibiotics. Infections are among the leading causes of newborn death in developing countries, accounting for 420,000 deaths each year. Studies in South Asia and Africa document that 68 to 98 percent of families do not or cannot access hospital-based inpatient care. USAID and partners supported research that demonstrated the safety of a combination of injectable and oral antibiotics delivered by trained health workers in lower-level health facilities. Drawing on this research, a newly released WHO policy recommends hospitalization as best, but also advises governments that newborns can be safely treated with antibiotics as outpatients. Ongoing implementation research and evaluation is guiding safe introduction of these treatments in countries such as Bangladesh.

**Developing Effective and Affordable Medicines for the Treatment of Malaria:** USAID contributes to the drug development pipeline through its support for the Medicines for Malaria Venture. Two novel classes of malaria drugs shown to be effective as single-drug treatments have entered late-stage clinical trials in combination with partner drugs. These new treatments offer the greatest hope for an alternative

to artemisinin-based combination therapies. Both a novel antimalarial compound and the first antimalarial molecule discovered by an African-led team have entered early-stage clinical trials.

**Addressing Behaviors That Affect Voluntary Family Planning:** Many social norms, including child marriage and gender-based violence, affect voluntary family planning. Community-based interventions showed that girls offered conditional livestock transfers were 50- and 66-percent less likely to marry before the age of 18 in Ethiopia and Tanzania, respectively. In northern Uganda, community-based interventions tailored to life stages reduced gender-based violence by 16 percent and increased use of voluntary family planning by 10 percent. USAID is working with policymakers and program managers to tailor these community-based behavioral interventions to target adolescents.

**Developing New Contraceptive Technologies:** Initial work was completed on the development of a low-cost, safe, and effective biodegradable contraceptive implant that would last for 1–2 years, thus filling the gap in contraceptive methods between the short-term, 3-month injectable and the long-term, 5-year implant.



Three complementary technologies were tested for proof-of-concept in the laboratory, with two moving into the next stages of development with leveraged support from the Bill & Melinda Gates Foundation. Work was initiated to develop new technologies and improve existing methods to enhance choice and reduce unmet need for voluntary family planning, including development of a lower-dose injectable and a micro-needle patch. In addition, the non-hormonal SILCS diaphragm, marketed as Caya, is now in more than 25 countries. Work is underway to bring this new product to low-income countries.

**Advancing Understanding Around Malnutrition, Birth, and Growth Outcomes:** Preventing stunting requires a deep understanding of how nutritional supplementation affects the “1,000 days” between pregnancy and a child’s second birthday. USAID-supported studies in Malawi and Bangladesh are examining the effects of lipid-based nutrient supplements and micronutrient powders alongside other health interventions for pregnant women and children under age 2. Initial findings from Malawi have resulted in five high-impact journal publications this year, with several more anticipated. These studies are contributing to the global evidence base on the impact of nutrition-specific interventions on birth outcomes and child growth, and will shape the direction of programming and investments by USAID and the global community.

**Developing New Tools for Women-initiated HIV Prevention:** Given that women and girls account for more than half of the 34 million people living with HIV worldwide, USAID continues to prioritize research toward the long-term goal of developing a range of options for women to protect themselves from HIV. A pivotal USAID-supported study indicated that the dapivirine vaginal ring has strong potential as one such tool, while USAID also continues to advance research on other prevention products for women, including lower-cost oral tablets, vaginal inserts, long-acting injectable agents, and biodegradable implants. Multi-purpose prevention technologies that protect women from both HIV and unintended pregnancy are also in development, including the tenofovir plus levonorgestrel vaginal ring, which showed promising results in women in a recently completed Phase I trial.

**Advancing the Foundation for a HIV/AIDS Vaccine:** USAID continues to support exploration of genetic, viral, and immunological correlates that might be capable of blocking the virus. Efforts are

ongoing to further characterize antibodies isolated from ongoing research, which is the largest longitudinal study of HIV infection among Africans. It has enabled the landmark discoveries of new, broadly neutralizing antibodies. This body of work will lead to an improved understanding of envelope immunogens that are thought to be critical for an HIV vaccine.

**Advancing Rapid Diagnosis of Tuberculosis:** USAID-supported modeling studies provide policymakers with information vital to selecting cost-effective diagnostic tools to improve patient outcomes and limit transmission of tuberculosis (TB). Using a novel approach called “virtual implementation,” these studies link transmission modeling with operational modeling. Working in close collaboration with the national TB program in Tanzania, the modeling study evaluated the impact of alternative diagnostics on patients, health systems, and the population. The study identified three strategies as cost-effective in Tanzania, including: 1) full scale-up of GeneXpert®; 2) same-day use of LED fluorescence microscopy; and 3) targeted use of GeneXpert® for diagnosis of presumptive TB cases with HIV infection.

**Developing a New Malaria Vaccine:** In spite of major successes to control malaria during the past decade, WHO estimates that more than 400,000 people, mostly children in sub-Saharan Africa, died from the disease in 2015. It is widely appreciated that the addition of a highly effective and affordable vaccine to the current armamentarium of insecticides for prevention and drugs for treatment could accelerate progress toward elimination of malaria as a major public health problem, preparing the way for eventual eradication. As demonstrated by the current most advanced malaria vaccine, vaccines may become an additional tool in the fight against malaria. The USAID Malaria Vaccine Development Program continues to work with partners including the DOD and the Department of Health and Human Services, as well as academia and commercial entities, to devise innovative approaches for the development and evaluation of new and improved malaria vaccines. Currently, multiple vaccines are undergoing preclinical evaluation and two are expected to be evaluated clinically in 2016.

**Strengthening Health Systems:** USAID has supported research on tax reform and resource mobilization for health to determine whether improvements in tax revenue performance in lower-middle-income countries (LMICs) actually result in more government funds for the health sector.

The analysis of 188 countries over 18 years (1995–2012) found that increased tax revenues do not necessarily translate to increased health spending. Many countries are still far from reaching their tax capacity; however, if countries' tax effort rose to the average rates, then government health expenditures could increase by an additional \$2-\$8 per capita. This study identified four factors that favor the allocation of additional tax revenue toward the health sector: 1) generating national political priority for health, 2) creating tax funds for health, 3) earmarking a proportion of tax revenue mobilized, and 4) decentralized spending. El Salvador's and Rwanda's experiences with successful tax administration reforms that resulted in increased allocations for health provide lessons for other LMICs.

**Innovation to Respond to the Ebola Crisis:** While personal protective equipment (PPE) offers critical protection, it can also be a great source of discomfort and stress for healthcare workers. In hot climates

such as the areas stricken by Ebola in West Africa, PPE cannot be worn for more than an hour, severely limiting the time health care workers can care for patients. To help workers on the front lines provide better care and stop the spread of Ebola, USAID, in partnership with the White House Office of Science and Technology Policy, CDC, and DOD, developed the Fighting Ebola Grand Challenge for Development—a program that enabled innovators around the world to quickly identify and deliver practical and cost-effective solutions while forging the public-private partnerships necessary to test and scale up these solutions. The challenge generated close to 1,500 ideas, and USAID is now supporting 14 of these identified for their potential to reinforce the response to current and future outbreaks. Some of the most promising include: redesigned PPE; a low-cost, battery-powered infusion monitor that delivers intravenous fluids with precision to patients; and state-of-the-art, easy-to-assemble decontamination chambers.



This redesigned personal protective equipment was one of 1,500 ideas generated under the Fighting Ebola Grand Challenge for Development. Image: Staff, Johns Hopkins Center for Bioengineering Innovation and Design, Jhpiego, and Clinvue.

## FOOD SECURITY

Research programs under the U.S. Government's global hunger and food security initiative, Feed the Future, are critical to sustainably enhancing growth in agricultural productivity, which is strongly linked to economic growth in developing countries. Ensuring global food security will become more difficult given the challenges created by the growing global population, as well as from land degradation, climate change, scarce water supplies, and competition for energy resources from industry and urbanization.

USAID's Bureau for Food Security (BFS) leads the implementation of the Feed the Future Research Strategy. Research projects are organized around six key research program areas related to sustainably transforming agricultural production systems, ensuring access to nutritious and safe foods, creating enabling and supportive policies, and addressing the emerging challenges of climate change and natural resource scarcity. These research priorities are shown in Appendix B.

The food security research programs focus on the development of tools, technology, and knowledge to advance developing country agriculture and contribute to global food security. The activities are designed to bring U.S. research scientists and others into collaborations with developing country scientists to ensure the research is oriented toward concrete problem-solving and building local skills in undertaking agricultural research for development.

### LEVERAGING FOOD SECURITY R&D WITH OTHER PARTNERS

Food Security R&D activities engage a range of partners such as international agricultural research centers, including the multilaterally funded Consultative Group on International Agricultural Research (CGIAR), U.S. universities (through investments known as Innovation Labs), U.S. Government agencies, advanced research institutes outside the United States, and private sector partners. USAID engages CGIAR as a critical partner to link advanced public and private research institutions around the world to crosscutting issues in agricultural development. For example, through the Mexico-based International Maize and Wheat Improvement Center (known by its Spanish acronym, CIMMYT), USAID and other U.S. partners are collaborating with experts globally to develop heat-tolerant maize and pest-resistant wheat. Strategic research



Researchers from the Feed the Future Innovation Lab for Climate Resilient Chickpea visit the Agro Prom chickpea processing facility in Adama, Ethiopia. Thanks to a \$164,000 innovation grant from the Ethiopia Mission's Agriculture Market Development project, local private-sector partner Agro Prom was able to acquire the processing plant, including seed cleaning and processing equipment to produce chickpea-based products. By better understanding the needs of local market actors like Agro Prom, Chickpea Innovation Lab researchers will be able to develop new, demand-driven technologies that meet the needs of Ethiopian chickpea producers and processors. Photo: Tracy Powell, USAID.

partnerships also leverage the expertise and resources of U.S. actors, including federal agencies, academic institutions, and industry. For example, the Norman Borlaug Commemorative Research Initiative, a partnership between USDA and USAID, leverages the deep technical capacity of USDA to advance research on global challenges from wheat stem rust—a major threat to global wheat production—to a vaccine for East Coast fever, a devastating disease of cattle in East Africa. Feed the Future Innovation Labs, awarded to and led by U.S. universities, conduct research that delivers dual benefits to citizens of the United States and Feed the Future focus-country beneficiaries. These U.S. university-based commodity research programs—for example, the Feed the Future Innovation Lab for Collaborative Research on Sorghum & Millet—leverage complementary investments from private sector stakeholders from commodity associations and seed companies. They also build on substantial investments in basic and applied sciences funded through other federal science granting agencies, such as NSF, NIH, DOE, and USDA.



## SIGNIFICANT ACHIEVEMENTS OF FOOD SECURITY R&D

### **Dramatically Reduced Development Period for Higher-Yield Maize:**

Maize is a major food staple for much of Africa and the fastest-growing cereal in South Asia. However, maize is particularly vulnerable to increasing temperatures. For every degree rise in temperature, maize yields decrease by 7 percent. The USAID-funded Heat Tolerant Maize for South Asia project accomplished something unprecedented. Led by CIMMYT, along with Purdue University, national agriculture research stations in India, Pakistan, Nepal, and Bangladesh, and 11 seed companies, researchers within three years of project launch licensed 17 new heat-tolerant maize hybrids that outperform the yield of commercial varieties in the region. These hybrids normally take five to 10 years to license. This success attracted new seed companies, with eight new companies joining in the past year, resulting in increased investments from the private sector. Researchers continue to develop even better hybrids as there are more than 700 heat-tolerant hybrids under testing, thereby providing a pipeline of technology for future years.

### **Ensuring High Yields and Stability of Chickpea Production:**

Chickpeas, a staple throughout South Asia and parts of Ethiopia, are susceptible to pests and diseases and do not grow well in hot, dry environments. To improve the robustness of chickpeas, researchers at the University of California-Davis, in collaboration with counterparts at Harran University

and the Aegean Agricultural Research Institute in Turkey, have collected, deposited, and for the first time made publicly available the largest collection of wild relatives of chickpeas ever archived. The research team, including Ethiopian agricultural research partners in the national program, is now using this foundational contribution by characterizing these plants to identify traits to include in mainstream breeding programs. The importance of this work is evidenced by strong public and private sector support, as this project leveraged more than \$8 million in complementary funds from the Australian Grains Research Development Council, Saskatchewan Pulse Growers Association, Western Grains Research Foundation, Global Crop Diversity Trust, NSF, and the U.S. National Academies of Sciences.

### **Innovative Vaccines for Livestock:**

Rift Valley Fever is an infectious disease of livestock across Africa that can be fatal in humans and livestock. It is a trade barrier for livestock exports, which can have significant effects on jobs and livelihoods. The Innovation Lab for Rift Valley Fever Control in Agriculture is developing a vaccine, already known to be safe in humans, which will provide lifelong immunity for livestock in areas affected by the disease. Researchers are also exploring a needle-free delivery system to improve the ability to do widespread vaccine delivery. This project represents a collaborative effort between the University of Texas at El Paso, University of Texas Medical Branch at Galveston, Sokoine University of Agriculture in Tanzania, and MCI Sante Animale, a private animal vaccine company based in Morocco.



USAID works to boost nutrition in Malawi. Photo: Grace Nachiola, USAID.

**Wheat Varieties With Resistance to Stem Rust That Benefits Both Developing Countries and U.S. Farmers:**

BFS has invested in research to develop wheat varieties with resistance to stem rust, a serious threat to wheat production that can cause 70 percent or more yield losses and can spread over long distances. BFS had previously invested in renovating a greenhouse facility at the USDA's Agriculture Research Service Cereal Disease Lab to enable researchers to analyze samples from around the world to identify emerging strains of the pathogen. Through a new USAID-funded project led by CIMMYT, USDA researchers screened hundreds of leaf samples from Ethiopia and Kenya for new strains of stem rust. The resistant wheat varieties developed through these programs and the screening activities benefit developing countries and also ensure that U.S. wheat is protected from stem rust, a disease that could have major economic ramifications.

**Market and Policy Changes:** A number of accomplishments have been made in areas related to market and policy research. For example, research found that urban citizens purchase significantly more medium to large farms than outside investors, and that in some of the highest population-density farming areas in Africa, these transactions, together with large-scale foreign transactions, now account for the majority of land in those areas. Understanding these shifts in land ownership is critical to understanding economic

transformations that inform the design of USAID policies and programs. In another example, analytical tools developed under Feed the Future support to the International Food Policy Research Institute are now being mainstreamed into Central American governments' decisions on investment and service delivery in agriculture, nutrition, child migration, and food security, helping shape responses to El Niño in Central America's dry corridor. In a third example, USAID brought together global researchers to address underinvestment in the nutrition policy agenda, with focus on dietary diversity, reduced contamination, nutritional quality, and gender dynamics, as well as inclusive income growth.

**Analytical Tools That Aid Decision-Making:** USAID invested in the development and use of powerful analytical tools to identify effective approaches to policy change, governance, and decision-making in the food security policy system, which are critical to effecting systemic changes needed to strengthen food security. Some of these tools include the Kaleidoscope model to analyze policies, refinement and application of the Rutgers-Yale public and political will approach, and the application of USAID's political economy tools. These tools were tested in Ghana, Malawi, Tanzania, and Zambia to understand the process related to fertilizer subsidies and micronutrient policy issues.



Women inspect maize in Kenya. Photo: Siegfried Modola, USAID.



## U.S. GLOBAL DEVELOPMENT LAB

The Lab works collaboratively within USAID and with its external partners to produce breakthrough innovations by sourcing, testing, and scaling potential solutions, and accelerating the transformation of the development enterprise through modern tools and approaches. The Lab prioritizes its R&D activities to strengthen and improve research practices at USAID and to invest in locally-driven R&D projects that are strongly tied to a development outcome and that fill a gap not being addressed by USAID.

### LEVERAGING THE LAB'S R&D INVESTMENTS WITH OTHER PARTNERS

The Lab implements R&D programs with other USAID bureaus, U.S. Government agencies, bilateral and multilateral donor agencies, and the private sector. Through partnerships, USAID engages diverse partners in solving development challenges and supporting locally-driven research. The Partnerships for Enhanced Engagement in Research (PEER) program, implemented by the U.S. National Academies of Science, Engineering, and Medicine, provides one example. PEER brings

together USAID and nine U.S. science agencies including NIH, NSF, United States Geological Survey (USGS), NASA, Smithsonian Institution, USDA's Forest Service and Agricultural Research Service, National Institute of Food and Agriculture (NIFA), and National Oceanic and Atmospheric Administration (NOAA). PEER supports developing country researchers partnering with U.S. researchers at these federal science agencies. Increasingly, the private sector is also supporting the program with National Instruments and General Electric joining PEER in 2015.

USAID brought together seven core university partners to form the HESN: University of California, Berkeley, Texas A&M University, Massachusetts Institute of Technology, Duke University, College of William and Mary, Makerere University (Uganda), and Michigan State University. The network now spans more than 60 countries and 700 organizations, including higher education institutions, commercial enterprises, and nongovernmental and government entities. Since the beginning of the award, the HESN Development Labs have collectively leveraged more than \$45 million in funding from other universities, the private sector, NGOs, civil society organizations, and foundations.



The Partnerships for Enhanced Engagement in Research (PEER) program is an international grants program that funds scientists and engineers in developing countries who partner with U.S.-Government funded researchers to address global development challenges. Photo: Christopher Kiernan, USAID.

Since the beginning of the PEER program in 2011, PEER researchers have worked with and trained more than 4,000 students and research assistants. PEER researchers have also helped develop new or improved curriculum at educational institutions in their countries. Through their research, PEER scientists made discoveries including devices for detecting and treating water pollutants, advances in salt-tolerant crops, rapid diagnostic tests in medicine, and composite maps for predicting extreme weather events.

## **SIGNIFICANT ACHIEVEMENTS FROM THE LAB'S R&D INVESTMENTS**

### **Strengthening Research Ecosystem and Supporting Developing Country Researchers:**

Since the beginning of the PEER program in 2011, PEER researchers have worked with and trained more than 4,000 students and research assistants. PEER researchers have also helped develop new or improved curriculum at educational institutions in their countries. Through their research, PEER scientists made discoveries including devices for detecting and treating water pollutants, advances in salt-tolerant crops, rapid diagnostic tests in medicine, and composite maps for predicting extreme weather events.

### **Local Scientific Capacity Allows for Real-Time Genomic Analysis of Ebola Outbreak:**

One example of PEER's accomplishments is found in its support for Lassa fever virus research in Sierra Leone. A research team of local doctors, nurses, and hospital staff had been studying key gaps in the knowledge of Lassa fever virus epidemiology and were working in districts at the heart of the Ebola outbreak in 2014. The research team in Sierra Leone immediately pivoted their work to treat Ebola-infected patients while monitoring the epidemic in real time. Their U.S. partner, Tulane University, added capacity by tracking gene mutations and reporting the evolution of the Ebola virus. Having locally trained and technically proficient researchers with access to global research networks on the ground helped to enable real-time genomic monitoring of the spread of the disease. Through this PEER effort, the research team has also developed the first-of-its-kind rapid diagnostic test for the Ebola virus.

**Innovation for Clean Water:** The PEER program builds local capacity through research-driven innovation. For example, over the past few decades, availability and access to potable water in Lebanon

has continued to decline. Droughts, pollution, and international border crises threaten the country's water security, even as public demand for domestic water use already exceeds supply. A researcher at the American University of Beirut, in partnership with Stanford University, used a PEER award to develop a low-cost machine capable of detecting pollutants in drinking water. This machine will aid municipalities in properly treating drinking water.

Under his PEER award, he also trained 10 students in his lab, including seven women. He leveraged the PEER funding to develop new uses for his water quality machine. In addition to developing an advanced technique for detecting pollutants in water samples, he applied the same technique to invent a system that detects counterfeit ink in currencies and passports. In partnership with a U.S.-based National Instruments' Planet NI program, he filed a patent application in the United States for his anti-counterfeiting system.

**Directing Academic Communities Toward Development Challenges:** Some regions of the developing world urgently need greater access to reliable diagnostic testing, particularly for infectious diseases. The Fletcher Lab at the University of California, Berkeley, supported by the HESN Development Impact Lab, has designed specialized equipment that, when attached to the camera of a standard cell phone, becomes a diagnostic-quality microscope known as CellScope. CellScope is a mobile digital microscope that can be used by non-expert health workers in remote settings.



Amit Gandhi of MIT, a partner university in the Lab's Higher Education Solutions Network (HESN). Photo: Prithvi Sundar, USAID.





Designed by the Fletcher Lab at the University of California, Berkeley, CellScope transforms a mobile device into a microscope. Photo: USAID staff.

Different versions of the easy-to-use device can rapidly capture images of blood, sputum, or other patient samples and perform diagnostic analysis on the phone or wirelessly transmit the data to clinical centers, allowing the patient to be evaluated remotely and treated at the point of care. CellScope is a major step forward in taking clinical microscopy out of specialized laboratories and into field settings for disease screening and diagnosis.

### Implementing Collaborative Resilience

**Innovation Design:** To minimize the spread of Ebola, victims are treated in tents and workers wear protective gear, but in hot conditions the tents and gear can create new health problems for patients and staff alike. The Resilient Africa Network (RAN), through HESN, used a collaborative, co-creation design approach to reimagine treatment tents. Students in architecture and mechanical engineering at Makerere University, Uganda, met weekly to design prototypes of a new Ebola treatment unit in cooperation with a team of engineers, social scientists, epidemiologists, and medical doctors. Named the EpiTent, this innovation features a double-peaked roof with vents and porous walls that increase airflow naturally, lower the internal temperature, and promote

healthier and safer working conditions for responders to varying challenges and events. USAID provided support as the RAN team tested the design, worked with local manufacturers and vendors, and determined the optimal implementation plan.

### Developing a Low-Cost, High-Quality Primary Care Model:

More than 32 million people in India fall below the poverty line each year due to unexpected health shocks, which in turn result in lost income and spiked medical expenses. Research indicates that lowering the cost of primary care can reduce these health shocks by about 84 percent. The Development Innovation Ventures (DIV) program supported Swasth India Services Private Limited in developing a model that provides access to high-quality primary health care services to urban poor at half the market rates. This model was developed through three years of on-the-ground experimentation and innovation. Swasth established four sites in Mumbai slums and served more than 130,000 patient-visits, delivering more than 50-percent reductions in out-of-pocket expenses and a patient satisfaction rating of 92 percent, as compared with a 52-percent satisfaction rate with private and public providers. Swasth is expanding the model across Mumbai, establishing 24 new clinics. The company is also developing a “Primary Health Care in a Box” innovation that entrepreneurs and organizations in other geographies can use to replicate the model.

### Data-Exchange Networks for Earthquake Monitoring and Warnings:

The DIV program is also helping a scientist in Mexico develop an Earthquake Early Warning System for developing countries. The awardee is combining the exciting potential of the Internet of Things (a data-exchange network created by physical objects—such as buildings and cars—that are embedded with electronics such as sensors or software) with the more traditional field of seismology. Using low-cost, \$50 sensors (as compared to the usual \$20,000 sensor), the awardee will create a dense and cost-effective earthquake early-warning system. DIV funding is being used to finalize the early warning system that utilizes the latest in solid-state accelerometers and cloud-based data storage capability and deploys sensors along the Mexican coast to measure the impact of earthquake notifications for a growing community of connected users.



## ECONOMIC GROWTH, EDUCATION AND ENVIRONMENT

The Bureau for Economic Growth, Education, and Environment (E3) provides technical leadership, research, and field support for worldwide activities in Economic Growth and Trade, Infrastructure and Engineering, Education, Environment and Global Climate Change, Water, and Gender Equality and Women's Empowerment. Below are some of the highlights of E3's R&D portfolio.

### LEVERAGING E3 R&D WITH OTHER PARTNERS

E3's R&D investments are implemented in partnership with USAID missions, bureaus, and other operating units, as well as with U.S. Government agencies, other donors, and partner governments. In developing mobile technologies, E3 leveraged funds from USDA and missions to scale their impact. In Tanzania and Zambia, the government is considering nationwide use of mobile technology piloted by E3 to efficiently document land rights. Further, E3 funding for USDA led to the successful development of the first and only mobile application allowing anyone, anywhere in the world, to easily capture soil and vegetation information and instantaneously store and share the information on a web portal. In addition to USDA, partners include the International Soil Reference and Information Center, World Agroforestry Center, Regional Center for Mapping of Resources for Development (RCMRD), and World Overview of Conservation Approaches and Technologies, among others.

### SIGNIFICANT ACHIEVEMENTS FROM E3'S R&D INVESTMENTS

**Innovative Challenges:** E3 is working on three challenges for development, in education, energy, and wildlife trafficking. Through its partners in the All Children Reading Grand Challenge, E3 developed a Global Reading Repository of early grade reading materials. E3 also combined resources with other donors and the private sector as part of the Powering Agriculture Grand Challenge, which supports clean energy solutions to increase agricultural productivity and value. Finally, E3 worked to source and scale new and innovative solutions to wildlife trafficking through the Wildlife Crime Technology Challenge.

### Enhancing the Capacity of Local Organizations

**Worldwide:** E3 investments focused on capacity development for institutions in host countries. Research found that instead of focusing on enabling local NGOs to implement donor-driven projects, a greater focus is needed on "wholesale" approaches that build capacity through strengthening local networks. This research was seminal to E3's recently launched \$45 million Localworks program, which seeks to promote locally owned and led development at several pilot missions.

**Biodiversity and Food Security:** E3 funded the Center for International Forestry Research (CIFOR) to research key biodiversity themes, including a global research program on bushmeat and the role of forests in food security. This research produced a change in thinking regarding the role of forests and trees for food security. For example, this research established a relationship between dietary diversity and tree cover, and how tree-based systems play a role in agricultural production by providing ecosystem services such as pollination, climate regulation, and watershed protection. CIFOR's global bushmeat initiative contributed to a better understanding of the patterns of bushmeat use and trade through the study of market chains, consumption patterns, nutritional value, and exchange networks.

**Biodiversity and Human Health:** In other CIFOR research funded by E3, scientists found that Ebola virus hotspots are more widespread across Africa than suspected due to a greater number of animal species susceptible to infection and capable of secondary transmission. The study's findings challenge the notion that the Ebola virus is mainly sustained in the environment by three species of fruit bats; rather, it found that numerous animals including rodents, primates, hoofed mammals, civets, and shrews are known or potential carriers of the Ebola virus. This improved understanding may help prioritize geographies for preventative measures and inform efforts to contain or study Ebola spillover from wildlife to humans. This research was shared at a May 2015 interagency symposium organized by E3 in collaboration with USAID's Global Health Bureau, and published in June 2016.

**Tools and Mobile Applications:** E3 piloted a Sustainability Index Tool in Ethiopia and Liberia. In Ethiopia, the tool helped determine the sustainability of USAID/Ethiopia's water, sanitation, and hygiene (WASH) program. In Liberia, the tool was used to assess rural water points. Once finalized,

the Sustainability Index Tool will determine the sustainability and programming of future WASH activities.

In partnership with NASA and other institutions around the world, E3 supports SERVIR. SERVIR is helping people in more than 30 countries access and use satellite images and climate and weather information to make better decisions about development.

In addition, in partnership with USDA, E3 piloted the Land-Potential Knowledge System tool in Namibia and Kenya to support local land-use planning and to optimize design and implementation of food security, land restoration, climate change adaptation, and biodiversity conservation programs. This tool uses open-source mobile phone and cloud computing technologies to globalize access to local and scientific knowledge about land potential; provide information relevant to each type of land or soil to anyone with a mobile phone; and connect people with similar types of lands and challenges to share learning and experiences. More than 1,000 validated data points, filling critical gaps, have been uploaded and are available on an open data portal.

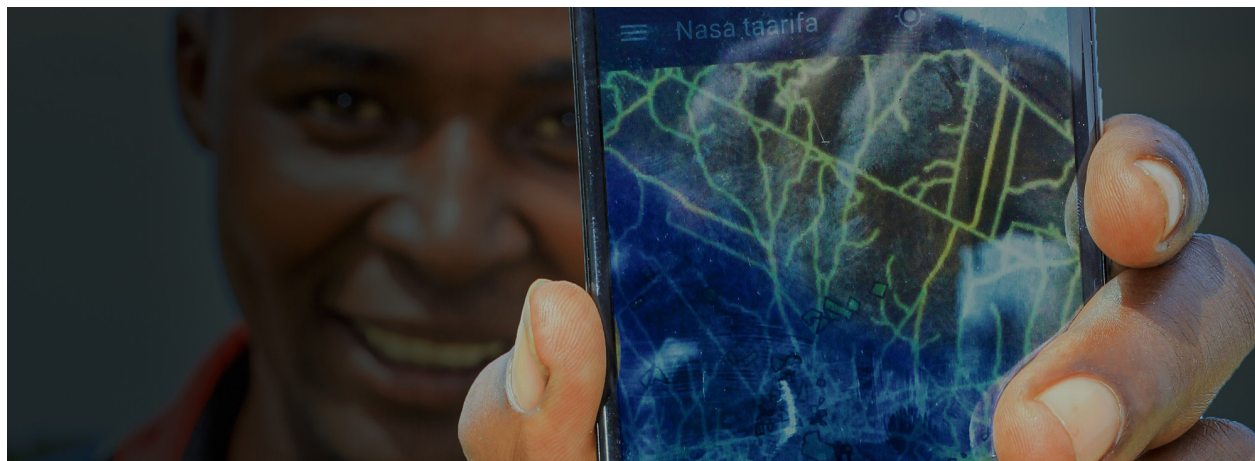
Related to this, E3 is also piloting the use of open-source smartphone applications to help smallholder farmers in Tanzania, Zambia, and Cote d'Ivoire capture the information needed to obtain formal documentation of land rights. Coupled with a cloud-based data management system to store geospatial and demographic information, the project is designed to lower the cost and time to register land rights and, importantly, to make the process more transparent and accessible to local people. So far, in

Tanzania more than 1,000 parcels were mapped in three weeks, with 30 percent of parcels registered in the name of women and 40 percent jointly registered to men and women. In Zambia, more than 6,300 parcels covering nearly 16,500 hectares were mapped across 130 villages, with 25 percent of parcels and 23 percent of the land registered to women.

#### **Impact Evaluations to Inform Program Design:**

E3 funded nine impact evaluations in five countries. In Cambodia and Kenya, two impact evaluations built upon the minimal empirical research that existed on the combined effects of improved WASH and nutrition practices. The evaluations come at a time when international development organizations and NGOs are exploring different approaches for integrating WASH and nutrition interventions and documenting their experiences.

In addition, E3 undertook seven rigorous, gender-sensitive impact evaluations on land programs in Ethiopia, Guinea, Zambia, and Liberia, drawing on detailed quantitative and qualitative data, including geospatial data and analysis. A growing body of evidence suggests that stronger land tenure security has a positive impact on important development outcomes, such as household investment, women's empowerment, agricultural productivity, rental markets, and credit. While the initial evidence is encouraging, important knowledge gaps remain. E3's impact evaluations on land programs test development questions related to eliminating extreme poverty, empowering women, enhancing food security, improving natural resource management, improving climate change mitigation and adaptation, mitigating conflict and promoting democratic governance and resilience.



A villager in Tanzania using E3's mobile application to demarcate household parcels within customer village lands. Photo: Cloudburst staff.

## DEMOCRACY, CONFLICT AND HUMANITARIAN ASSISTANCE

USAID's work in Democracy, Conflict, and Humanitarian Assistance (DCHA) promotes democratic and resilient societies that are able to mitigate disasters and conflicts and stay on a path toward peace and prosperity. DCHA rapidly deploys teams, resources, and capabilities to save lives and lay the groundwork for good governance and inclusive growth. In support of this, DCHA undertook several R&D investments to advance operational applications in disaster response, risk reduction, and food safety.

### LEVERAGING DCHA R&D WITH OTHER PARTNERS

DCHA collaborated with other U.S. Government agencies to fund innovative solutions in disaster technologies, management, and response. DCHA also partnered with important nongovernmental entities such as Global Earthquake Model Foundation and Tufts University, and with multilateral organizations such as the U.N. World Meteorological Organization, to enhance understanding of food shelf life and earthquake communications, respectively. The results of these and other partnerships are described below.

### SIGNIFICANT ACHIEVEMENTS FROM DCHA'S R&D INVESTMENTS

**Improving Meteorological Data Collection and Forecasting:** DCHA partnered with NOAA, USGS, U.N. World Meteorological Organization, and others to test operationalizing technologies to improve meteorological data collection and forecasting. One activity included the use of 3-D printing technology to improve monitoring of weather and climate hazards to support early warning that could save lives. This activity went beyond producing accurate forecasts and timely warnings to improve understanding and anticipation of the likely human and economic impacts of such events. The Volcano Disaster Assistance Program (VDAP), implemented by USGS, can be mobilized quickly to assess and monitor hazards at volcanoes threatening to erupt and helps to build local capacity by strengthening volcano-monitoring networks. This program benefitted 1.66 million people who live within 10 kilometers or in downstream hazard zones of volcanoes from where VDAP responded.

USAID's Famine Early Warning Systems Network (FEWS NET) activity represents one of the longest-running and most successful examples of interagency collaboration in the U.S. Government, involving NASA, NOAA, USDA, USGS and USAID. For 30 years, the FEWS NET team has been applying science, technology, innovation, and partnerships (STIP) to inform and guide more than \$2 billion annually in specific, complex, and lifesaving food security and humanitarian assistance operations of the U.S. Government and other national, regional and international partners around the world. Much of FEWS NET's early STIP work centered on applying U.S. satellite resources to identify hot spots of human suffering associated with agricultural drought. With time and greater experience, and in response to new challenges in hunger and vulnerability, the emphasis has shifted to answering more fundamental and complex questions about the nature of climate change, causes and frequency of drought, and localized trends in water availability. Especially notable in all these efforts is the growing number of instances where a global set of partners has been brought together to form the most effective platforms to assess and address such fundamental issues, such as the monthly Crop Monitor for Early Warning produced under the auspices of the Group on Earth Observations.



Vegetable Oil fortified with Vitamins A and D is ready for distribution to conflict-affected families in the Democratic Republic of Congo. Photo: USAID staff.





This 3-D-printed weather station will help developing countries forecast weather-related disasters and save lives. Photo: Kelly Sponberg, NOAA

### Improved Earthquake Disaster Assistance:

DCHA funded R&D that enabled the USGS Earthquake Disaster Assistance Teams to respond quickly following significant earthquakes as well as help local seismologists build capacity. The scientific data produced by assistance teams and local counterparts are used to improve understanding of seismic hazards and serve as the basis for the creation, adoption, and implementation of appropriate building codes and land-use plans by local and national governments in affected countries, ultimately reducing the adverse impacts of earthquakes. Following the magnitude 7.8 earthquake in Nepal on April 25, 2015, a six-person Assistance Team deployed to Nepal to support earthquake-related damage assessments, install and upgrade low-cost seismic monitoring instruments, provide technical assistance on data analysis, and conduct trainings on seismic hazard monitoring.

**Improved Understanding of Seismic Hazards and Risks:** DCHA support to the Global Earthquake Model Foundation has enabled the global scientific community to improve the understanding and communication of seismic hazards and risks worldwide. The Foundation produces decision-making models that allow users—ranging from government officials to homeowners—to process earthquake risk information, inform decision-making, and reduce potential loss of life and damage to livelihoods and economies.

### Improved Safety and Nutritional Quality of

**Food Aid:** Significant progress was made in areas such as food safety, identification of new commodities, and R&D on improving the nutritional quality of food aid commodities. Important accomplishments included:

- Establishment of an agreed to specification of ready-to-use-food;
- Addition of a new high-energy biscuit for emergency response;
- An interagency (USAID-WFP) food aid supply chain assessment;
- Putting forward multi-donor efforts that included the World Food Programme, USAID, USDA, and Eidgenössische Technische Hochschule to assess the effectiveness of two fortified rice technologies;
- Establishment of a systematic interagency food safety and quality auditing scheme to comply with the Food and Drug Administration (FDA) guidelines, as well as with the FSCC 22000;
- Identified food aid commodity packaging solutions to enhance shelf life; and
- Assessment of essential fatty acids levels in ready-to-eat foods.

In partnership with USDA, DCHA was instrumental in the development and approval of international guidelines for ready-to-eat foods. This includes microbiological and nutrition criteria that followed WHO's technical guidance on foods for treatment of

moderate acute malnutrition. USAID championed an agency-wide food safety and quality networking group to increase awareness around food safety and as an implementation framework of USAID's multi-sectoral global nutrition strategy on food safety.

In collaboration with Tufts University, DCHA funded research projects that focused on specialized food harmonization, research, and evidence mining, as well as completion of accelerated shelf life and stability studies of new and upgraded food aid products. Finally, DCHA funded a study implemented in Malawi on the impacts of increased rations of fortified vegetable oil and porridge prepared by mothers and caretakers.

Over the last five years, USAID has embraced a shift in philosophy around nutrition delivery to vulnerable communities in the world. The agency has progressively moved from blanket-type nutrition programs assisting general populations to more nutrition-specific models, tailoring food formulations as a function of the characteristics of target groups. These target groups include children under age 2, malnourished children under age 5, pregnant and lactating women, and other vulnerable groups such as households and communities displaced by natural disasters or conflict, as well as those whose immune

systems are compromised by conditions such as HIV and environmental or tropical enteropathy.

This nutrition-specific approach has led the agency to work with partners on the identification of more evidence-based specialized foods. Since 2011, DCHA/ Food for Peace has upgraded or developed more than 20 specialized food products; these commodities are energy and nutrition-dense, ranging from ready-to-eat formulas in the form of pastes or bars to foods needing minimum preparation such as fortified flours. Together with an increased focus on food safety and quality delivery, these improvements are leading to longer-lasting impacts on health and growth.

USAID's Bureau for Europe and Eurasia, in recognizing the need for greater civic engagement, worked with the Georgian Government to design an e-petition system (known as iChange) that is customized for the Georgian context. Per iChange regulations, a petition that gathers 5,000 signatures in a 30-day period compels the government to consider the matter and publish an official response. If used effectively, iChange offers the Government of Georgia an opportunity to solicit innovative ideas from the citizenry and to keep its finger on the pulse of public sentiment.



Raspberry Pi, a computer the size of an iPhone, can hold a year's worth of weather information collected from a 3-D-printed station. Photo: Heather Freitag, USAID.





Students at the African Leadership Academy. Photo: Odhiambo Franklyn, USAID.

## AFRICA REGION

The goal of R&D programs in the Africa Bureau is to provide new knowledge that will improve the Bureau's development programs. R&D activities center on three objectives: 1) increased understanding of the broad challenges, opportunities, and trends characterizing the development landscape in Africa; 2) using operations research to determine the best programmatic solutions to specific development problems; and 3) broadening understanding of how problems and solutions cut across technical, geographic, and institutional sectors.

### SIGNIFICANT ACHIEVEMENTS FROM AFRICA BUREAU'S R&D INVESTMENT

**Determining the Relationship Between Gender-Based Violence and Academic Performance:** The Africa Bureau funded research to determine if there is a relationship between a safe school climate (defined as an absence of school-related, gender-based violence such as bullying, corporal punishment, and sexual violence) and student performance. A secondary analysis conducted in three African countries—Botswana, Ghana, and South Africa—indicated that bullying was one of the key drivers that lower academic performance. In Botswana, students who experience bullying score lower than those who are not bullied by between

14 and 32 points. These effects are meaningful: at an average score of 400 points, the score differences correspond to from a 4-percent decrease in reading scores to an 8-percent decrease in science test scores. In South Africa, students who are bullied score 25 points lower than those who are not, corresponding to a 6-percent decrease in reading scores.

**Best Practices Regarding Conflict, Peacekeeping and Governance:** Research to benefit people living in unstable locales has deepened the knowledge base and increased the availability of best practices and new findings through knowledge sharing and capacity-transfer activities with USAID missions and implementing partners. These results will contribute to future problem analysis and project design. In addition, this research would fund pilot studies that test interventions and evaluations of performance and impact.

As a result, guidelines with programming options were developed and disseminated to staff, implementing partners, and other stakeholders on the drivers of violent extremism. These guides have been widely influential within the donor and practitioner community. In addition, the research has: (1) produced the first evaluations of Countering Violent Extremism (CVE) programming in Africa using mixed and quasi-experimental methodologies; (2) commissioned numerous country and regional CVE assessments

that guide program design; (3) conducted a series of studies on drug trafficking and transnational organized crime to better understand the causes and development impacts; (4) supported a pilot activity in Benin to address crime and subsequent evaluation; and (5) produced regional studies on rule of law and decentralization and local governance with country case studies.

**Regulatory Framework for Broadband Universal Access:** Research was carried out to analyze the regulatory structures necessary to achieve universal access to broadband services. The study examined various approaches to public regulation of utilities, with special emphasis given to broadband internet connectivity. The research led to improved program designs and advising country governments on appropriate regulatory regimes for ensuring a sustainable information and communications technology infrastructure, particularly in difficult to service communities, regions, and countries.

**Impact of the Ebola Epidemic on the Economies of Liberia and Sierra Leone:** To better understand the impact of the Ebola epidemic on the economies of Liberia and Sierra Leone, USAID initiated a telephone survey of both countries. The survey was

conducted periodically through the first half of 2015. The findings provided important information on what was happening to employment, incomes, and prices in both countries. These findings enabled the Africa Bureau to better understand the breadth and depth of the impacts of the Ebola epidemic on the economic wellbeing of households in the two countries and to design appropriate programs in response.

**Violence Against Children Survey:** This research is the only national population-based survey that assesses current and previous experiences of violence against children and violence against girls. The research also identified potential risk and protective factors, and enables analysts to link exposure to violence with important health outcomes such as HIV/AIDS in ways that have not been undertaken previously, which is very important for a country that has a high HIV prevalence such as Botswana. Currently, the connection between gender-based violence and Botswana's enormous HIV/AIDS epidemic is becoming clearer. Women in Botswana who experience gender-based violence are 50 percent more likely to be infected with HIV than women in nonviolent relationships, making gender-based violence an important driver for the spread of HIV/AIDS.



A researcher analyzes a malaria smear. Photo: USAID staff.



## LATIN AMERICA AND CARIBBEAN REGION

In order to accelerate cost effective and sustainable development, the Bureau for Latin America and the Caribbean harnesses advances in science, technology and innovation to expand the reach and success of programming throughout the region. The Latin America and Caribbean missions integrate STIP as core components across portfolios, and funding for applied and development research leverages innovative and collaborative solutions to local and regional development challenges. Recent R&D efforts support a variety of sectors yet widen understanding of solutions to cut across disciplines and boost impact.

### SIGNIFICANT ACHIEVEMENTS FROM LAC BUREAU R&D INVESTMENTS

**Geocoding to Maximize Impact:** USAID/Haiti expanded DevResults, a Geographic Information System (GIS) and online mapping tool that was integrated into the mission's knowledge management architecture. Through close coordination with local organizations and other implementing partners, DevResults contains location information for nearly all mission programming both before and after the 2010 earthquake. USAID staff were able to better visualize project trends and results with this data and have a clearer understanding of the value that place-based development may have for activities. As a result, USAID/Haiti collaborated with host-country counterparts to foster use of GIS technologies for improved management of donor funds and targeted interventions yielding greater impact.

**Expanding Coffee and Cacao Yields:** USAID/Peru promoted the use of new agricultural technology among cacao and coffee growers. For example, the integration of drip irrigation into the Synchronized Pruning and Fertilization Technique (TAPS) aligned practices more closely with physiological cycles, resulting in less stress to plants. 10,000 cacao and coffee smallholder farmers have benefitted from this method so far. After scale up, participating planters have experienced increased yields (as measured by kilograms per hectare) of at least 53 percent and up to 200 percent.

**Conserving Biodiversity and Managing Natural Resources:** In South America, USAID inspired community engagement through applied research on protected areas, conservation, natural resources, and climate change. The Higher Education



Maria Tamani knits a basket with chambira, while offering her products to the tourists in Puerto Prado, who visit the community to see how they live on the bank of the Marañon River. The sustainable use of natural resources like chambira, huingo, semillas de achioté, reduces the impact on the environment. Photo: Adrian Portugal, SPDA.

for Development program enabled cooperation between universities in Brazil, Colombia, Ecuador, Peru, and the United States and concentrates on local ability to conduct analysis. Research themes have addressed institutional arrangements for indigenous natural resource management, best practices for climate change adaptation at the local level, bio-economic review of indigenous hunting behavior, and willingness of water users to pay for upstream forest conservation. USAID also encouraged partners to conduct environmental monitoring backed by high-resolution Digital Globe satellite imagery. The Association for the Conservation of the Amazon Basin (ACCA) has used high-resolution imagery provided by USAID in a new near-real-time deforestation monitoring tool to inform knowledge of legal and illegal clearing in the Peruvian Amazon. Consequently, ACCA releases maps and commentary every two weeks to highlight recent deforestation events and offer current updates to decision makers.



**Defining the Links between Quality Education and Violence:** In partnership with higher education stakeholders, USAID’s development research systematizes, analyzes, and disseminates key education indicators for high-risk schools in El Salvador. The USAID Education for Children and Youth Activity stresses management of these measures to promote quality education as a counterweight to the pull of gangs and other violent actors. For instance, research has investigated techniques for early identification of potential dropouts and assessments of workforce readiness in vulnerable municipalities. USAID encourages application of pilot results to active learning methodologies among target schools and shares gains made with the Ministry of Education. Due to this effort, USAID/El Salvador support for research has led to evidence-based decision-making and improved design approaches for reducing early withdrawal from school.

**Reducing Community Violence:** Violence imposes enormous social and economic burdens in Latin America and the Caribbean. A USAID meta-review of activity in El Salvador, Guatemala, and Honduras has found deterrence and cognitive behavioral therapy interventions are the most likely to reduce violence in local communities. The study revealed six key elements characteristic of effective local violence reduction programming: (1) focusing on those individuals most at-risk; (2) preventing violence through proactive effort; (3) increasing the perceived and actual legitimacy of strategies and institutions; (4) paying attention to program implementation, evaluation, and fidelity; (5) defining and understanding a clear theory of change; and (6) engaging and partnering actively with critical stakeholders.



Dexter Amasifuen of the Puerto Prado Community, returns from his fishing activity with palometas and doncellas to feed his family. Sustainable fishing contributes to the conservation of biodiversity in the protected area of ACP Paraiso Natural Iriwati. Photo: Adrian Portugal, SPDA.



LAWIN applies freely available open-source software including CyberTracker for the data collection interface and the Spatial Monitoring and Reporting Tool (SMART) for data analysis, mapping and report generation. Data can be transferred to Google maps and other tools for creation of actionable reports, which facilitate decision-making. Photo: USAID and Chemonics staff.

## ASIA REGION

USAID's Asia Bureau has supported R&D activities that address a variety of development issues and build capacity for local researchers and research institutions. These activities strive to develop evidence-based approaches for each USAID mission in the region. Funds have supported R&D in sectors such as natural resource management, economic growth, disaster readiness, health, democracy and governance, and education. R&D efforts have also explored new applications of mobile messaging to enhance health outcomes and supported research to promote sustainable approaches to food security. We have directly supported the science research ecosystem to improve the capacity and global competitiveness of local researchers and academic institutions. A few highlights are provided below.

### SIGNIFICANT ACHIEVEMENTS FROM ASIA BUREAU'S R&D INVESTMENTS

**Mobile Phone-Based Health Interventions:** In Bangladesh, USAID conducted research on the efficacy of mobile phone-based health information systems on caregiving and care-seeking behavior and service

utilization. The results are being used to refine current mobile phone-based health interventions. USAID also worked with the Bangladesh Rice Research Institute and Arcadia Biosciences, Inc. to develop new rice varieties, including saline-tolerant, high-yielding, and stress-tolerant varieties.

**Developed Scientific Tools and Methods:** In India, USAID funded a program that developed solutions to connect primary forest data collection to robust information technology solutions for analysis and reporting. USAID has also supported research studies on reproductive, maternal, newborn, child, and adolescent health, health financing, and tuberculosis, and built the capacity of partners and government agencies undertaking related research. These studies filled gaps in evidence to provide critical information for health sector strategies, programs, and projects.

**Strengthening Indonesia's Research Ecosystem:** In Indonesia, USAID, in collaboration with the Indonesian Government and the Governments of Australia and Great Britain, has supported development of the Indonesian Science Fund, a novel organization to support high-quality, merit-based, peer-reviewed science and research. This will



strengthen Indonesia's research ecosystem and global scientific competitiveness. USAID has also supported the establishment of the Policy Research Network, a coalition of Indonesian think tanks and research institutions aiming to influence public policy making by providing evidence-based policy recommendations. In other funded research, the Kalimantan Wetlands and Climate Change Study, a partnership with Oregon State University, has concluded that peatlands and mangroves, which make up a large proportion of Indonesia's forested area, contain an even larger supply of stored carbon than previously thought, and, as a result, the destruction of these ecosystems both harms the people and animals that depend on them and contributes to greenhouse gas emissions. This information can be used to inform policy and better target interventions.

**Development of Advanced Scientific Tools:**

In Cambodia, USAID provided technical assistance to 155 government and community rangers, as well as monthly oversight of the Spatial Monitoring and Reporting Tool (SMART), toward conserving Cambodia's forests and wildlife. A new method

for streamlining and enhancing the collection data, using Cybertracker software together with SMART software loaded onto tablet or smartphone devices, allows rangers in the field to quickly and accurately enter data, thereby greatly reducing the time it takes to receive information from the field. Analysis of SMART data on law enforcement activities continues to provide insights into the impacts of patrolling and patterns of illegal activities. The initiative has recorded and compiled camera-trapping data of species of birds and mammals too elusive to observe directly, including globally vulnerable and endangered large mammals such as the Asian elephant, clouded leopard, and gaur. In addition, USAID has supported Cambodia's Royal University of Phnom Penh in continued development of ecosystem services maps using the InVEST tool, a suite of free, open-source software models used to map and value goods and services from nature. The maps show the current distribution of six priority ecosystem services, including carbon stocks, habitat quality, open access or non-timber forest products, water yields, sediment retention, and nutrition retention.



Photo: USAID staff.

## MIDDLE EAST REGION

USAID operates six bilateral missions in the Middle East: Egypt, Iraq, Jordan, Lebanon, Morocco, and West Bank/Gaza. Development assistance to Yemen is currently under suspension. USAID also operates regional programs out of the Middle East Bureau's Office of Technical Support and the Middle East Regional Platform in Frankfurt and manages development programs in countries without missions, including Libya and Tunisia. The Middle East Regional Cooperation (MERC) Program supports science and technology cooperation between Israel and its Arab neighbors through joint Arab-Israeli applied research projects to solve common development problems.

Despite increased tension in the region and instability in overall Arab-Israeli relations in recent years, MERC is succeeding in advancing two key foreign assistance goals: increasing Arab-Israeli cooperation, and building science and technology capacity for development in the Arab world. Links with public- and private-sector institutions that implement research results help MERC projects produce positive impacts and demonstrate the tangible benefits of cooperation. MERC projects have produced significant technical results and development contributions across a variety of technical fields, notably in water, agriculture, health, and the environment.

USAID also supported the creation and strengthening of the Middle East and North Africa Network of Water Centers of Excellence (MENA NWC). This association of research and educational institutions works collaboratively with governments, businesses, and civil society organizations across the region to solve longstanding water issues. MENA NWC's current membership includes 19 national research institutions and universities in Algeria, Bahrain, Egypt, Iraq, Israel, Jordan, Morocco, Oman, Qatar, Tunisia, the West Bank, Yemen, and the United Arab Emirates, and international research Centers based in Jordan, Dubai, Oman, and Sri Lanka.

### SIGNIFICANT ACHIEVEMENTS FROM THE MIDDLE EAST BUREAU'S R&D INVESTMENTS

Some recent accomplishments resulting from the Middle East Bureau's R&D investments are highlighted below.

**Improved Water Resources:** MERC researchers discovered widespread high levels of naturally



Lysimeter experiments in Jordan used by MERC scientists to minimize agricultural water use requirements. Photo: Dr. Alon Ben Gal.

occurring radioactivity in a major aquifer slated to be developed for urban use and eventually become the primary source of drinking water for a community.

The team published detailed maps and also cited avoidance and remediation strategies. In another project, scientists developed ultra-high-frequency, low-volume irrigation techniques to deliver nutrients and water to crops in a precise manner. This vastly improved water conservation by applying water and nutrients so that plants absorb them most efficiently and little is lost to evaporation. These scientists established minimum requirements for a number of key crops and trained more than 75 researchers and farmers in these techniques.

**Improved Agricultural Yields:** MERC has funded research involving six Arab countries, Israel, and the United States in developing tests for 38 Middle Eastern strains of plant viruses that affect major crops. These tests were refined and made available for diagnostic purposes, and as a result the national governments are presently implementing these tests. Another MERC project joined scientists from Israel, six Arab countries, and the United States who developed tomato lines and hybrids resistant to tomato yellow leaf curl virus, one of the most costly horticulture diseases in the world. The MERC scientists successfully tested their resistant germplasm against the strains of the virus found in each of the seven Middle Eastern countries. The project also used conventional and marker-assisted breeding of resistant tomatoes with local tomato lines to yield local consumer-preferred characteristics in size, taste, and shape, which vary widely among the countries in the region.



**Regional Partnerships:** MENA NWC's various research programs encourage international partnerships and support the sharing of research outcomes and application of knowledge gained to aid communities, governments, and the private sector. Some highlighted projects include:

- Using radar sounding technology developed by the Jet Propulsion Laboratory and the California Institute of Technology for exploring Mars' subsurface to locate and map desert aquifers in Oman and Morocco.
- Forecasting algal blooms to reduce harmful impacts on desalination plants in the Arabian Gulf.
- First-time regional production and testing of bio-fouling-resistant nanocomposite membranes to desalinate brackish water.
- Assessing renewable energy feasibility for large scale water pumping and desalination in Jordan and the West Bank.
- Testing and demonstrating soil and plant moisture sensors to improve on-farm irrigation management.

**U.S.-Egypt Science and Technology Fund:** Launched in 1995 through a bilateral agreement, the U.S.-Egypt Science and Technology Joint Fund

promotes collaboration between U.S. and Egyptian scientists to address development challenges and promote economic growth, particularly in applied research and technology commercialization. This program works in areas such as public health, food security, energy, and water security. Results of the Joint Fund include high-impact scientific research, training for the next generation of youth and female scientists, and expanded collaboration between U.S. and Egyptian public and private sector institutions.

**Innovations in Desalination:** MIT and Jain Irrigation Systems designed a photovoltaic-powered electro dialysis reversal (EDR) system that desalinates water using electricity to pull charged particles out of the water and further disinfects it using ultraviolet rays. The system was designed for low energy consumption, limiting costs especially in off-grid areas. With USAID and UNICEF support, this system is being piloted in the Palestinian Territories. The goal is to provide scalable, efficient, and sustainable water solutions for irrigation and potable drinking water. The activity will result in new water provision technology as well as the engineering knowledge required to adapt and scale the technology for various environmental conditions and geographic regions.

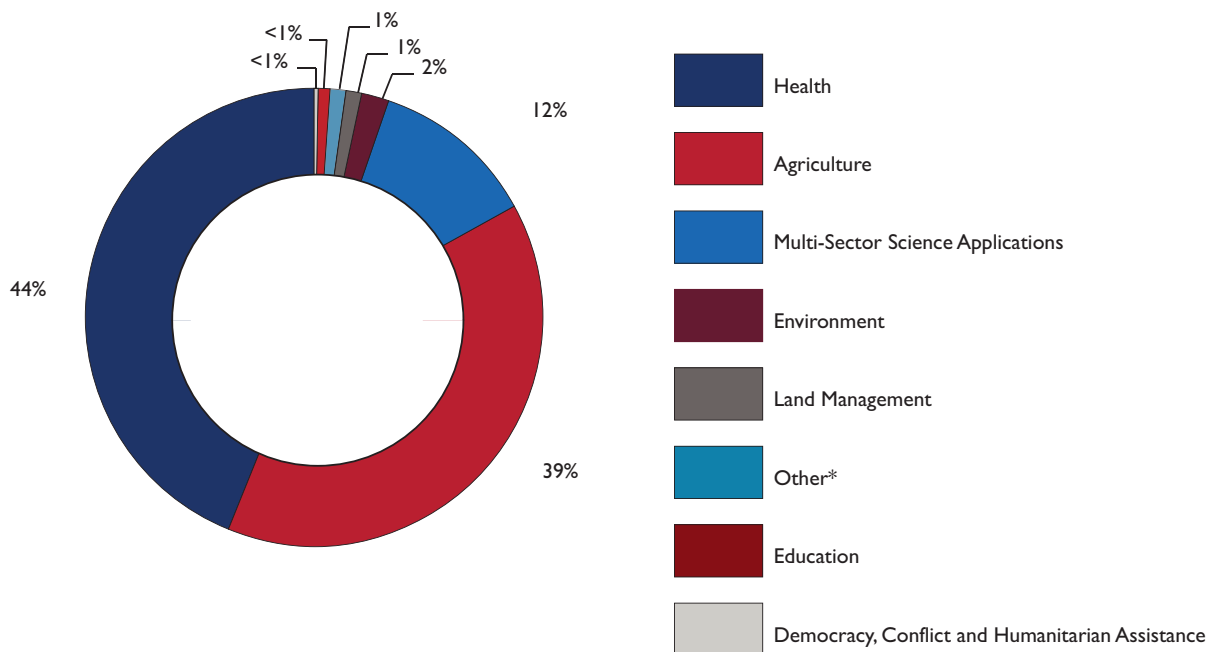


Biology students study a heart. Photo: USAID staff.

## RESEARCH AND DEVELOPMENT INVESTMENTS

USAID budgeted R&D investments for Fiscal Year 2015 were \$425 million. Of this amount, most of the investments (88 percent) were made by three bureaus: Global Health, \$186 million (44 percent); the Bureau for Food Security, \$146 million (34 percent); and the U.S. Global Development Lab, \$42 million (10 percent). Table I provides the total R&D investments by bureaus and regions. Figure I shows bureau level and regional investments by development sector. Divided by sector, health research makes up almost half of USAID's investment (44 percent), agriculture comprises 39 percent, and multi-sector science applications, such as digital development and science partnerships make up 12 percent. Research on environmental issues, education and other topics comprise less than 5 percent of investments.

**FIGURE I**



\* Includes water, public-private partnerships, citizen security, gender equality and women's economic empowerment.

TABLE I

RESEARCH AND DEVELOPMENT ACTIVITIES	FY2015 FUNDS (IN THOUSANDS)
<b>TOTAL</b>	<b>\$424,931</b>
<b>BUREAU FOR GLOBAL HEALTH*</b>	<b>\$185,557</b>
Maternal and Newborn Health	\$10,249
Child Health	\$1,930
Nutrition	\$4,238
Family Planning and Reproductive Health	\$24,485
HIV/AIDS	\$77,854
Malaria	\$12,343
Tuberculosis	\$24,701
Neglected Tropical Diseases	\$900
Global Health Security and Development	\$23,900
Health Systems Strengthening	\$4,956
<b>BUREAU FOR FOOD SECURITY*</b>	<b>\$146,400</b>
Advanced Approaches to Combat Pests and Diseases	\$15,461
Markets and Policy Research and Support	\$16,307
Climate Resilient Cereals	\$26,318
Legume Productivity	\$20,867
Nutritious and Safe Foods	\$20,282
Sustainable Intensification	\$28,887
Scaling Seeds and Other Technologies	\$9,805
Other Science and Tech Partnerships	\$8,473
<b>GLOBAL DEVELOPMENT LAB*</b>	<b>\$42,029</b>
Open Innovation Funds and Prizes	\$21,000
Geospatial Research	\$2,021
Higher Education Partnerships	\$15,308
Partnerships for Engagement in Research (PEER) and Research Ecosystems	\$3,700
<b>BUREAU FOR ECONOMIC GROWTH, EDUCATION AND ENVIRONMENT*</b>	<b>\$6,903</b>
Land Management and Land Rights	\$3,510
Local Sustainability	\$1,224
Forestry and Biodiversity	\$1,500
Water	\$669
<b>BUREAU FOR DEMOCRACY, CONFLICT AND HUMANITARIAN ASSISTANCE**</b>	<b>\$1,191</b>
Conflict Management and Mitigation	\$841
Democracy, Human Rights and Governance	\$350
<b>BUREAU FOR MIDDLE EAST*</b>	<b>\$5,000</b>
<b>BUREAU FOR AFRICA**</b>	<b>\$25,698</b>
<b>BUREAU FOR LATIN AMERICA AND THE CARIBBEAN**</b>	<b>\$5,959</b>
<b>BUREAU FOR ASIA**</b>	<b>\$6,195</b>

\* Data reported by Bureau

\*\* Data from FY2015 FACTS Info Ops Plan



Photo: USAID staff.

## CONCLUSION

Research and development activities are central to improving international development results. R&D helps USAID's global staff and partners to understand complex challenges, produce innovative solutions, and bring these solutions to scale. USAID-led R&D will also continue to bring new partners into the global fight to eliminate the causes and impacts of extreme poverty.

In FY 2015, USAID invested \$425 million in R&D activities, which yielded a return in the form of myriad accomplishments across sectors—including those described in this report—with more results still to come. While these R&D activities represent a deep, diverse portfolio of partnerships, actions, and results, each investment has something in common: It strives to solve a problem in a way that endures and can be built upon.

Harnessing scientific research is critical to reaching USAID's vision to end extreme poverty, promote resilient, democratic societies, and advance our security and prosperity. USAID's R&D investments establish long-lasting relationships that build scientific

research capacity, strengthen the research ecosystem in developing countries, and enable collaborators to become better partners in working on the most difficult development priorities. Finally, USAID's R&D investments in partnership with the private sector have enabled us to better mobilize resources, broaden our design efforts, and strengthen implementation for better outcomes in host countries.

This report has described the breadth and depth of USAID investments in significant achievements in development that will ultimately improve the stability and livelihoods of people well beyond the direct beneficiaries. If we are to continue to make progress toward ending extreme poverty, we must continue to invest in and support R&D and the scale-up of breakthrough innovations. The challenge before us is to sustain and expand the progress and achievements that have led to saving and improving millions of lives around the world. This disciplined approach to R&D investment and partnering in international development is the right thing to do and will more than pay for itself over time.



## APPENDIX A: GLOBAL HEALTH R&D STRATEGIC GOALS 2011-2015

### MATERNAL & NEWBORN HEALTH

1. Develop and introduce evidence-based interventions for care during pregnancy and at birth.
2. Strengthen and standardize obstetric care for the prevention, management, and treatment of fistula.
3. Design, evaluate, and introduce evidence-based interventions to reduce newborn morbidity and mortality from birth asphyxia.
4. Develop, test, and introduce community-based health interventions to treat and prevent newborn infections.
5. Develop scalable approaches for integrating maternal, family planning, and neonatal health services.
6. Assess evidence-based approaches to improve the access and utilization of quality maternal, neonatal, and child health interventions.
7. Develop standardized criteria and effective tools for measuring maternal and perinatal mortality and morbidity.

### CHILD HEALTH

1. Support research to inform the uptake of integrated community case management.
2. Evaluate interventions to increase the use of efficacious diarrhea treatments.
3. Develop cost-effective approaches to decrease acute lower respiratory infections.
4. Develop and test scalable approaches to improve drinking water quality and access, use of sanitation, and hygiene behaviors.

### MALARIA

1. Develop safe and effective vaccines for Plasmodium falciparum malaria.
2. Develop effective and affordable medicines for the treatment and prevention of malaria.
3. Develop new, effective insecticides for improved vector control.
4. Improve malaria control program implementation and impact.

### POPULATION & REPRODUCTIVE HEALTH

1. Refine, develop, and introduce new contraceptive methods.
2. Improve and expand access to family planning methods in developing countries.
3. Develop and introduce effective, scalable service delivery models to increase the healthy timing and spacing of pregnancies.

### NUTRITION

1. Strengthen and expand the evidence base on integrated multi-sectoral approaches to improve nutrition outcomes, including reducing stunting and maternal and child anemia.
2. Support implementation research for improved diet diversity and quality.
3. Develop, refine, and expand use of state-of-the-art measurement tools for nutrition programs and policies.

### HIV & AIDS

1. Develop, test, and introduce microbicides for women to reduce the risk of HIV infection.
2. Accelerate development and clinical testing of novel HIV vaccine candidates and build global capacity for vaccine research.
3. Strengthen the programmatic evidence base for HIV and AIDS prevention, care, and treatment to achieve epidemic control.

## TUBERCULOSIS

1. Evaluate diagnostic tools to more effectively detect TB in individuals with and without HIV.
2. Develop regimens that improve the treatment of multi-drug resistant TB.
3. Conduct operations research for improving TB program performance and management of TB-HIV co-infection.

## GLOBAL HEALTH SECURITY & DEVELOPMENT

1. Develop and introduce surveillance methods to increase pathogen detection.
2. Develop and test methods to improve the understanding of risk including how human behavior contributes to the risk of disease emergence.

## NEGLECTED TROPICAL DISEASES

1. Support innovative approaches in disease mapping.
2. Develop new laboratory diagnostics and tools.
3. Support best practices for monitoring and documenting progress toward elimination.
4. Develop tools to manage morbidity.
5. Deliver a macrofilaricide for onchocerciasis and lymphatic filariasis.

## HEALTH SYSTEMS STRENGTHENING

1. Identify practical solutions through applied research.
2. Synthesize, share, and promote the use of evidence.
3. Develop, refine, and test tools and frameworks.

## CENTER FOR ACCELERATING INNOVATION & IMPACT

1. Catalyze innovation and leveraging partnerships.
2. Identify market tools and best practices for acceleration.
3. Accelerate introduction and scale-up.

## APPENDIX B: FOOD SECURITY R&D STRATEGIC PRIORITIES

**Climate-Resilient Cereals:** Investments focus on developing high-yielding, climate-resilient cereals along with complementary approaches to improve resource efficiency, enabling farmers to grow more cereals on less land, using fewer resources like fertilizer, water, labor, and energy.

**Legume Productivity:** Investments focus on increasing the production and availability of nutritious legumes, such as beans and groundnuts, in order to improve food security, nutrition, soil health, and economic opportunities for poor farmers, especially women.

**Advanced Approaches to Combat Pests and Diseases:** Investments use emerging molecular tools to create new animal vaccines and develop crops and animals that are resistant to major pests and diseases.

**Nutritious and Safe Foods:** Investments focus on research to improve the production and safe processing of nutritious agricultural products and on increasing our understanding of the role of fruits, vegetables, meat, fish, dairy, and legumes in improving household dietary quality.

**Markets and Policy Research:** Investments focus on research to strengthen three essential components of an effective and sustainable policy system: a) substantive policy agenda; b) institutional architecture (i.e., human and institutional capacity and the consultative and stakeholder mechanisms within which policies are considered, decided and implemented); and c) mutual accountability mechanisms.

**Sustainable Intensification:** The program works with smallholder farmers and global, regional and national research partners to identify and adapt promising strategies and technologies for local farming systems, in order to intensify and diversify major production systems where the poor and undernourished are concentrated.



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