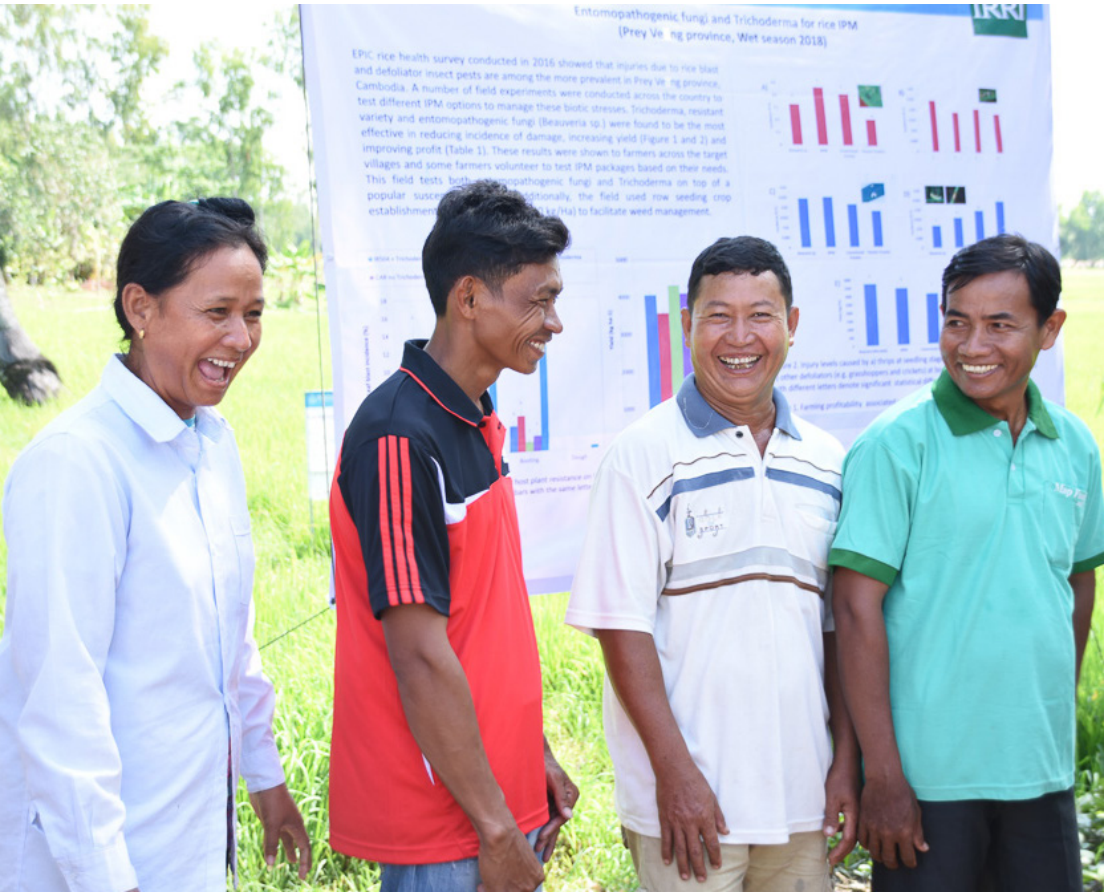
Feed the Future Innovation Lab for Integrated Pest Management (IPM)

A program at the Center for International Research, Education, and Development



"I used to be known by my father's name, but now people know me by my own."

-Rupa Thapa, Community Business Facilitator Promoting IPM in Nepal

FOREWORD

The Feed the Future Innovation Lab for Integrated Pest Management, funded by USAID and managed by Virginia Tech, has been in operation since 1993. In the past two and a half decades, the team has worked in West and East Africa; Eastern Europe; Central, South, and Southeast Asia; and Latin America and the Caribbean. Some of the crops addressed include cereals, legumes, peanut, vegetables, and fruits. This program is dedicated to improving livelihoods and building resilient, self-sufficient communities in the developing world. In the beginning, this was achieved by directly addressing problems encountered by farmers through applied research, and later by preparing scalable IPM packages for specific crops so that farmers could choose and implement IPM components best suited to their farm structure, skill-level, and resource level. The IPM Innovation Lab has helped expand credible technologies on both a regional and global scale. In addition to using national, regional, and international news outlets for this purpose, the program has effectively utilized and led national, regional, and professional meetings, symposia, and conferences.

In recent years, globalization has enhanced the movement of invasive species and the IPM Innovation Lab has been at the forefront of modeling their spread, creating awareness, and developing management technologies. To cite a few, the team has been implementing biological control of the invasive weed *Parthenium hysterophorus* in Ethiopia in an effort to alleviate its adverse impacts on people and to prevent its spread to West Africa. The team effectively controlled the papaya mealybug when it spread to Asia and Africa by introducing its natural enemies, an approach that brought immense economic benefits to many communities.

Currently, the IPM Innovation Lab is modeling the spread of *Tuta absoluta* and the fall armyworm in Asia. Simultaneously, it is also developing environmentally benign, socially acceptable, economical, and effective control methods that offer farmers long-term, sustainable strategies against emerging pest and disease threats.

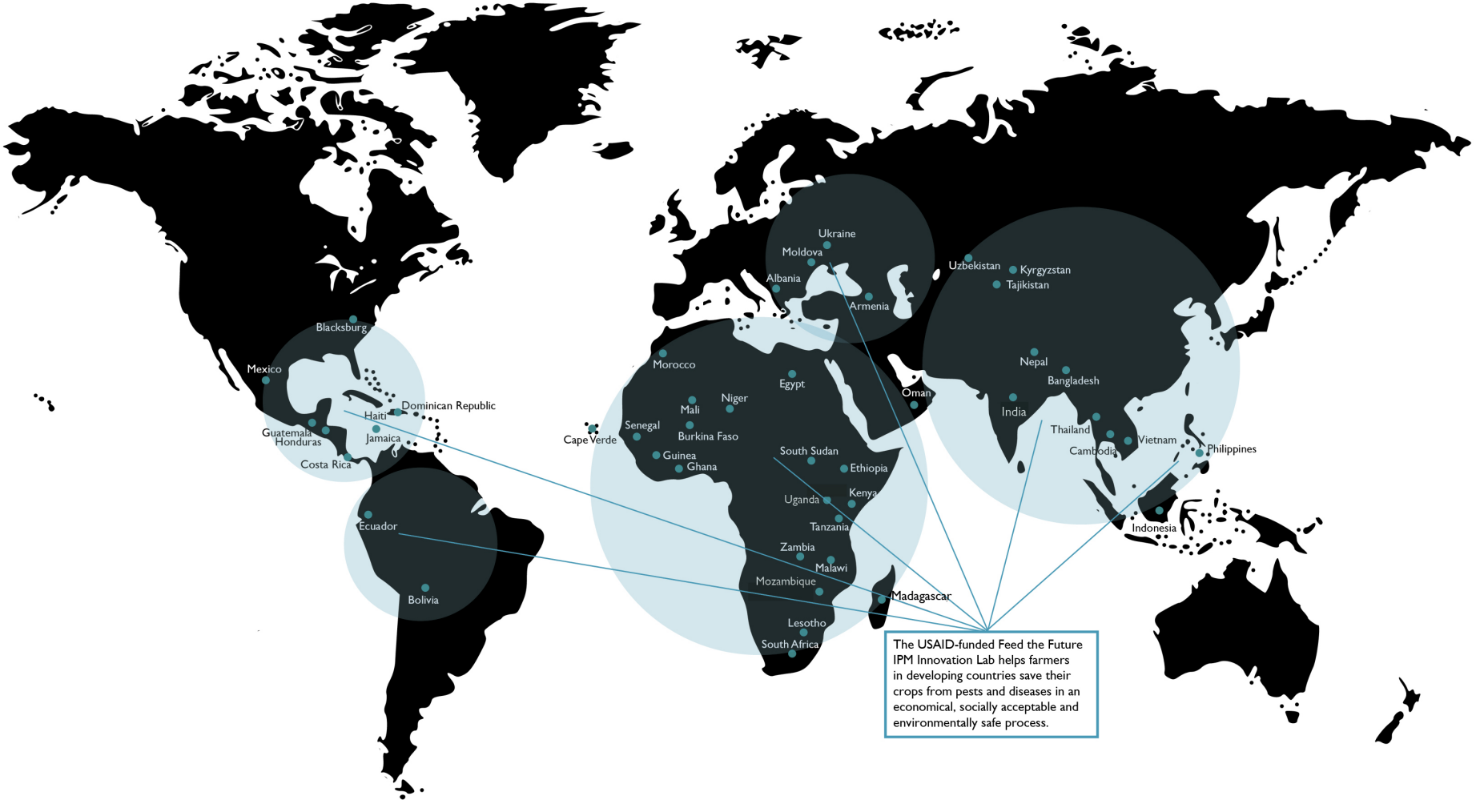
The IPM Innovation Lab also addresses human and institutional resource development in its host countries. Thus far, over 600 individuals have obtained their graduate degrees. The program emphasizes gender considerations in each project. Millions of farmers have been exposed to and benefited from short-term training and other extension methods. Additionally, the IPM Innovation Lab has encouraged South-South scientific collaboration and regional economic development.

The program has also generated over $10 million in leveraged funds based on its credible track record in different parts of the developing world. It has worked with national governments and private institutions, value chain projects of local missions, U.S. universities and agencies, and international institutions in developing technologies and disseminating them.

It is my great pleasure to congratulate the Virginia Tech-led IPM Innovation Lab and its many local implementing partners in Feed the Future countries for their incredible and impactful work carried out for the benefit of the developing world.

John E. Bowman, Ph.D.
USAID/Bureau for Food Security
Agreement Officer's Representative
IPM Innovation Lab

Where we Work: Past and Present



Increasing Food Security, Improving Livelihoods

In the developing world, nearly 40 percent of all crop yields are lost due to pests and disease. For the 1.5 billion smallholder farmers living or working on less than an acre of land, that shortage can have an extremely high price. Farmers in rural communities with limited access to sustainable methods and materials often depend on pesticides to combat emerging crop issues, despite the threat synthetic chemicals pose to human, environmental, and animal health.

Launched in 1993 at Virginia Tech's Center for International Research, Education, and Development (CIRED), the IPM Innovation Lab helps developing countries combat agricultural issues with methods that are affordable, environmentally sound, safe to human health, and culturally acceptable. The $18 million program, funded by the U.S. Agency for International Development (USAID) in October 2014 for five years, currently has eight projects in seven countries – Ethiopia, Kenya, Tanzania, Bangladesh, Cambodia, Vietnam, and Nepal. Over the course of its 25-year history, however, the program has introduced Integrated Pest Management (IPM), or ecological, strategies in nearly 30 countries around the world.

Monitoring and managing invasive species, increasing crop yields, and improving farmer access to sustainable crop solutions are among a few of the program's central components.

Investing in people in order to strengthen agricultural innovation is a long-held Virginia Tech and IPM Innovation Lab principle. Thus, the IPM Innovation Lab works to increase farmer income, enhance IPM research, extension, and education program capabilities, strengthen private businesses, commercialize technologies, develop human and institutional capacity, and increase the ability of women in IPM decision-making and program design in each of its projects. Over the last 25 years, the team has exceeded many of those goals. Having successfully trained 500 graduate students and impacted millions of farmers, collaborated with 100 institutions, directly leveraged more than $10 million, and generated nearly $2 billion in economic benefits in the developing world, more than 35 times USAID's investment in the IPM Innovation Lab.

Building sustained, long-term strategies for resilience against the increasingly frequent stresses and shocks of the 21st century is not only key to increasing global food security, but also to reducing the developing world's future reliance on foreign aid.

Monitoring and Managing the Spread of Invasive Species

The National Wildlife Federation has named invasive species one of the leading global threats to native wildlife – approximately 42 percent of threatened or endangered species are at risk due to invasive species. Rural areas in the developing world are disproportionately affected by invasive species, as many depend heavily on natural resources for survival.

The IPM Innovation Lab monitors and manages the spread of invasive species to curb the global threat that causes trillions of dollars in damage every year. In Nepal, where land biodiversity is central to the nation's economic growth, the team tracks the movement of invasive weeds. Research findings demonstrate that as the global temperature slowly rises, invasive weeds spread more rapidly as well, prompting the program to conceive of new methods and policies to protect vitamin-rich crops whose future land availability is threatened. Also in Nepal, the IPM Innovation Lab uses computer modeling to track the invasive *Tuta absoluta*, a tomato leafminer, along trade routes through domestic markets.

Establishing that food-transport systems and human movement are linked to new incursions of invasive species is imperative to getting ahead of future invasions.

This is especially true for a pest like *Tuta absoluta*, which is projected to eventually reach the U.S. Another component of the IPM Innovation Lab is generating ecological management strategies for controlling the spread of invasive species. *Tuta absoluta* has limited natural enemies, but the promotion of pheromone traps and lures for monitoring and capturing the pest has dramatically reduced the pest's importance in Nepal, triggering increased farmer income and agribusiness sales of sustainable solutions.

Tuta absoluta

The tomato leafminer, *Tuta absoluta*, has the potential to wipe out 100 percent of crop yields.

Tuta absoluta movement

In East Africa, the IPM Innovation Lab manages the spread of invasive species through biological control. In Ethiopia specifically, the program releases the natural enemies *Zygogramma bicolorata* and *Listronotus setosipennis* against the invasive *Parthenium hysterophorus*, a highly noxious weed that farmers call "faramsissa," meaning, "sign your land away." The method abets increased crop yields, reduced tainted livestock milk, and decreased human health issues, especially for women, who often hand-weed. The IPM Innovation Lab also mobilizes against the fall armyworm, a formidable pest that threatens more than 300 plant species, especially maize, and thrives in harsh climates.

The program prepared a risk assessment of the fall armyworm for the USAID Mission in Egypt that predicted the pest's future movements based on wind currents, and has identified several local natural enemies of the pest in Africa, a strategy that could protect crop yields for millions of farmer families.

Over half of the world's food comes from only three crops – rice, wheat, and maize – and it is estimated that they alone suffer yield losses of up to 16 percent due to invasive species. Maintaining biodiversity is critical for smallholder farmers who continue to contribute to the majority of economic production in developing communities. The IPM Innovation Lab's alerts and management strategies to countries at risk of invasion serve the goal of instituting early, preventative measures to help farmers preemptively strike against emerging threats to their farms.

Protecting Crops, Protecting People

It is estimated that 815 million of the 7.6 billion people in the world suffer from chronic undernourishment, the majority of which live in lower-middle income countries. With the global population expected to rise to 8.5 billion by 2030, the demand for plentiful, nutritious food is higher than ever.

The IPM Innovation Lab employs dozens of tested, sustainable technologies to accelerate food production in the face of rapidly changing ecosystems and shrinking land availability. In East Africa, one of those methods is the Push-Pull technique, a cropping system that harnesses natural enemies and health-promoting plants to repel pests. Farmers utilizing the system in East Africa report increased milk and crop yields, as the initiative suppresses stemborers and weed activity, improves soil fertility, and provides fodder for livestock. In addition to cropping systems, the IPM Innovation Lab implements and promotes bio-products like *Trichoderma*, a beneficial fungus, and cocopeat, the dust of a coconut, both of which support early, stable, disease-free plant growth in rural communities that often struggle with seed health.

The popularity of these two natural solutions in particular have helped boost the plant nursery industry across Asia, the boom opening new income-generating opportunities for underemployed women. In fact, Rebaka Sultana runs the foremost organization that supplies *Trichoderma* to farmers in Bangladesh, and employs numerous women at her establishment.


Fall armyworm

"I have been able to prove that this sort of business is possible by a woman. Every woman has potential to do better."

-Rebaka Sultana, Producer of Trichoderma Fungus in Bangladesh

One of the constraints that often keeps rural communities from battling crop threats with sustainable solutions is limited communication, which the IPM Innovation Lab addresses in Nepal through a text messaging system that links farmers with crop experts. The text messages, written in the local language, contain information on how to tackle emerging pests and diseases, and the contacts of community business facilitators (CBFs) who help provide farmers with access to agricultural materials. In East Africa and Vietnam, efforts to foster information sharing continue with farmer groups created through WhatsApp. Farmers use the platform to document crop issues that extension personnel, also included in the group, can help identify or address. The group is also a space for farmers to receive information on upcoming trainings, new IPM products, and updated market data.

Breaking cycles of vulnerability with accessible solutions is a critical component of decreasing hunger and malnutrition. In Asia, where reducing pesticide use improves the export of high-value tropical fruits to foreign markets, the IPM Innovation Lab employs fruit bagging to cut down on chemicals and mitigate pests.

Wrapping mangos in paper bags in Bangladesh abates 100 percent of fruit flies, while in Vietnam, mango, dragon fruit, and longan bagging reduces chemical sprays up to 7 times and increases marketable fruit up to 30 percent. The program's technologies target crop issues based on farmers' specific needs, access, and abilities. In Cambodia, plastic barriers trap rats destroying rice crops, while in Niger, biological control of the millet headminer is better suited for increasing yields of the country's staple, drought-resistant grain.

WhatsApp groups help bridge information gaps between farmers and extension personnel.

The IPM Innovation Lab currently collaborates with 69 institutions including:

27 Universities

5 Nonprofits

20 Government Agencies

6 Non-governmental organizations (NGOs)

7 Private Companies

2 Value Chains

2 Innovation Labs

IPM Associate Awards

1995

$540,360 for controlling tomato virus in Mali

$600,000 for implementing IPM on olives in Albania

$310,821 for controlling Coffee Wilt in Uganda

1996

$190,000 for leading the CRSP initiative in West Africa

$922,078 for snowpea leaf miner control in Guatemala

$1,296,862 for pest/pesticide management in Ukraine

$300,000 for training in Eritrea

1997

$132,320 for Jamaica hot pepper gallmidge control

1998

$10,000 for control of cashew pests in Mozambique

2005

$374,251 for use of environmentally friendly biopesticides against the desert locust

2007

$20,684 for Pesticide Examination Report and Safe Use Action Plant (PERSUAP) for the Egypt Global Development Alliance Tomato Project

2008

$400,000 for Development and Promotion of IPM of mango pests in Senegal

$1,000,000 for the African Food Security Initiative

2010

$2,500,000 for building local capacity in IPM solutions in Mali

$57,593 for Pesticide Examination Report and Safe use Action Plan (PERSUAP): Hydroponic Sector Development in Lebanon (JSDL) Program Farmer-to-Farmer

$900,000 for Integrated Pest Management (IPM) Technologies implemented in Indonesia

2013

$11,066 from the Feed the Future Innovation Lab for Collaborative Research on Peanut Productivity & Mycotoxin Control Subaward under University of Georgia

$500,000 for IPM technology transfer for vegetable crops in Nepal

Buy-in for $191,904 for technology transfer in Bangladesh

2014

$207,017 subaward from the Feed the Future Innovation Lab for Collaborative Research on Sorghum and Millet under Kansas State University for biocontrol of the pearl millet head miner

2017

$50,000 from the Egypt Mission to prepare a risk assessment of the fall armyworm

Collaboration and Education

Providing innovative knowledge to farmers, scientists, and students can help catalyze in-country self-reliance. While the IPM Innovation Lab works predominately in specified Feed the Future countries, the team has conducted countless symposia, workshops, and trainings around the world.

The meetings aim for gender-inclusivity, to bring together stakeholders from various regions, and widen the net for information sharing. From 2013 to 2017, the IPM Innovation Lab conducted 20 awareness workshops on *Tuta absoluta* alone, bringing together participants from 50 different countries.

The program has been a part of and steered similar initiatives for emerging threats such as the devastating fall armyworm, boosting cross-border efforts to address major global issues.

Training on IPM methods and materials is also a major component of technology transfer. A local training on the Push-Pull system in 2018 garnered nearly 1,000 participants in East Africa, allowing farmers to bring back to their communities what they learned. Meanwhile, the program's facilitation of biological control training between just two individuals, one from Kenya and one from Niger, helped prompt regional technology transfer. Along with farmers, participants from the private sector also participate in IPM trainings, contributing to long-term goals of in-country linkages and self-sustainability.

Peter Malusi, a collaborator from the International Centre of Insect Physiology and Ecology (*icipe*), scouts for the fall armyworm in Niger.

Samir Regmi, for example, is an agribusiness owner in Nepal who learned about an emerging seed virus at an IPM training, and was able to swap his product out early for virus-free alternatives. The IPM Innovation Lab's collaboration with the private sector drives demand for locally-produced goods and services – biological control labs in India, Agricare in Nepal, Real IPM in Kenya, *Trichoderma* companies in Cambodia and Bangladesh and a netting company in Tanzania are among a few of the private companies in which the program collaborates.

The IPM Innovation Lab also works with U.S. institutions. The team collaborates with USAID, for example, to establish action plans for safer pesticide use in the developing world, and funding from the IPM Innovation Lab supports groundbreaking student work at both U.S. and international institutions. In the last five years, the program has facilitated training for students from the doctoral to the undergraduate level at five U.S. and 22 host country institutions, with student research areas ranging from the gendered components of IPM to the impacts of climate change on finger millet in Nepal.

"The IPM Innovation Lab has always supported me in my business promotion. Currently, my business is one of the renowned agrovets [agricultural supply store] in this region, especially for the supply of bio-pesticides, insect traps, lures, irrigation technologies and now for disease-resistant seeds."

-Samir Regmi, Agribusiness Owner Selling IPM Supplies in Nepal

A virus-infected plant

History of IPM Innovation Lab

1993 — IPM Collaborative Research Support Program (IPM CRSP) begins at Virginia Tech

1996 — Helps lift USDA/APHIS quarantine on snowpea from Guatemala to U.S.

1998 — Introduces natural enemies for control of sorghum and maize stem borer in Uganda; Identifies hot pepper gall midge in Jamaica; IPM adoption increases yield of hot pepper by 30 percent in Jamaica

1999 — IPM for potato produces $643 net benefit per hectare in Ecuador

2000 — Faba bean used as a trap crop for leafminer in snowpea fields of Guatemala

2002 — IPM for Andean potato weevil saves $87 per hectare in Ecuador; Tomato IPM results in $1,700 net benefit per hectare in the Philippines; Eggplant and tomato grafting for bacterial wilt implemented in Bangladesh and the Philippines

2003 — Early harvesting of olives in Albania reduces fruit fly incidence

2005 — The book *Globalizing Integrated Pest Management* is published

2008 — Host free period technique introduced to control tomato virus disease in Mali

2009 — Begins conducting *Trichoderma* workshops around the world

2010 — Natural enemies of papaya mealybug introduced to India; Cocopeat introduced for raising vegetable seedlings in India

2011 — Begins conducting plant virus disease workshops around the world

2012 — Grafting of desirable naranjilla plants resistant to soil-borne *Fusarium* wilt in Ecuador; The book *Arthropod Pests of Horticultural Crops in Tropical Asia* is published

2013 — Begins conducting *Tuta absoluta* awareness workshops around the world; Name is changed to Feed the Future Innovation Lab for Integrated Pest Management; Begins conducting *Tuta absoluta* management workshops around the world

2014 — Director awarded Scientific Excellence within a Feed the Future Innovation Lab for Collaborative Research by BIFAD

2015 — Awarded the International Plant Protection Award of Distinction by the International Association for the Plant Protection Sciences

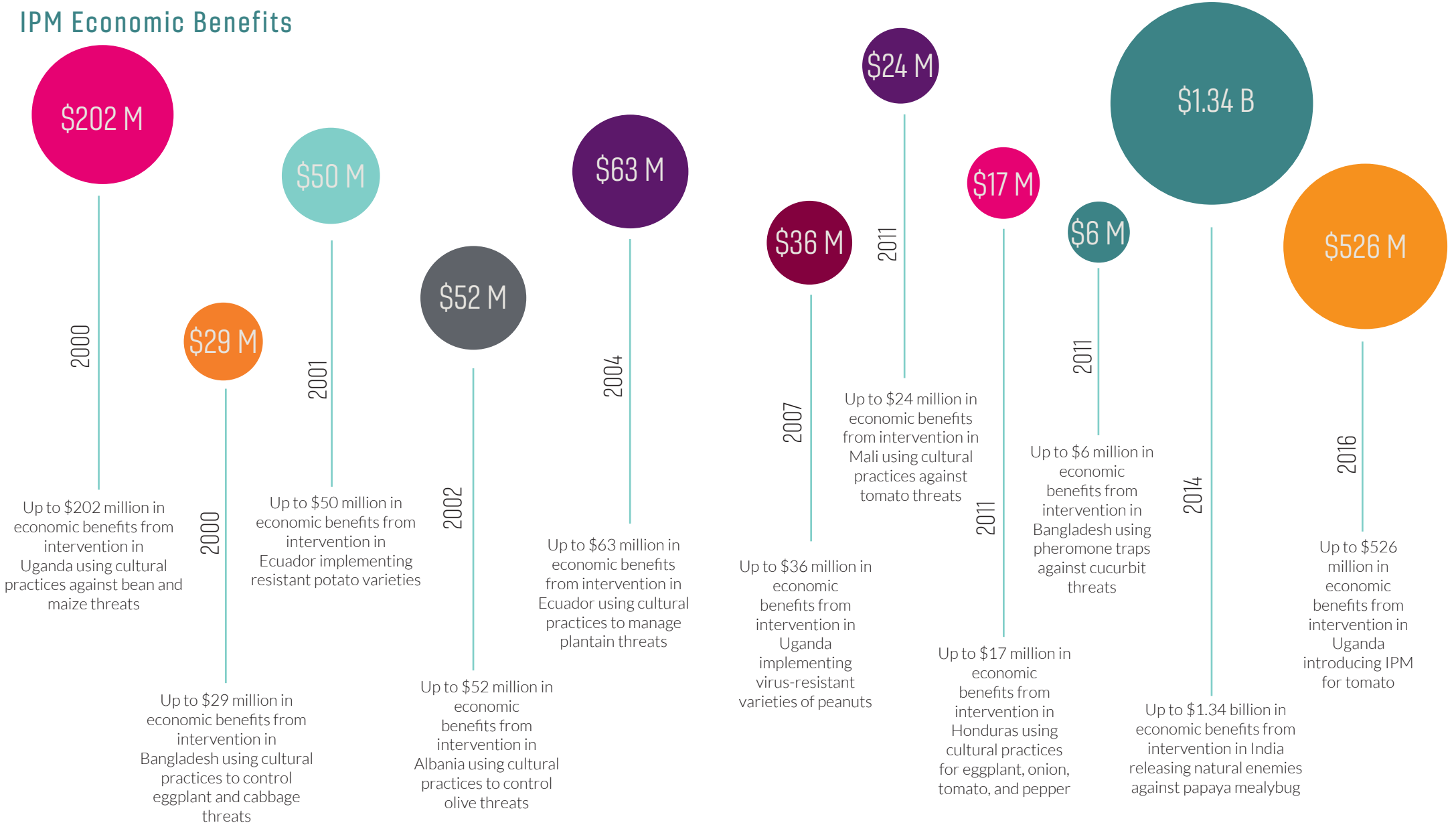
2016 — The book *Integrated Pest Management of Tropical Vegetable Crops* is published

2017 — Identifies the causative organism, the eriophyid mite, of longan witches' broom; Begins conducting fall armyworm management workshops around the world

2018 — Identifies natural enemies of fall armyworm in Africa

2019 — Helps secure permits for Uganda and Kenya to introduce two natural enemies against *Parthenium*

IPM Economic Benefits



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