FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Innovations for Addressing Food, Nutrition, Climate and Soil Security

Professor Jayashankar Telangana Agricultural University
Diamond Jubilee Celebration (1964 – 2024): Lecture
21 December 2024
Rajendranagar, Hyderabad, Telangana, India

P.V. Vara Prasad

University Distinguished Professor and R.O. Kruse Endowed Professor
Director, Climate Resilient Sustainable Intensification Innovation Lab
Director, Center for Crops, Climate, and Communities
Kansas State University
E-mail: vara@ksu.edu

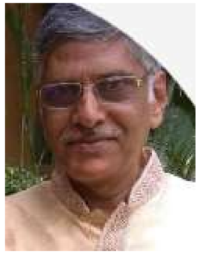
USAID FROM THE AMERICAN PEOPLE

KANSAS STATE UNIVERSITY

Honoring and Thanking: Family, Advisors, Teachers, and Friends.

Amma, Nanna, Akka; Lakshmi (wife), Abhinav (son), Ananya (daughter); and Bava Garu and Tanvi.






Advisors: Drs. V. Satyanarayana, M.V. Potdar, and S. Muralidhar
Teachers: Drs. P. C. Rao, V. Praveen Rao, and V. R.K. Murthy
and many other teachers/mentors who influenced me directly or indirectly.

In-laws.



Lifelong Friends: Sudhakar, Rakesh, Ravi, Vijaya, Shanti, Yashoda, Somagani, Anil, Bhargava, Jaggu, Puru, Sharma, Harinath, Vijayender, Bharat, Uma Reddy, Umakanth, Suresh(s), Bade, Puri, and others (87 BS Batch; and 91 MS Batch).

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Outline

- Partnership of Kansas State University and PJTAU (APAU, ANGRAU and PJTSAU)
- Global Challenges and Need for Innovations
- Status of Sustainable Development Goals (SDGs), Yield Gains, Hidden Costs of Agrifood Systems and Greenhouse Gas Emissions
- Systems Platform: Sustainable Agricultural Intensification (Goal and Components)
- Sustainable Intensification Innovation Lab – Overview and New Focus on Climate Resilience
- Selected 17 Innovations to Address Food, Nutrition and Climate
- Conclusions and Summary

USAID
FROM THE AMERICAN PEOPLE

KANSAS STATE UNIVERSITY

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Kansas State University (K-State)

First Operational Land Grant University
After the Morill Act was Signed
Founded (1863)

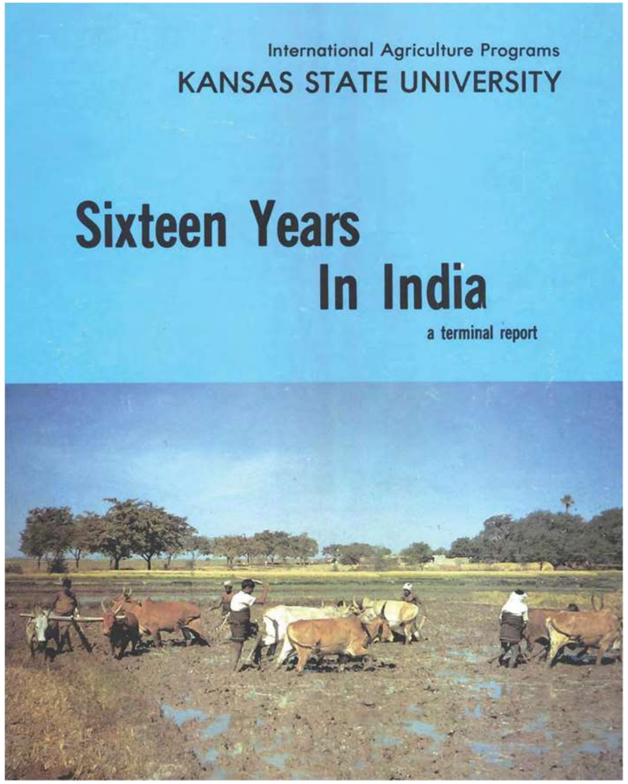
One of the Top College of Agriculture
in the United States
Ranked (6 in 2024)

USAID
FROM THE AMERICAN PEOPLE

KANSAS STATE
UNIVERSITY

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

K-State Established APAU in 1964



Campus Development Specialist, H. James Miller, reviews campus plans with Dr. Emil C. Fischer, Dean of Architecture and Design at KSU, and Chief of Party, Dr. A. D. Weber.

Andhra Pradesh Agricultural University

Changes in the Program

Clearly the change from assisting many institutions to concentrating on one called for a different approach. Two short-term consultants at Andhra Pradesh Agricultural University arrived in 1964. The first, H. James Miller, who reached Hyderabad August 15, was consultant in Campus Development and worked at Rajendranagar and other Indian locations for six months. The other, Gilbert R. Dodge, who had been administrative assistant with the KSU-AID Home Staff, was sent to Andhra Pradesh Agricultural University for two months as Consultant to the Comptroller.

Professor Miller found an immense task awaited him at APAU, since a whole new campus was to be built on a large tract of ground at Rajendranagar. He found the plans which had been rapidly prepared by the Public Works Department very inadequate. As a result of this evaluation, he found it necessary to convince university officials of the weaknesses in these plans by preparing a set of his own.

Mr. Dodge reviewed the budget and plans at Andhra Pradesh Agricultural University and assisted in preparing estimates of development needs of the University for the next seven years. Special effort was taken to determine the rupee needs to be supplied by AID during the period. Operations and business forms were reviewed and recommendations made before the Consultant to the Comptroller left Hyderabad.

USAID FROM THE AMERICAN PEOPLE

Work Started in 1955 and continued to establish land grant system in Andhra Pradesh and India.

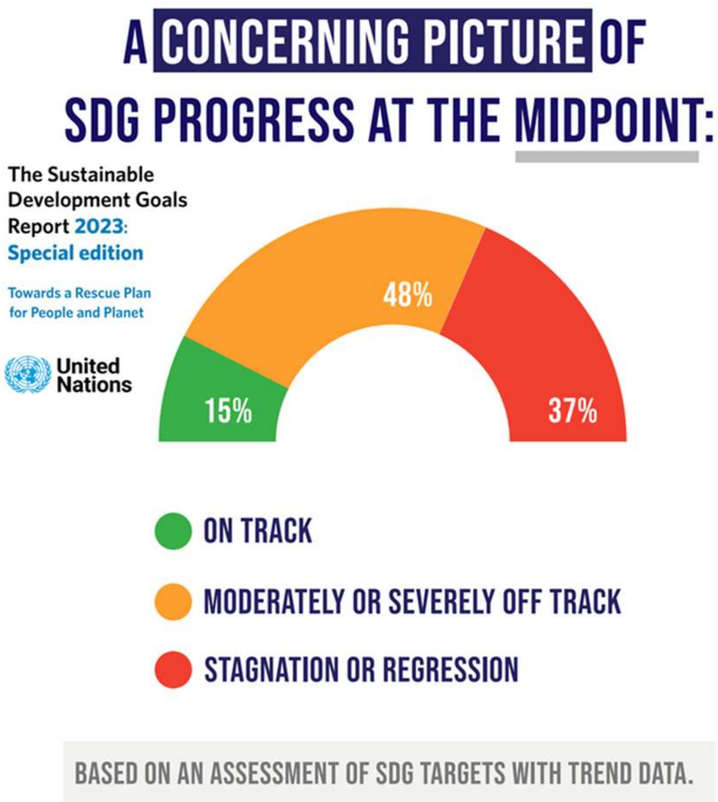
KANSAS STATE UNIVERSITY

Global Challenges Needs Innovative Solutions

- Food Security: About 828 million people do not have access to food.
- Nutrition Security: About 2 billion are malnourished (under and over).
- Climate Security: Earth has warmed by 1.2°C and lost biodiversity.
- Water Security: Prolonged droughts, limited water, and rapid flooding.
- Soil Security: Soils are rapidly degrading and soil health is being lost.
- Energy Security: High demand and need for renewable sources.
- Equity and Equality: Access to food, resources & knowledge is not equal.

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Sustainable Development Goals (SDGs)



SDGs (2015 to 2030): Midway (2023)

Limited Progress: Only 15% of them on track

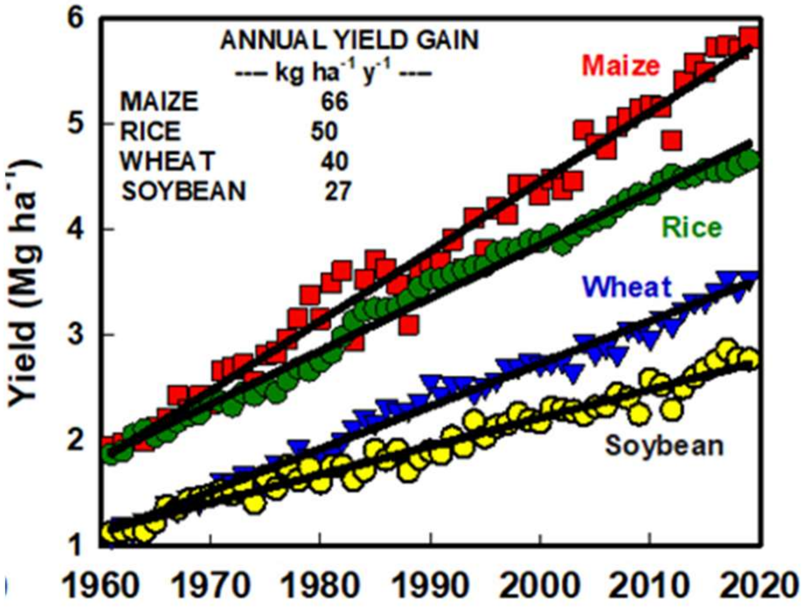
To address many of SDGs will require significant change in our approach; with focus on transdisciplinary innovations (**both** biophysical and social) and their largescale adoption.

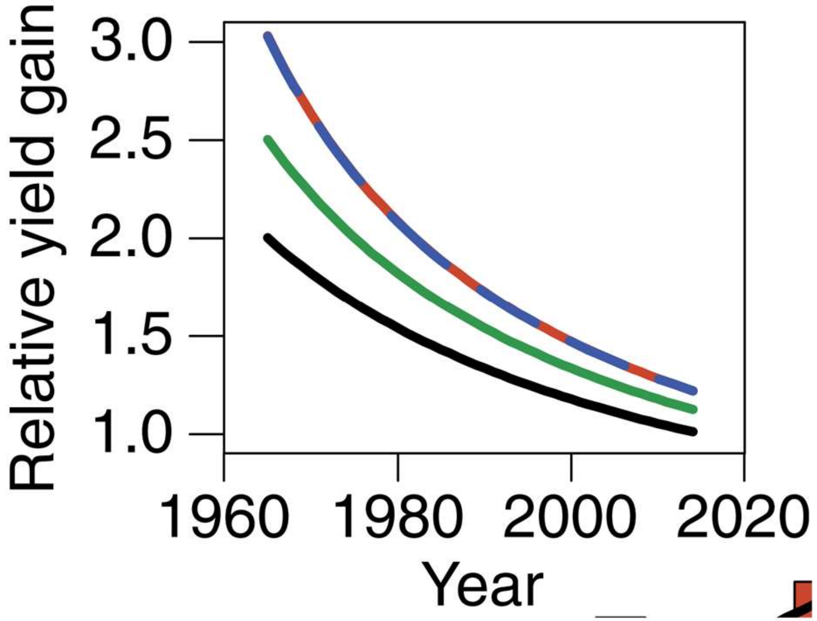
New investments are urgently needed.

USAID
FROM THE AMERICAN PEOPLE

KANSAS STATE UNIVERSITY

Relative Yield Gains: Continually Decreased over Decades





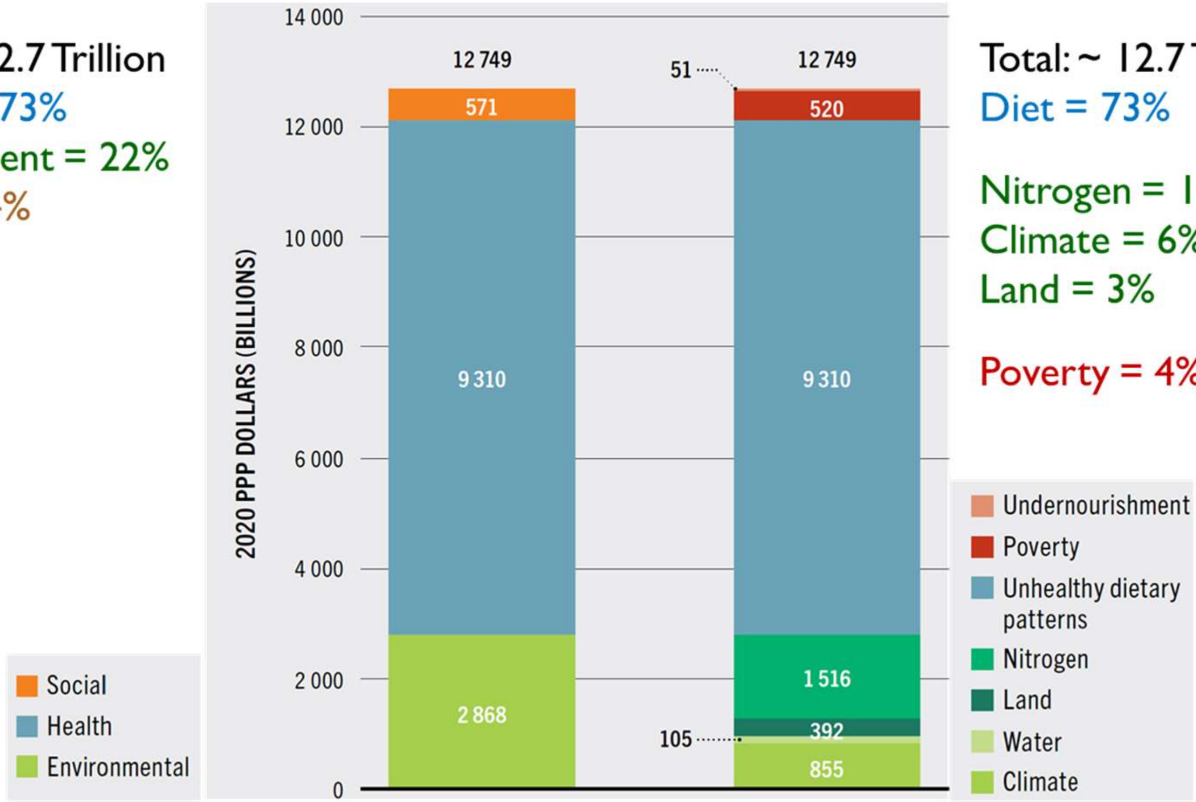
Cassman and Grassinni (2020). Nature Sustainability 3: 262-268

New innovations such as novel and rapid breeding, genomics, phenomics, modeling, and artificial intelligence tools provides opportunities to reverse this trend.

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Global Agrifood Systems: Hidden Costs

Total: ~ 12.7 Trillion
Health = 73%
Environment = 22%
Social = 4%



SOURCE: Adapted from Lord, S. 2023. *Hidden costs of agrifood systems and recent trends from 2016 to 2023 – Background paper for The State of Food and Agriculture 2023.* FAO Agricultural Development Economics Technical Study, No. 31. Rome, FAO.

Total: ~ 12.7 Trillion
Diet = 73%

Nitrogen = 11%
Climate = 6%
Land = 3%

Poverty = 4%

Health is primarily through diet and nutrition; environment is through nitrogen, climate, land and water use; and social being poverty.

Innovations and technologies should be focused on enhanced nutrition, health, increase inputs and resource use efficiencies.

This will require transdisciplinary research and solutions.

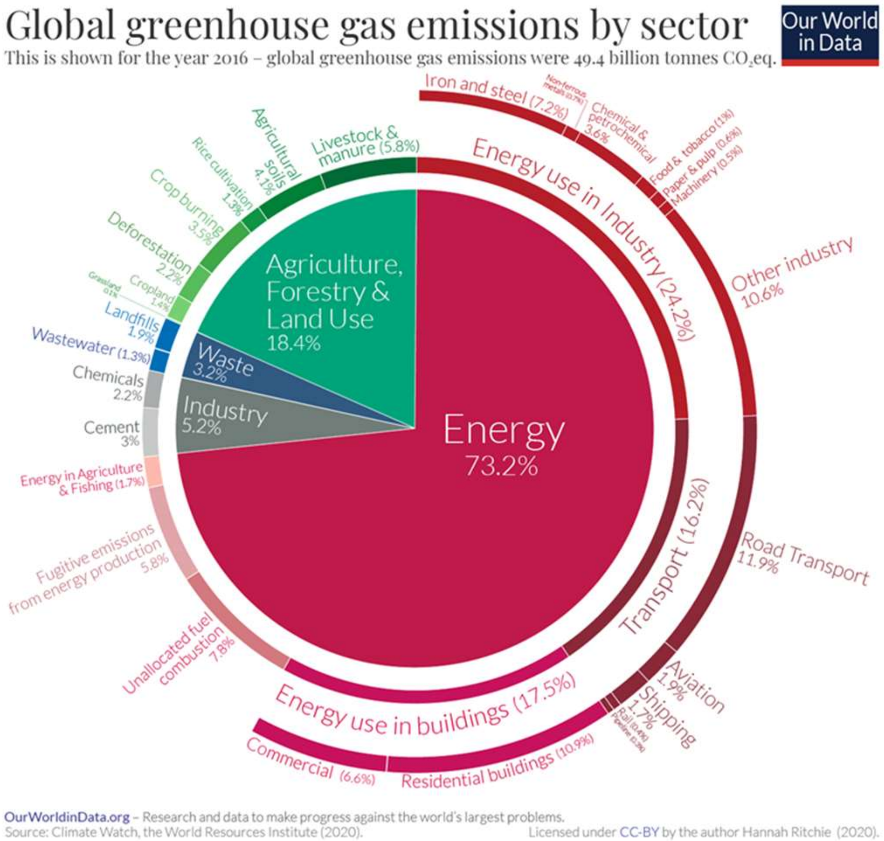
USAID FROM THE AMERICAN PEOPLE

Indirect cost is large ($12.7 Trillion) mostly on health.

KANSAS STATE UNIVERSITY

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Global Agrifood Systems: Greenhouse Gas Emissions



Although in its current form global agrifood systems are contributor to greenhouse gas emissions (GHGs: 18.4%), but using principles of:

Climate Adaptation, Mitigation and Resilience

and

Sustainable Agricultural Intensification (SAI);

combined with use of novel technologies agrifood systems can be "**Net Negative in GHGs**" i.e., sequestering (terrestrial and soil) more than it produces.

USAID
FROM THE AMERICAN PEOPLE

Agriculture can become net negative in GHGs.

KANSAS STATE UNIVERSITY

Systems Approach: Sustainable Intensification

Socio-Economic Intensification

- Developing markets
- Building social capital
- Creating sustainable livelihood
- Understanding barriers
- Enabling environment
- Institutional Building

- Income generation
- Private sector engagement
- Education

Agro-Ecological Intensification

- Farming systems (crops, livestock)
- Improved soil & water management
- Integrated nutrient management
- Diversified systems
- Efficient ag. practices & input use
- Integrated pest management

- Mechanization
- Precision agriculture
- Microbiome

Genetic Intensification

- Higher yield
- Resistance to pest and diseases
- Tolerance to climate change
- Improving nutrition
- Medicinal value
- Precision breeding
- Genomics/molecular methods

- Geospatial Tools
- Artificial Intelligence
- Nanotechnology

Genotype x Environment x Management x Social Interactions

Education; Youth; Gender; Scaling; Data Science; and Communication

Goal: provide access to safe, nutritious, and healthy food at all times to all people from existing farmland and without damaging natural resources and ecosystem health.

These components help us address the global challenges of food, nutrition, climate, soil security, inequalities and access to resources.

Systems approach and framework to address many global challenges.

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Sustainable Intensification Innovation Lab: Overview

https://www.ksu.edu/siil/

USAID
FROM THE AMERICAN PEOPLE

Global Multi-Country & Regional Partnerships

Collaborative Research on Sustainable Intensification

KANSAS STATE UNIVERSITY

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

SIIL – Overview
[$75 Million Initiative]
2014 to 2024

9 - FtF Countries and IL Portal (2021 to 2026)

10 - Guatemala (2024 to 2028) – G-SCAT

Global Partnership:

>130 scientists from **>120 organizations** (NARES; Univ.; Private Sect.) including about **20 US** universities and **9 CGIAR** centers; and **>300 students.**

Across 14 Countries

West Africa (Senegal, Niger and Burkina Faso): Crop-Livestock Interactions (Dual Purpose Crops – Millet, Sorghum, Cowpea)

East Africa: Cereal Legume Systems and Commercial Home Vegetable Gardens

Asia (Bangladesh and Cambodia): Rice – Fallow/Cover Crops, Home Gardens (Horticultural Crops) and Perennial Gardens.

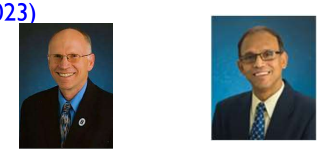
Lead: Anchor Quisqueya Univ. + 5 Others) (2021 to 2026)

Lead: CORAF (Secretariate – Senegal) (2020 to 2024)

Lead: Royal University of Agriculture (Cambodia) (2016 to 2026)

Lead: International Fertilizer Development Center; and KSU

Lead: Univ. Illinois – Urbana-Champaign (2015 to 2023)



Lead: Univ. California – Davis (2014 to 2019)
Lead: Kansas State Univ. (2020 to 2024)

Lead: Rutgers University (Ended: 2022)

https://www.ksu.edu/siil/

USAID FROM THE AMERICAN PEOPLE

Multi-Disciplinary and Global Partnerships

Feed the Future Innovation Lab — Collaborative Research on Sustainable Intensification

KANSAS STATE UNIVERSITY

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Climate Resilient Sustainable Intensification Innovation Lab

✓New Feed the Future **Climate Resilient** Sustainable Intensification Innovation Lab (CRSIIL) Funded by USAID (United States Agency for International Development).

✓$ 50 Million over 5 years (**2024 to 2029**) and has broad portfolio with emphasis on farming systems.

✓Focused in Eight Countries: Cambodia, Bangladesh, Ethiopia, Tanzania, Senegal, Ghana, Guatemala and Honduras.

✓The Goal of CRSIIL is to empower people and institutions with knowledge and innovations that positively impact agricultural productivity, environment, and natural resources.

✓ Five Key Areas:

1. Climate Adaptation, Mitigation and Resilience;
2. Improved Use of Resources and Input Use Efficiency;
3. Soil Fertility Management and Soil Health;
4. Ecological Intensification and Nature-Positive Solutions;
5. Circular Bio-economy and Use of Renewables
6. Digital Agriculture and Decision Tools

https://www.ksu.edu/crsiil/

USAID FROM THE AMERICAN PEOPLE

Multi-Disciplinary and Global Partnerships

KANSAS STATE UNIVERSITY

Selected Innovations to Address Food, Nutrition, Climate and Soil Security

Seventeen Diverse Examples Around the World
[Highlighting Importance and Future Need]

Disclaimer: Some examples are from literature (sources identified and acknowledged)

Innovation: 1. Speed Breeding Technologies

Global

Traditional plant breeding is limited by long time to grow each generation of crop.

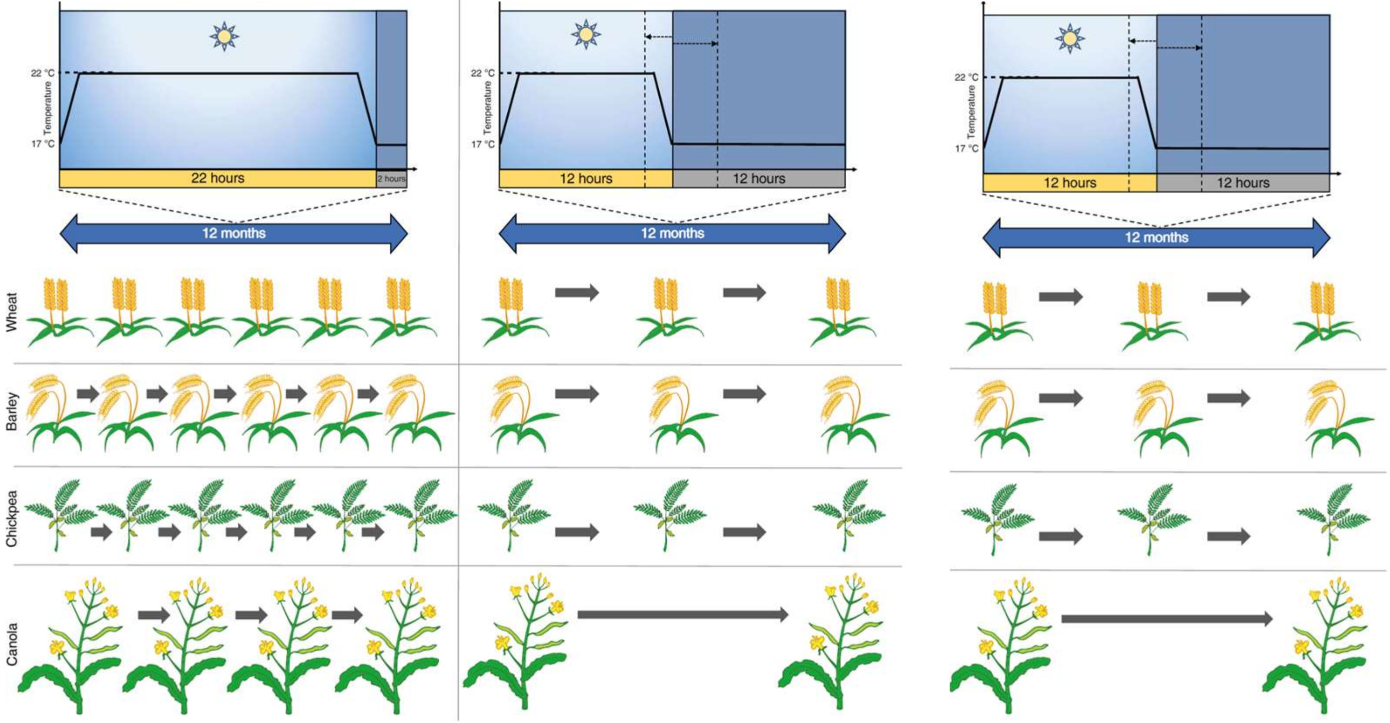
Shuttle breeding or use of greenhouses can help shorten some time.

Speed breeding significantly shortens this time by manipulating photoperiod and temperatures.

Speed Breeding: Growth Rooms
6 Generations (2- 3 Years)

Traditional Breeding: Greenhouses
2 to 3 Generations (6 – 8 Years)

Traditional Breeding: Natural Felds
1 to 2 Generations (8 to 12 Years)



Watson et al. (2018). Nature Plants 4: 23-29 (Figure Modified to add Natural Fields)

Other Innovations: Double Haploids, Tissue Culture Techniques and Transformation Tools.

USAID FROM THE AMERICAN PEOPLE

KANSAS STATE UNIVERSITY

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Innovation: 2. Express Edit Technology

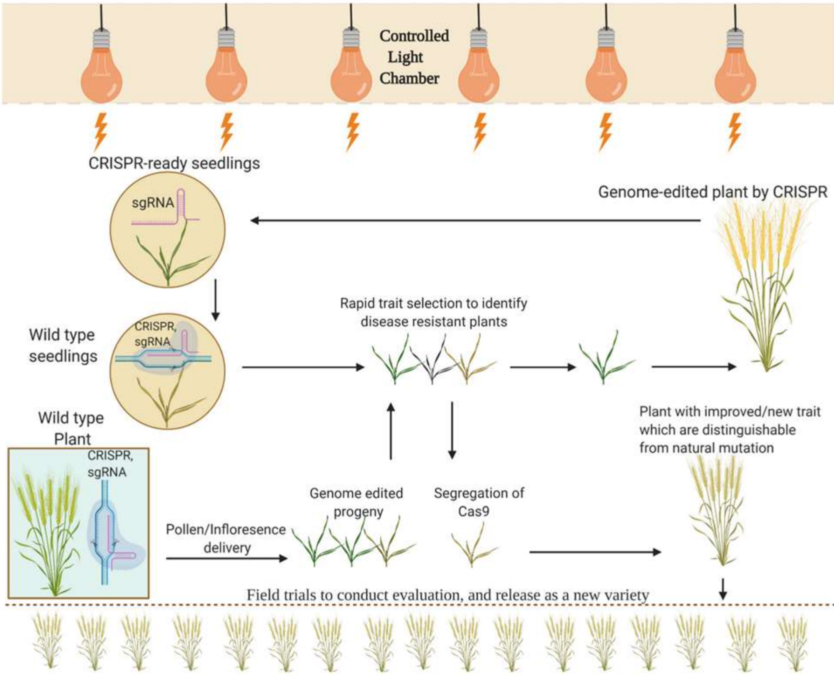
Global Combining genome editing tools (e.g. CRISPR-Cas9, CRISPR-Cpf1 and others) with speed breeding can further make the process efficient and fast by rapid selection and isolation.

Speed breeding coupled with genome editing tools (GETs), which is called the ExpressEdit approach, can further shorten the generation time and make it faster.

To save time, Cas9 gene and sgRNA sequences can be applied directly to plants without regenerating the plants in labs. During the rapid trait selection (screening), segregated progenies are screened and isolated for the new trait and identify the plants that do not contain Cas9 but have new traits.

Alternatively, CRISPR-ready plants may contain Cas9 and can be subjected for the further cycles of gene editing.

Haroon et al. (2022). Plants 11: 1052



These innovations can be combined with rapid phenotyping and predictive modeling gene stacking for multiple traits.

USAID FROM THE AMERICAN PEOPLE

KANSAS STATE UNIVERSITY

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Innovation: 3. Crops for Targeted Farming Systems

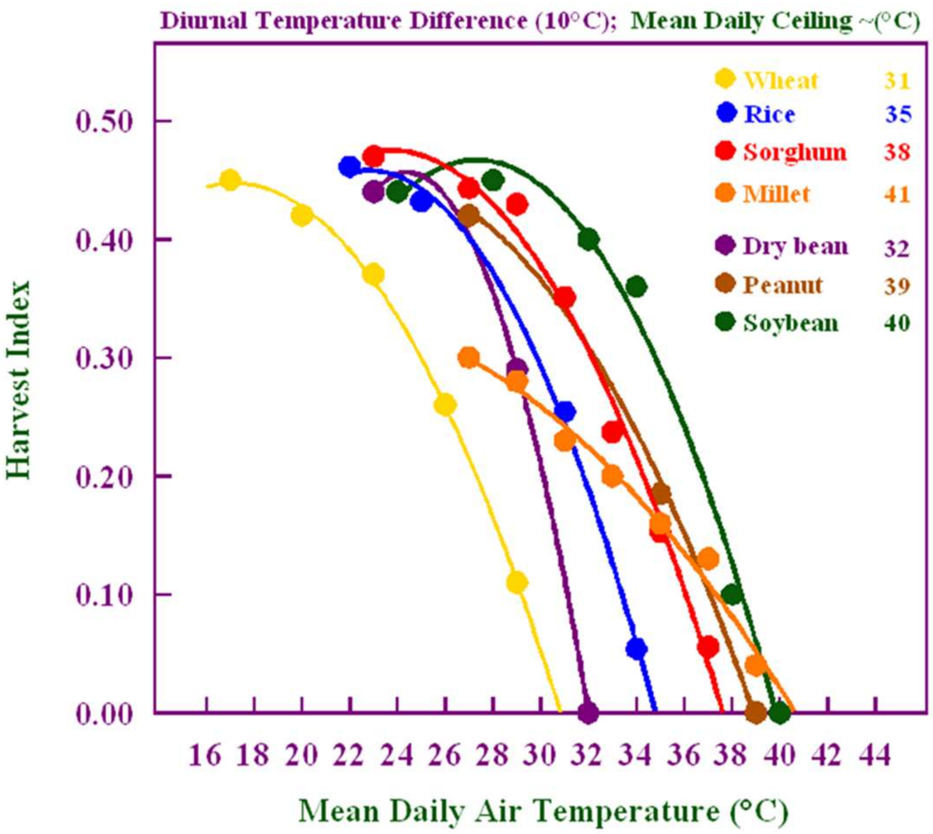
Global

Different crop species have different cardinal temperatures (minimum, optimum and ceiling temperatures) for growth, development and yield.

Crops should be matched with the environment (based on temperature, photoperiod, rainfall and water resources) and targeted for farming systems (there are over 72 farming around the world).

Prasad et al. (2017). Field Crops Research 200: 114-121

Bean: Prasad et al., 2002. Global Change Biol. 8: 710-721.
Rice: Snyder, 2000. M.Sc Thesis, University of Florida.
Peanut: Prasad et al., 2003. Global Change Biol. 9: 1775-1787.
Soybean: Pan, 1996; Thomas, 2001. PhD Thesis, Univ. Florida.
Sorghum: Prasad et al., 2006. Agric. For. Meterol. 139: 237-251.
Millet: Djanaguiraman et al., 2018. Plant Cell Environ. 41: 993-1007
Wheat: Prasad and Djanaguiraman 2014. Fun. Plant Biol. 41: 1261-1269.



We must grow suitable crops, grasses, livestock and other species based on the identified farming systems.

USAID FROM THE AMERICAN PEOPLE

KANSAS STATE UNIVERSITY

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Innovation: 4. Climate Resilient and Nutritious Crops

Global

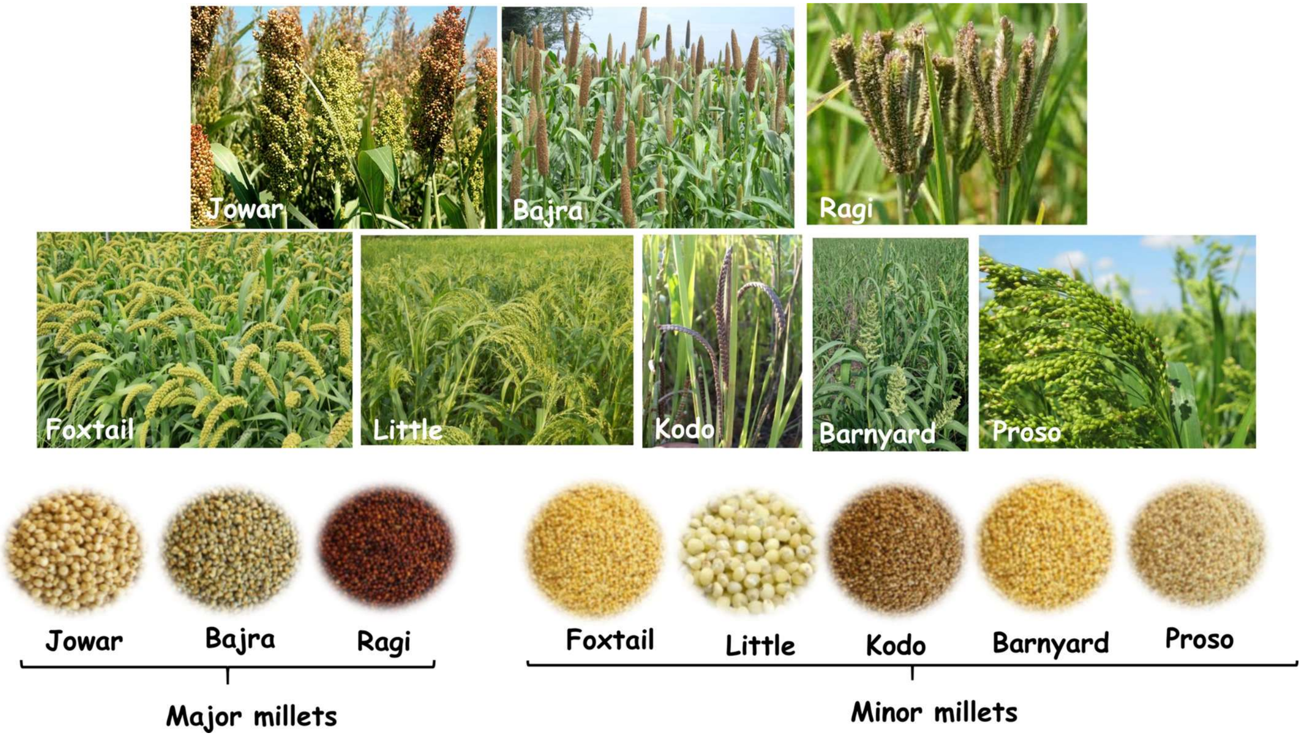
The World of Millets

(over 17 crop species)

Large genetic diversity within each crop.

Millets are key for food, nutrition, climate, water and soil security.

Yields are low and there is a need for improved technologies to increase yields, processing and value-added products.



Others: Browntop millet; Adlay millet; Guinea millet; Polish millet; Japanese millet; Taiwan oil millet; Fonio millet; Sonoram millet;

INTERNATIONAL YEAR OF MILLETS 2023

USAID FROM THE AMERICAN PEOPLE

There is a need for targeted focus on market opportunities (both domestic and international), policies and support price.

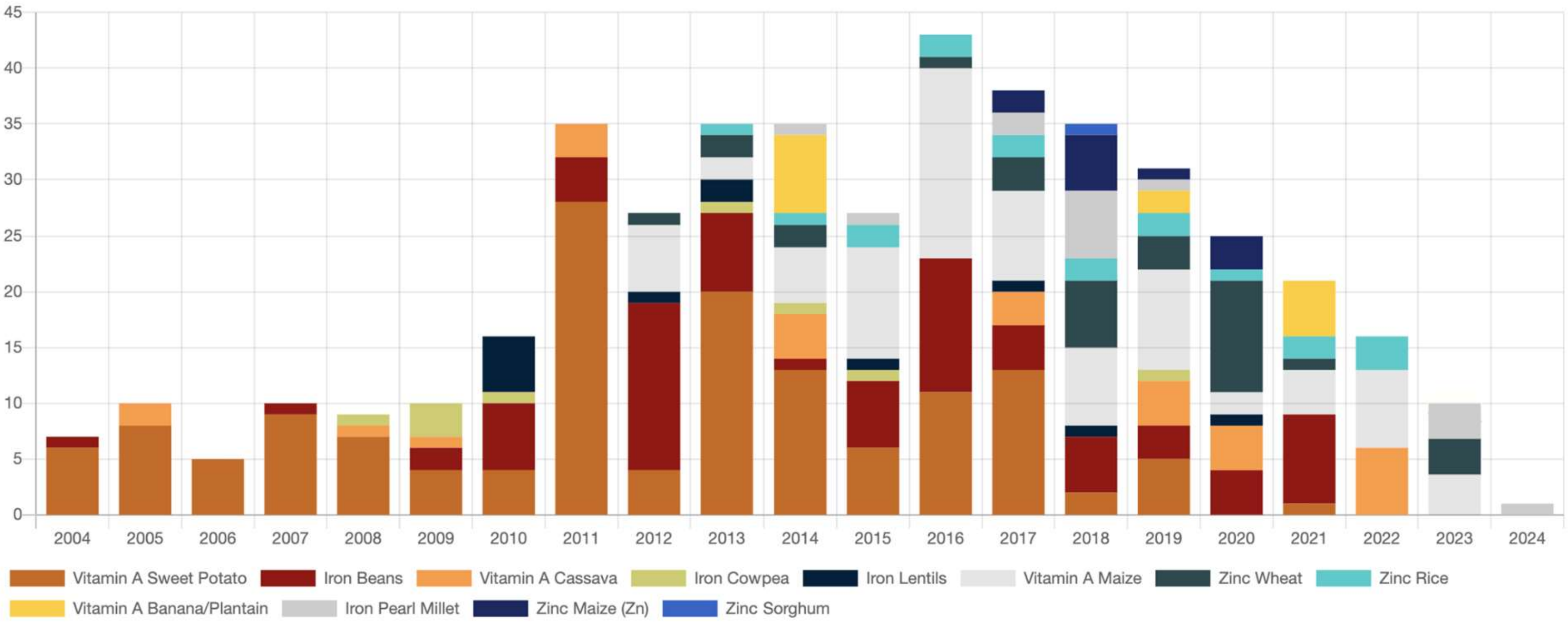
KANSAS STATE UNIVERSITY

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Innovation: 5. Biofortified Crops and Varieties

Global

HarvestPlus **Varieties released to date by year and crop**



High Iron (Fe):
- Beans; Cowpea; Lentils; Pearl Millet

High Zinc (Zn):
- Wheat; Rice; Maize; Sorghum

High Vitamin A:
- Sweet Potato; Cassava; Maize; Banana/Plantain

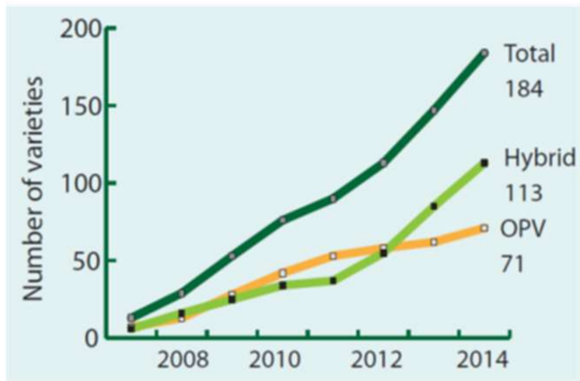
Focus should be on quantifying bioavailability, health outcomes; and suitable agronomy and climates.

USAID
FROM THE AMERICAN PEOPLE

KANSAS STATE UNIVERSITY

Innovation: 6. Stress Tolerant Varieties

- DTMA (Drought Tolerant Maize for Africa until 2014) and later STMA (Stress Tolerant Maize for Africa until 2020) program implemented in 13 countries in Africa, which account for 72% of all maize grown.
- DTMA produced 184 distinct varieties (mostly hybrids).
- These produced ~ 50% more grain yield than open pollinated varieties (on-farm).
- Doubled yields under drought or stress conditions.
- No penalty under normal conditions.



BILL & MELINDA GATES foundation USAID FROM THE AMERICAN PEOPLE IITA Research to Nourish Africa CIMMYT International Maize and Wheat Improvement Center

USAID FROM THE AMERICAN PEOPLE

Emphasis should be on timely availability of quality seeds to all farmers at appropriate pricing.

KANSAS STATE UNIVERSITY

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Innovation: 7. Doubled-Up Legume Systems
(Maize / Sorghum / Millet + Pigeonpea + Beans / Groundnut / Cowpea)

Tanzania, Malawi, Uganda and Global

- Increases efficiency of nutrient/fertilizer use
- Improves yield of protein-rich grains
- Decreases labor requirement
- Improves diet diversity and nutrition.

Cereals and legume combinations + Pigeonpea
Maize and Common Bean (erect or climbing)
Sorghum and Groundnut (erect or runners)
Pearl Millet and Cowpea (erect or bushy)

MICHIGAN STATE UNIVERSITY

Sieg Snapp
Jerry Glover

Africa RISING

Genotypes suitable under these configurations must be evaluated and grown with appropriate agronomy.

USAID FROM THE AMERICAN PEOPLE

KANSAS STATE UNIVERSITY

Innovation: 8. Dual Purpose Crops

Senegal, Burkina Faso and Global

Dual Purpose (Grain for Humans and Biomass for Livestock) – Sorghum, Pearl Millet and Cowpea

ILRI
INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

INERA

ISRA

Higher Yielding; and High Zn and Fe in Grain & Biomass

Higher Livestock Productivity (Meat and Milk Gains)

Augustine Ayantunde, ILRI;
Aliou Faye, ISRA; and
Doohong Min, KSU
Augustine Obour, KSU

USAID
FROM THE AMERICAN PEOPLE

There is a need for improved agronomy, understanding bioavailability and nutritional and health outcomes.

KANSAS STATE
UNIVERSITY

Innovation: 9. Agroforestry Systems (Annuals and Perennials)

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Senegal and Sub-Saharan Africa

Richard Dick

Feed the Future Innovation Lab for Peanut

Feed the Future Innovation Lab for Legume Systems

West Africa: *Faidarbia albida* Trees
(Reverse Phenology; Hydraulic Lift;
Green Manure and Animal Manures)

Native Shrubs – Cropping Systems:
Guiera senegalensis; Piliostigma reticulatum
(Green Manures; Microbial Diversity and Hydraulic Lift)

Need to quantify carbon sequestration, greenhouse gas emissions and resource use for carbon credits.

USAID FROM THE AMERICAN PEOPLE

KANSAS STATE UNIVERSITY

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Innovation: 10. Perennial Grain Crops – Rice, Wheatgrass (e.g., Kernza ®)and Sorghum

China and Global

THE LAND INSTITUTE

Perennial grains, legumes and oilseed varieties represent a paradigm shift in modern agriculture and hold great potential for truly sustainable production systems.

Perennial Wheat

Perennial wheat work at The Land Institute focuses on hybrids made from crossing annual wheat species – especially durum wheat used for making pasta – with wheatgrass species including intermediate wheatgrass (the same species being domesticated as Kernza®).

Perennial Sorghum

Sorghum is a tropical grass originally domesticated as a crop in sub-Saharan Africa. Like annual sorghum, the perennial hybrids maintain good seed yield, but seed size and flavor require further breeding attention. Land Institute perennial hybrids are being trialed in several sub-Saharan African countries to determine if they can persist through dry seasons.

Perennial Rice

Perennial rice is a grain developed in Yunnan, China, through a collaborative agreement with The Land Institute. Since 2008, the institute has provided funding and scientific support to scientist Fengyi Hu, dean of agriculture at Yunnan University in China. The perennial rice developed there was released to farmers for commercial production in 2018, with significant progress shown in the journal Nature Sustainability in 2022.

Perennial rice named by Science as one of the 2022 top 10 scientific breakthroughs (December 16, 2022)

The cultivation of perennial rice has been named by *Science* as one of the top 10 scientific developments of 2022, becoming the only Chinese project to be featured in the leading journal's annual listing.

USAID FROM THE AMERICAN PEOPLE

Need to understanding farmers perceptions and provide necessary knowledge to overcome barriers.

KANSAS STATE UNIVERSITY

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Innovation: 11. Conservation Agricultural Practices with Solar Powered Drip or Micro-Irrigation Systems with Sensors

Ethiopia, Cambodia and Global

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

IWMI
International Water Management Institute

TEXAS A&M UNIVERSITY

Feed the Future Small Scale Irrigation Innovation Lab

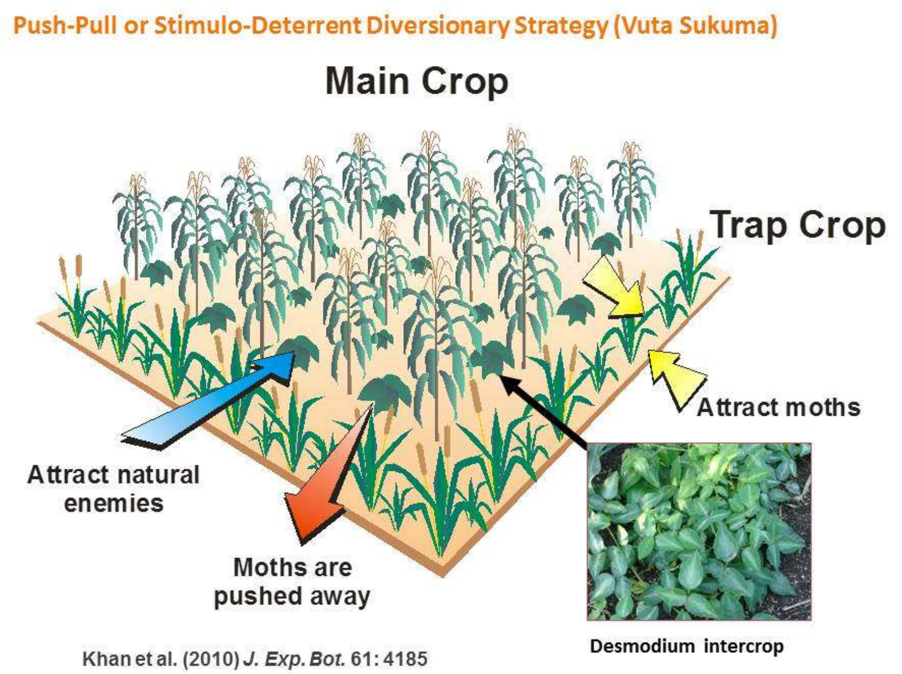
USAID
FROM THE AMERICAN PEOPLE

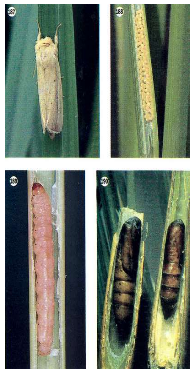
Carbon credits from conservation practices (no-tillage, continuous soil cover and rotations) must be incentivized.

KANSAS STATE UNIVERSITY

Innovation: 12. Integrated Pest Management - Push/Pull

Africa and Global





Desmodium intercrop with maize [(legume – volatiles – repels (Push)]

Napier grass or *Brachiaria* sp. borders [volatiles attracts moths of stem borer (Pull)]

icipe INTERNATIONAL CENTRE OF INSECT PHYSIOLOGY AND ECOLOGY

USAID FROM THE AMERICAN PEOPLE

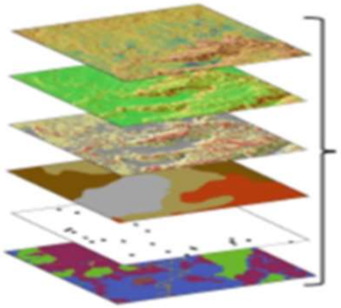
New such plant species should be identified and evaluated to be used as push-pull principles for pest management.

KANSAS STATE UNIVERSITY

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Innovation: 13. Digital Tools for Site Specific Management

Global



TOP-DOWN INFORMATION (GIS Based)

GIS/Map Based information

- Soil, Climate, Vegetation, Et al.

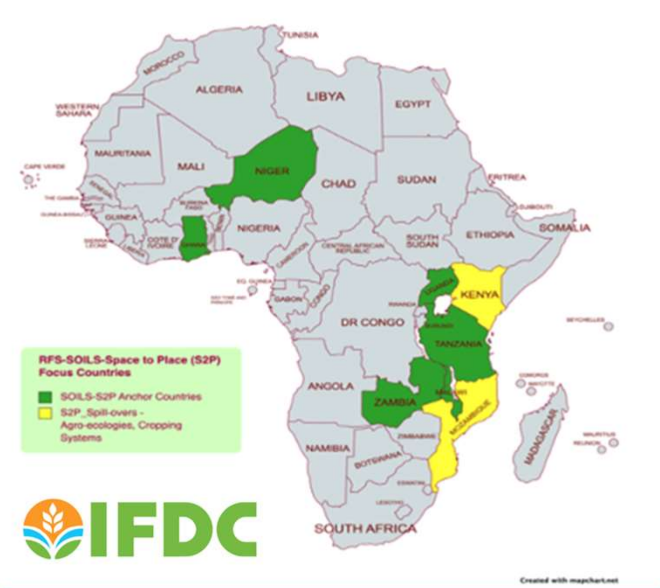
ISRIC
World Soil Information

GOAL: Practical, profitable, scale-appropriate soil and land use management technologies and recommendations for improved efficiency

BOTTOM-UP INFORMATION (User Sourced)

On-site information

- Soil texture, Soil PH, Slope, Plant cover, Past management, Et al.



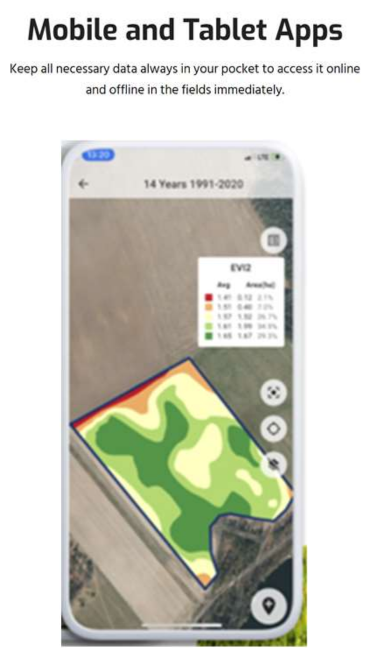
Anchor Countries of Operation: Ghana, Niger, Malawi, Tanzania, Zambia with spillovers in Kenya, Uganda, Mozambique farming systems

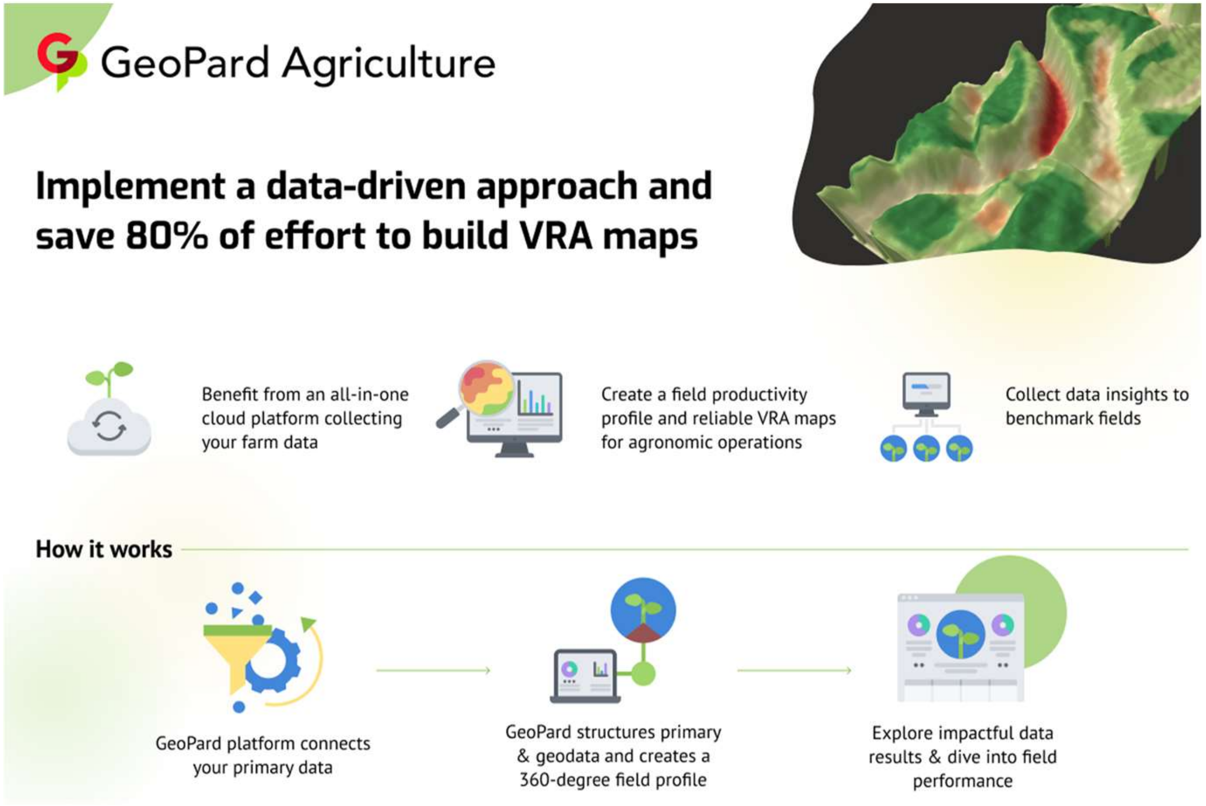
USAID
FROM THE AMERICAN PEOPLE

Space to Place framework for fertilizer/nutrient management to enhance input efficiency.

KANSAS STATE UNIVERSITY

Innovation: 14. Digital Zone Maps & Variable Rate Applications

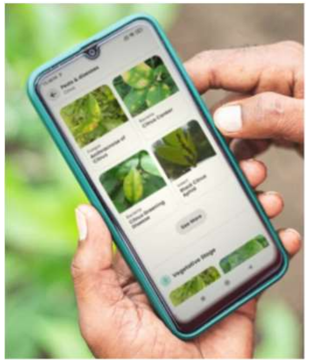




GeoPard Agriculture (German Based) is a cloud-based powerhouse for Precision Ag data analysis, creation of zonal maps and smart management of all inputs.

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Innovation: 15. Digital & AI for Pest/Disease Monitoring/Mgt.



plantix

Disease alerts and preventive measures

Your Crop Doctor
(100 M images; 700 diseases; 60 crops, 30 M downloads; 10 M annual users in 20 languages)

Progressive Environmental & Agricultural Technologies (PEAT), a German start-up company has developed Plantix, a multi-lingual plant disease and pest diagnostic App.

As the most downloaded ag-tech app worldwide, Plantix answered more than 100 million crop-related questions from farmers.

1.7 sec

Get your crop diagnosed in 1.7 sec.

82

You'll be able to detect 82 different kinds of crops!

608

Find the right treatment for more than 608 diseases.

90%

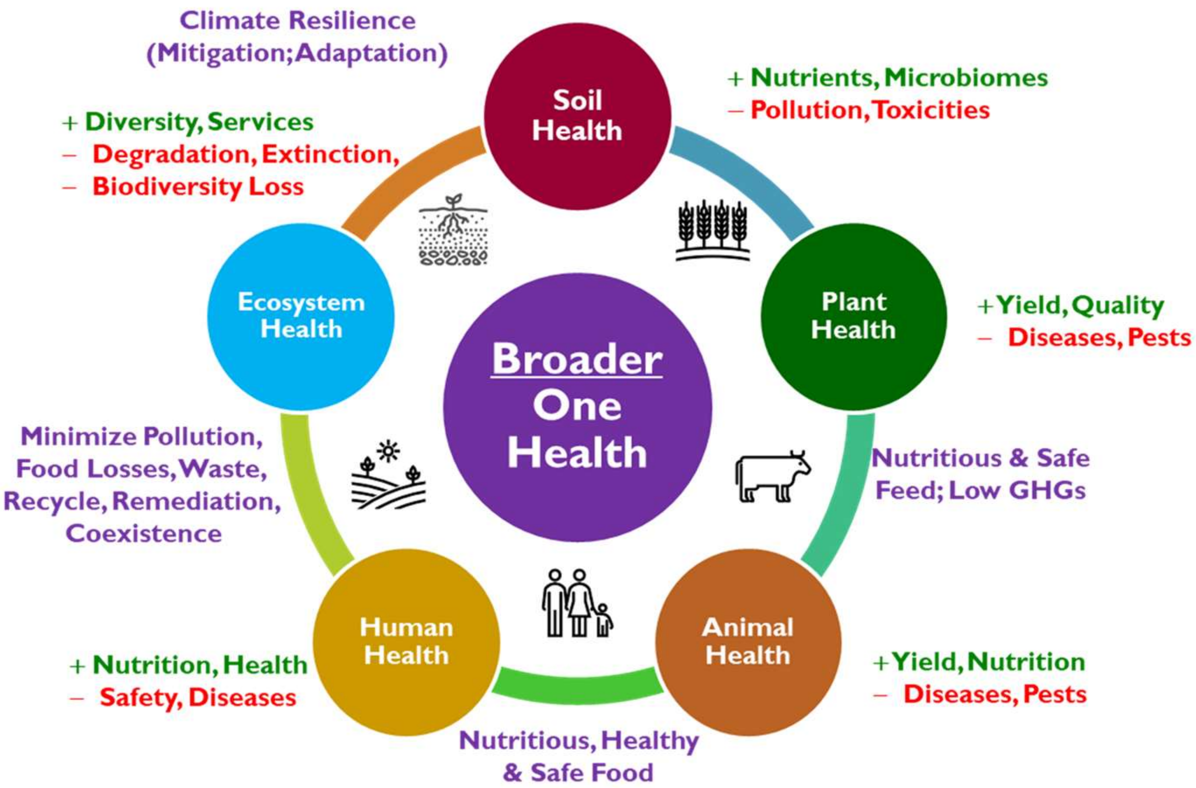
Farmers report an improvement in their farming of 90%.

USAID FROM THE AMERICAN PEOPLE

Disease and pest diagnostic based on images and use of AI tools for monitoring, protecting and managing.

KANSAS STATE UNIVERSITY

Innovation: 16. Microbiome, Microbials and Biomolecules



Exploring Microbiome and Use of Microbes

- Improved Plant Health (e.g., Biotic, Abiotic)
- Sensing & Signaling of Stresses (e.g., Drought, Heat, Salinity)
- Resource Use and Efficiency (e.g. Nutrient, Water)

This will require transdisciplinary research and systems thinking among all partners.

Innovation: 17. Nanotechnology – Stress and Precision Delivery

Stress Management and Precision Delivery (Nutrients, Pesticides and Biomolecules).

- Stress Sensing
- Stress Tolerance
- Stress Protection
- Precision Delivery

- Improved Plant Health and Stress Management (e.g., Biotic, Abiotic Stresses)
- Sensing and Signaling of Multiple Stresses (e.g., Drought, Heat, Salinity)
- Monitoring (e.g., Pests, Climate, Weather, Resources, Markets)
- Resource Use and Efficiency (e.g. Nutrient, Water)
- Precision Delivery and Targeting of Inputs

This will require transdisciplinary research and systems thinking among all partners.

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Cross Cutting Social Innovations: Traditional to Novel

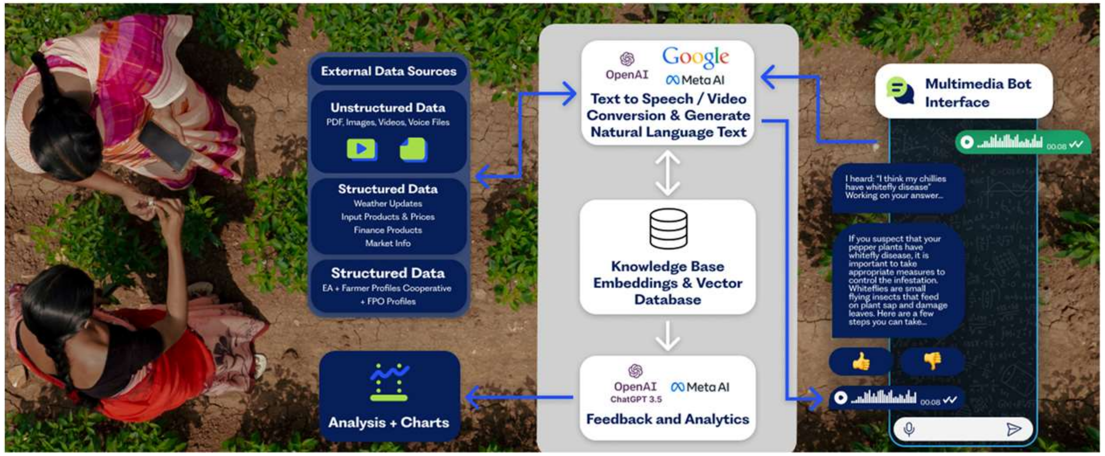
Public Private Partnerships; Entrepreneurship; and Policies

- Farmers Field Schools
- Women Self Help Groups
- Knowledge Sharing Platforms
- Targeted Communications

Digital Green

Farmer.CHAT

An AI Assistant created by Digital Green to make vetted farmer knowledge accessible.



USAID
FROM THE AMERICAN PEOPLE

This will require seamless dataflow and exchange of knowledge between multiple partners.

KANSAS STATE
UNIVERSITY

Conclusions / Summary

- Agrifood systems are complex and have many challenges.
- Solutions requires systems approaches and out-of-the box thinking.
- Our innovations and technologies should be productive, profitable, resilient, resource-smart, nutrition-smart and climate-smart.
- Focus should on producing more nutritious, safe and healthy food from existing farmland and with additional emphasis on rebuilding natural resources and climate resilience (Climate Resilient Sustainable Agricultural Intensification).
- There are many available innovations (as shown) – focus should on scaling.
- Transdisciplinary and convergence of biophysical and social sciences and effective partnership between public and private sector is key to success for developing, adopting and scaling new technologies to improve food, nutrition, climate and soil security.

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Climate Resilient Sustainable Intensification Innovation Lab

Team and Key Contacts

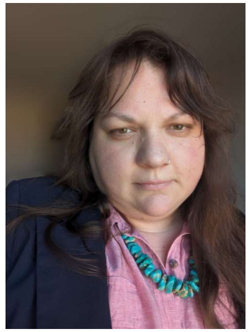
P.V. Vara Prasad
vara@ksu.edu

Beth Guertal
guertea@ksu.edu

Ignacio Ciampitti
ciampitti@ksu.edu

Jan Middendorf
jmiddend@ksu.edu

Araya Berhe
aberhe@ksu.edu



Emma Flemmig
flemmig@ksu.edu

https://www.ksu.edu/siil/

https://www.ksu.edu/crsiil/

Layne Davis
laynewilson@ksu.edu

Jessica Means
jess522@ksu.edu

Kinzey Cott
kinzeyc@ksu.edu

USAID
FROM THE AMERICAN PEOPLE

KANSAS STATE UNIVERSITY

Thank You: PJTAU and All Current and Future Students and All Alumni

"Sarve Jana Sukhino Bhavanthu"
"May All Be Happy and Prosperous"

"Anna Datta Sukhibhava"
"Farmers who Provide us Food be Prosperous"

Jai Javaan and Jai Kisaan

FEED THE FUTURE

The U.S. Government's Global Hunger & Food Security Initiative

www.feedthefuture.gov

USAID FROM THE AMERICAN PEOPLE

KANSAS STATE UNIVERSITY