FOOD SECURITY & AGRICULTURE CORE COURSE
WELCOME

As you meet your fellow participants, please begin by sharing:

• Name
• Years with USAID
• Mission location
• What do you hope to learn from this course?
U.S. GOVERNMENT PARTNERS
<table>
<thead>
<tr>
<th>MONDAY</th>
<th>TUESDAY</th>
<th>WEDNESDAY</th>
<th>THURSDAY</th>
<th>FRIDAY</th>
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</thead>
<tbody>
<tr>
<td>Welcome</td>
<td>8:30</td>
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</tr>
<tr>
<td>Introduction to Course, GFSS</td>
<td>Resilience</td>
<td>Policy, Governance and Standards</td>
<td>Research and Development</td>
<td>Data and Analysis</td>
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<tr>
<td>Break</td>
<td>10:30</td>
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<tr>
<td>Case Studies</td>
<td>Resilience</td>
<td>Policy, Governance and Standards</td>
<td>Scaling</td>
<td>Monitoring and Evaluation</td>
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<td>Lunch</td>
<td>12:15</td>
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<tr>
<td>Agriculture Innovation Systems</td>
<td>Nutrition</td>
<td>Sustainable Intensification</td>
<td>Market Systems and Value Chains</td>
<td>Case Study Application</td>
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<tr>
<td>Break</td>
<td>2:30</td>
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<tr>
<td>Sustainable Agriculture Productivity Growth Introduction</td>
<td>Nutrition</td>
<td>Sustainable Intensification</td>
<td>Financing and Investing in Agribusiness</td>
<td>Reflection</td>
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<td>Reflection</td>
<td>Reflection</td>
<td>Exchange – Digital Tools</td>
<td>Reflection</td>
<td>Wrap-up</td>
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<td>Evaluations</td>
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COURSE OBJECTIVES

• Apply state-of-the-art evidence to technical areas in the Global Food Security Strategy (GFSS) intermediate results (IR) through a theory of change (ToC)
  o Understand and adapt cutting-edge thinking on nutrition sensitive agriculture
  o Apply cross-cutting IRs (gender, climate, governance, nutrition, etc.) to the three GFSS Objectives to improve results

• Examine agriculture as main driver of economic growth, nutrition and food security

• Investigate resilience strategies that apply to small and mid-size farmers

• Develop and maximize linkages for improved program impact on reducing poverty and stunting (between agriculture, gender, youth, nutrition, health, climate, food safety, etc.)
MEET THE EXPERTS
INTRODUCTION & GLOBAL FOOD SECURITY STRATEGY

Food Security and Agriculture Core Course

Photo: Morgana Wingard
WHY AGRICULTURE?

Rob Bertram
USAID | BFS Chief Scientist
AGRI-FOOD SYSTEMS TRANSFORMATIONS & FOOD SECURITY
TAKEAWAYS

• The vision of agricultural transformation is in the eye of the beholder
  – “Transformation” takes complex forms
  – And affects many systems

• There are multiple drivers and measures of transformation
  – Including policy levers as drivers
  – And different drivers affect different systems differently

• Why can’t we get there the old fashioned way—driven by on-farm technical change?
  – On-farm technical change is still a key component
  – But not sufficient to catalyze
  – Increasing importance of value chains and market systems
WHAT ARE WE TRANSFORMING?

From subsistence agriculture to something with higher incomes, more and better food …

But to what, and how?
TRANSFORMING RURAL COMMUNITIES
PLANNED “GREEN” URBAN COMMUNITIES IN RURAL AREAS
TRANSFORMING RURAL SOCIAL SYSTEMS

WHEN MEN ARE OPPRESSED, IT'S A TRAGEDY.
WHEN WOMEN ARE OPPRESSED, IT'S TRADITION.

Letty Cottin Pogrebin
TRANSFORMING NUTRITION?
NOT ALL BOWLS ARE EQUAL

Photo: Morgana Wingard
TRANSFORMING EMPLOYMENT SYSTEMS
AND MANY MORE TRANSFORMATIONS

- Behavioral systems
- Migration patterns and system
- Rural market systems
- Rural food systems employment
- Rural service employment
- Non-commodity rural economies
THERE ARE MULTIPLE DRIVERS, POLICY LEVERS AND INDICATORS
**Brazil**
- World’s 3rd largest agricultural exporter and 8th largest economy
- 1992/94 – 2012/14 Food production up 125%
- Poverty: 3.7% (2014)
- Stunting: 7.1% (2007)
- Underweight: 2.2% (2007)

**Niger**
- Reclaimed 5,000,000 ha, 1/3 of arable land
- Food production up 158%, 1992/94 – 2012/14
- Poverty: 35.7 ppt (1994–2014)
- Stunting: 11.2 ppt (2000–2014)
- Underweight: 5.7 ppt (2000–2014)

Which country has an exemplary transformation that can be a model for your Feed the Future country?

- 2017 resurgence of deforestation
- 7% of global agricultural GHG emissions

- Ranks last on UNDP’s 2015 Human Development Index
TAKEAWAYS

• “Transformation” takes complex forms
  - And affects many systems

• There are multiple drivers and measures of transformation
  - Including policy levers as drivers
  - And different drivers affect different systems differently
  - The “optimal” transformation and policy drivers are very country- and context-dependent
HOW DO WE GET THERE?
TRENDS AND OPPORTUNITIES

• Green Revolution pattern:
  - Via research and technology driven increases in farm productivity
    (e.g., research to develop semi-dwarf rice)
  - Accompanied by manufacturing-led urban jobs growth
  - Capturing urban agglomeration economies

• But today’s transformations will be different
TODAY’S TRANSFORMATIONS WILL BE DIFFERENT

- Declining terms of agricultural trade
- Demographics
- De-industrialization
- Global climate change
- Lengthening food supply chains & dietary change
DIFFERENCE: DECLINING AGRICULTURAL TERMS OF TRADE

Inflation-adjusted corn, wheat, and soybean prices, 1912-2014

Index, 1940 = 100

DIFFERENCE: DEMOGRAPHICS

Nigeria 2015 and 2050
DIFFERENCE: DEINDUSTRIALIZATION

2015 Chinese cell phone manufacturing technology reduces work force by up to 90%
DIFFERENCE: LENGTHENING FOOD SUPPLY CHAINS

- Food is becoming more purchased: about 50% of food by value in rural Africa to 70% in Asia
- Food is becoming more perishable: 50%–70% of dietary costs; meats, dairy, fruit & vegetables
- Food is becoming more processed: >50%
Unprocessed non-perishable
High processed non-perishable
Low processed perishable
Low processed non-perishable
Unprocessed perishable
High processed perishable

Source: Author calculations from LSMS data sets
Average Number of Days/Week a Food Item Is Consumed by Household Income Group.

DIFFERENCE: WHERE VALUE IS CREATED

- Africa: Farm value is 40% of retail food cost
- South Africa: Wheat 13%–18% of retail bread cost
- Yet, debate on Ag Research is 90% on-farm
DIFFERENCE: IMPORTANCE OF SECONDARY, TERTIARY CITIES

• 60% of urban pop. in 2nd, 3rd cities
• Critical points in rural-rural, rural-urban, and urban-rural food flows
• Employment and growth centers
• Sustainable escape from rural poverty
THEN WHAT PATH TO TAKE?

• On-farm productivity
• Value chain productivity
• Rural job creation (food and non-food)
• Rural preparation for migration to city
• Development of rural towns and small cities
• Develop food market systems plus a broader set of rural goods and market services to support urban and rural growth
TAKEAWAYS

• “Transformation” takes complex forms
• And affects many systems
• There are multiple drivers and measures of transformation
  - Including policy levers as drivers
  - And different drivers affect different systems differently
• We can’t get there the old fashioned way, but we can get there
  - Better on-farm/off-farm balance
  - Market systems
BACKGROUND

• July 2016 enactment of the Global Food Security Act (GFSA) of 2016
• Passed with broad bipartisan majority
• Institutionalized the Feed the Future approach to improving food security and nutrition
• Required a whole-of-government, five-year Global Food Security Strategy (GFSS)
GLOBAL FOOD SECURITY STRATEGY

- Strategy developed over 10 weeks by 11 Feed the Future agencies and departments
  - External consultations held with key non-governmental and private sector stakeholders
  - Reflects learning and analysis over the past year through internal reflection and learning processes, the Feed the Future Global Performance Evaluation, roundtables on emerging issues, and other evaluations

- Strategy covers FY 2017–FY 2021
  - Includes implementation plans for individual agencies and departments outlining each agency’s financial, technical, and in-kind contributions to the strategy for FY17
  - Builds on Feed the Future experience and reflects changes in global context since initiative started
New Results Framework 2017–2021

Goal: Sustainably reduce global hunger, malnutrition, and poverty

**Objective 1**  
Inclusive and sustainable agricultural-led economic growth

**Objective 2**  
Strengthened resilience among people and systems

**Objective 3**  
A well-nourished population, especially among women and children

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**Cross-Cutting Intermediate Results (IR)**

<table>
<thead>
<tr>
<th>IR 1</th>
<th>IR 2</th>
<th>IR 3</th>
<th>IR 4</th>
<th>IR 5</th>
<th>IR 6</th>
<th>IR 7</th>
<th>IR 8</th>
<th>IR 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strengthened inclusive agriculture systems that are productive and profitable</td>
<td>Strengthened and expanded access to markets and trade</td>
<td>Increased employment and entrepreneurship</td>
<td>Increased sustainable productivity, particularly through climate-smart approaches</td>
<td>Improved proactive risk reduction, mitigation, and management</td>
<td>Improved adaptation to and recovery from shocks and stresses</td>
<td>Increased consumption of nutritious and safe diets</td>
<td>Increased use of direct nutrition interventions and services</td>
<td>More hygienic household and community environments</td>
</tr>
</tbody>
</table>

**Effective response to emergency food security needs**

**Complementary Results**  
Long-term food security efforts benefit from and contribute to complementary work streams that promote:

- Economic growth in complementary sectors
- Healthy ecosystems and biodiversity
- Stable, democratic societies that respect human rights and the rule of law
- A reduced burden of disease
- Well-educated populations
New Results Framework 2017–2021

Illustrative Activity Outcomes: Building Blocks to Achieve Our Goals

Objective 1
- Increased sustainable productivity of all types of small-scale producers (also Obj 2)
- Stronger inclusive market systems (also Obj 2)
- Increased access to business development and financial services (also Obj 2)
- Improved infrastructure, including digital and other ICT solutions (also Obj 2)
- More efficient land, water, and input use
- Technology and innovations developed through research and adapted to local conditions
- Increased access to and wide adoption of inputs, and other technology and innovation
- Expanded access to knowledge through agricultural extension
- Increased access to market infrastructure, such as improved storage systems and basic retail marketing structures
- Reduced time and cost of moving goods across borders
- Improved quality of produce that meets market standards

Objective 2
- Increased use of risk management services and practices
- Improved safety nets (also Obj 1.3)
- Improved social capital (also Obj 1.3)
- Diversified livelihood risk (also Obj 1)
- Expanded livelihood opportunities (also Obj 1)
- Application of risk reduction tools such as improved water management and drought/flood tolerant seeds (also Obj 1)
- Increased household and community assets, including savings
- Improved access to communal natural resources
- Improved use of early warning information
- Increased access to hazard, index, and other insurance
- Increased adoption of climate-smart practices (also Obj 1)

Objective 3
- Improved access to diverse and nutritious foods
- Increased demand for diverse and nutritious foods
- Improved access to nutrition services
- Increased demand for health services
- Improved infant and young child feeding practices and women’s diets
- Increased commercial production of safe and nutritious food products, including fortified food (also Obj 1)
- Increased availability of evidence-based food information for consumers (also Obj 1)
- Improved food safety systems (also Obj 1)
- Improved safe handling practices (also Obj 1)
- Improved access to clean water
- Improved access to sanitation
- Schoolchildren nourished through school feeding programs (also Obj 2)
- Improved access to handwashing facilities

Cross-Cutting Intermediate Results

CC IR 1 Strengthened global commitment to investing in food security
- Increased public and private investment in food security
- Strengthened bilateral and regional investment platforms

CC IR 2 Improved climate risk, land, marine, and other natural resource management
- Improved land and soil management
- Improved sustainable management of wild fisheries
- Improved and sustainable utilization of ecosystem services

CC IR 3 Increased gender equality and female empowerment
- Increased women’s leadership skills and opportunities
- Increased women’s decision-making power
- Strengthened women’s access to financial services

CC IR 4 Increased youth empowerment and livelihoods
- Improved youth entrepreneurial skills
- Improved access to nutrition services for adolescent girls

CC IR 5 More effective governance, policy, and institutions
- Natural resource governance, including land and marine tenure
- Improved evidence-based policies
- Improved institutional architecture
- Improved mutual accountability systems
- Well-functioning sanitary and phytosanitary systems
- Strengthened regional harmonization

CC IR 6 Improved human, organizational, and system performance
- Improved research, policy, regulatory, education, finance, data, and extension systems
- Improved skills for producers, scientists, civil society, private sector, and government actors
- Promotion of science, technology, and innovation
STRATEGY’S GOAL AND OBJECTIVES

- The strategy is heavily built around an updated results framework
- The goal is to sustainably reduce global hunger, malnutrition and poverty
  - Consistent with current Feed the Future goal plus elevation of malnutrition into the goal statement in alignment with SDG 2 and the GFSA
- Three mutually reinforcing and interdependent objectives to achieve this goal, two of which are similar to current Feed the Future results framework:
  - Inclusive ag-led economic growth
  - A well nourished population
  - Resilience (elevated as a third objective)
WHAT’S NEW

• **Elevation of malnutrition** into the goal statement
• **Elevation of resilience** as a third objective next to agriculture and nutrition
• **Doubling down on holistic nutrition approach**, including WASH
• **Taking a systems approach** that prioritizes facilitation and works throughout value chains and supporting systems (e.g., policy)
WHAT’S NEW

• **Breaking down silos** across sectors and between development and humanitarian assistance

• Recognizing **different pathways out of poverty** and strengthening **rural/urban linkages**

• **Natural Resource Management approaches** with more attention to fisheries

• Dedicated intermediate result on **youth**

• **Finance, investment and financial inclusion**
CONTINUING AREAS OF FOCUS

- **Focus on high impact interventions**: Prioritization of evidence-based interventions that will deliver impact at scale
- **Gender and female empowerment**: Dedicated intermediate result, which commits us to measuring progress against it
- **Country-led and local ownership**: At the heart of our approach for sustainability
- **Policy and governance**: Dedicated intermediate result; land tenure mentioned multiple times in the GFSA
CONTINUING AREAS OF FOCUS

- **Capacity building**: Improved human, organizational and system performance is a new intermediate result
- **Partnerships** with governments, the private sector, civil society, research and university community
- Harnessing the **power of research, science, technology and innovation**
WHOLE-OF-GOVERNMENT APPROACH

- Identifies initial mechanisms for coordination at headquarters (DC) and at a regional and country-level
- Maintains USAID’s leadership role to coordinate the initiative
- Commits to joint reporting, monitoring, evaluation, and learning
STRATEGY ROLL-OUT & NEXT STEPS

- Country selection process and graduation criteria
- Monitoring, evaluation and learning plan (e.g., indicator selection, target-setting, baselines, etc.)
- Guidance for country and regional strategies
- Stakeholder collaboration platforms
- Whole-of-government coordination platforms and country-level interagency teams
TWO BY FOUR

• All moves must be made in pairs; a pair is you and anyone standing next to you
• When a pair moves out of the middle of the group, the empty spot they leave must be filled by another pair
• Pairs may not pivot or turn around
• There should be no gaps in the solution
DEBRIEF
CASE STUDIES

Food Security and Agriculture Core Course

Photo: Kelley Lynch
OBJECTIVES

• Apply key concepts and components of the 5R Framework in the context of a real-world case study

• Analyze information and interpret data to identify challenges, gaps and assumptions

• Apply critical thinking in formulating analytical questions to clarify research and data collection needs, proposing evidence-based solutions and exercising judgement

• Work collaboratively, drawing in outside resources for integrated programs that achieve targeted outcomes
CASE STUDIES
5 Rs ACTIVITY

Results
Resources
Rules
Relationships
Roles

You have 10 minutes!
CASE STUDIES
CAPACITY DEVELOPMENT FOR AGRICULTURE INNOVATION SYSTEMS
AGRICULTURAL INNOVATION SYSTEM

- **Science and Technology Policy**

- **Political System**

- **Research and Education**
  - Agricultural Research (public, private, civil society)
  - Education (primary, secondary, tertiary, vocational)

- **Bridging Institutions**
  - Shareholder Platforms
  - Agricultural Extensions (public, private, civil society)
  - Contractual Arrangements

- **Business and Enterprise**
  - Agricultural Value Chain Actors & Organizations (agribusiness, consumers, agricultural producers)

- **Enabling Environment**
  - Innovation policies & investments, agricultural policies
  - Informal Institutions, practices, behaviors, mindsets & attitudes

- **Science Actors**

- **Technology from Other Sectors**
WHAT IS CAPACITY DEVELOPMENT FOR AGRICULTURAL INNOVATION SYSTEMS?

The process whereby individuals or organizations generate and bring existing or new technologies, practices, and forms of organization into social and economic use to increase effectiveness, competitiveness, resilience to shocks and/or environmental sustainability, thereby contributing to food and nutritional security, economic development and sustainable natural resource management.
EVOLUTION OF APPROACHES TO INNOVATION IN AGRICULTURE

- **1960s**: Transfer of Technology
- **1970s**: Farming Systems Research
- **1990s**: Agricultural Knowledge & Information Systems (AKIS)
- **2000s**: Agricultural Innovation Systems (AIS)
FROM AKIS

TO AIS
WHAT DOES INNOVATION LOOK LIKE?
ACTIVITY: MAP THE AIS ACTORS

See participant’s manual page _____
THREE LEVELS OF CAPACITY DEVELOPMENT FOR AGRICULTURAL INNOVATION SYSTEMS

1. Individual
   • Technical
   • Functional

2. Organizations
   • Collective capability
   • Relationships within/among

3. Enabling Environment
   • Institutional dimensions of the social & legal norms and rules that underlie economic & social activity
INDIVIDUAL FUNCTIONAL CAPACITIES

- Capacity to Navigate Complexity
- Capacity to Collaborate
- Capacity to Reflect and Learn
- Capacity to Engage in Strategic and Political Processes

Capacity to Adapt and Respond in order to Realize the Potential of Innovation
ORGANIZATIONAL CAPACITY

Domains of Performance

- Achieving Results
- Meeting Standards
- Delivering Services
- Enhancing Reach
- Mobilizing Resources
- Increasing Social Capital
- Engaging Stakeholders
- Learning

Adapted from PACT
WHY CAPACITY DEVELOPMENT FOR AGRICULTURAL INNOVATION SYSTEMS?

Reflects GFSS principles and approach:

- Local capacity development for country ownership
- Sustainability through a systems approach
- Emphasis on partnerships and interactions among actors
- Based on science, technology and innovation
AGRICULTURAL INNOVATION SYSTEM

Research and Education
- Agricultural Research (public, private, civil society)
- Education (primary, secondary, tertiary, vocational)

Bridging Institutions
- Shareholder Platforms
- Agricultural Extensions (public, private, civil society)
- Contractual Arrangements

Business and Enterprise
- Agricultural Value Chain Actors & Organizations (agribusiness, consumers, agricultural producers)

Enabling Environment
- Innovation policies & investments, agricultural policies
- Informal Institutions, practices, behaviors, mindsets & attitudes

Science and Technology Policy

Political System
SUSTAINABLE AGRICULTURE PRODUCTIVITY GROWTH

Food Security and Agriculture Core Course

Photo: Neil Thoma
WHAT DO WE NEED FOR SUSTAINABLE AGRICULTURE PRODUCTIVITY?

Photo: Fintrac
DEFINITION OF SUSTAINABLE AGRICULTURAL PRODUCTIVITY GROWTH

Sustainably increasing the value of agricultural outputs relative to inputs by increasing efficiencies throughout the food system.

Determinants of productivity gains include:

• yields (on-farm production per unit area or animal)
• production (quantity of harvest or livestock or fish off-take available for consumption or sale)
• production value
• input costs (e.g., labor, land, seeds, mechanization, animal health and other services)
• resource-use efficiency (water, fertilizer, fuel)
• market efficiency
• postharvest loss reductions
• value addition
OBJECTIVES

• **Define Sustainable Agricultural Productivity Growth:** Sustainable Agricultural Productivity Growth requires that outputs increase relative to inputs, measured in value terms. Increases are maintained over time and do not come at the expense of the environment or social factors.

• **Identify and explore determinants of Sustainable Agricultural Productivity Growth.** Main determinants of Sustainable Agricultural Productivity Growth include: markets, inputs, environment, management, yields and post-harvest loss reduction.

• **Assess approaches for effective programming.** Cost effective programming requires identifying the main bottlenecks and opportunities through a system-wide assessment. Multiple opportunities, synergies and tradeoffs beyond a single activity or value chain should be considered.
SUSTAINABLE

Outcomes are maintained over time without further donor assistance

- Includes financial, environmental and social sustainability

U.S. Government GFSS (2016)
The enabling environment, including policies, laws and regulations, is important for all components, especially markets.
THIS SESSION IS AN OVERVIEW AND OTHER SESSIONS WILL DIVE INTO VARIOUS COMPONENTS
YIELD

- 73% of the under-achieving areas could close yield gaps by solely focusing on nutrient inputs.
- 16% of the under-achieving areas could close gaps by solely increasing irrigation.

Mueller et al. (2013)
YIELD – CROPS

- Yield gaps = difference between yield potential and actual yields
- Shown as t ha-1 harvested area in 10 sub-Saharan African countries
- A-E show yield gaps based on rainfed potential; F is for irrigated potential

van Ittersum et al. PNAS 2016;113:14964-14969
YIELD – LIVESTOCK

- There are large yield gains to be made for animal sourced foods.
- Livestock potential is not summarized in global yield gap studies, likely due to a wider range of metrics and driving factors among production systems.

(e.g., Rural poultry yield in Asia)

<table>
<thead>
<tr>
<th>Production system</th>
<th>N° of eggs/hen/year</th>
<th>N° of year-old chickens</th>
<th>N° of eggs for consumption and sale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional</td>
<td></td>
<td></td>
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<tr>
<td>Step 0: Scavenging: no regular water or feed, poor night shelter</td>
<td>20 – 30</td>
<td>2 – 3</td>
<td>0</td>
</tr>
<tr>
<td>Improved Traditional</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 1: offered water and supplementary feed, improved shelter, care in first weeks, ND vaccination</td>
<td>40 – 60</td>
<td>4 – 8</td>
<td>10 – 20</td>
</tr>
<tr>
<td>Step 2: as in step 1 plus further feeding, watering, housing; treatment for parasites, additional vaccinations</td>
<td>100</td>
<td>10 – 12</td>
<td>30 – 50</td>
</tr>
<tr>
<td>Step 3: (semi-intensive) as in step 2 with improved breeds and complete diets</td>
<td>160 – 180</td>
<td>25 – 30</td>
<td>50 – 60</td>
</tr>
</tbody>
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Sonaiya and Swan (2004), Bessei (1987)
### YIELD – AQUACULTURE

<table>
<thead>
<tr>
<th>Production system “intensity”</th>
<th>Fish yield</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Extensive</td>
<td>&lt;1 t/ha/yr</td>
<td>Crop wastes as feed, low operating costs</td>
</tr>
<tr>
<td>Semi-intensive</td>
<td>2–20 t/ha/yr</td>
<td>Uses fertilizers and farm-made feed, more management control, higher operating costs</td>
</tr>
<tr>
<td>Intensive</td>
<td>20–200 t/ha/yr</td>
<td>Relies completely on off-farm inputs (e.g., high quality feed, seed, fertilizers), uses more energy, higher operating costs</td>
</tr>
</tbody>
</table>

*Waite et al. (2014) World Resources Institute*
PRODUCTION

World fisheries production*

- capture fisheries
- aquaculture
- black – Inland
- red – Marine

* Global totals, excluding China (because of doubts over the reliability of the statistics)

Brander (2007) PNAS
WHAT IS NEEDED TO SUSTAINABLY CLOSE THE YIELD GAP?

- Inputs and Input Markets
  - Labor
  - Land
  - Water
  - Improved genetics (e.g., seeds or breeds)
  - Fertilizer
  - Finance and capital
  - Information
  - Risk reduction (e.g., index insurance)

- Environment
  - Soil
  - Weather
  - Topography
  - Agro-ecological zone
  - Ecosystem services

- Management
  - Integrated Pest Management
  - Water harvesting
  - Mechanization
  - Increased nutrient use efficiency
  - Biological nitrogen fixation

Sustainable Agricultural Productivity Growth requires pushes, pulls and feedback loops among the components.

Yields, off-take or equivalent
- e.g., primary productivity of crops, animal off-take, on-farm production per unit area

Production
- i.e., Quantity available for sale or consumption
  - Harvest practices (e.g., sorting, handling)
  - Drying
  - On-farm storage
  - Post-harvest loss reduction

Output markets
- i.e., Determines the value of the production
  - Off-farm storage
  - Value addition & processing

\[
\text{Increased Output Value} \div \text{Input Costs} = \text{Sustainable Agricultural Productivity Growth}
\]

increase efficiencies of resources
WATER

For smallholders to reduce impacts of low/variable rainfall on yield:

• Maintain and efficiently use water that enters the system
  - Reduce loss from soil evaporation, deep drainage and run-off e.g.,
    ▪ Increase soil organic matter (longer-term)
    ▪ Increase surface coverage
    ▪ Ridges, contours, etc.
    ▪ Good soil structure

• Select crops appropriate for the agro-ecological zone

• Consider most critical times—establishment and around flowering

• Pair water management with improved genetics

• Well nourished and disease-free plants can better handle water stress
NUTRIENT MANAGEMENT – FERTILIZER

- Response varies by crop, variety, type of fertilizer, and agro-ecology
- Most effective when combined with improved genetics and accompanying management practices
  - Plants need water to use fertilizer
- Response is not linear (more on next slide)

Figure 7.4: The curvilinear to plateau yield responses of five crops to fertilizer N in the Central Highlands of Kenya. HP and LP refer to high and low potential maize production situations

Wortman & Sonnes, eds. (2017) Fertilizer Use Optimization in sub-Saharan Africa
To be sustainable over time, fertilizer use has to be profitable to the farmer and maintain soil health

- Fertilizer additions are more profitable where the slope is greatest.
To afford inputs, mechanization services, storage and harvest technologies, etc., smallholders need access to finance.

The figure shows finance needs for smallholders in ‘loose value chains’ who produce for both subsistence and to sell.

Per farmer, the estimate is $500 in short term and $500 in longer term ag needs.

Estimates assume farmers can convert financing into income increases (cash or in-kind) that justify the cost of such financing.

ISF (2016) Inflection Point: Unlocking growth in the era of farmer finance
DIVERSITY – MIXED SYSTEMS

• Mixed systems of crops/animals can expand profit options and enhance synergies in the system.

• There’s a large range of mixed farming systems. Together, farmers in mixed crop-livestock systems produce about half of the world’s food.

• Animals supply producers with a source of regular income from sales of milk, eggs and other products. Animals can act as insurance against hard times.

• Livestock can supply manure and in some cases traction.

• Trade-offs: economies of scale may be compromised.

Photo by C. Njuguna
Plants have different functions and combining these functions can potentially increase yield and/or reduce variation in yield

- plants can access nutrients in different ways
  - biological nitrogen fixation
  - interactions with fungi

- plants can control/interact with pests in different ways
  - e.g., some legumes can reduce striga

- plants can use space in different ways
MORE ON LEGUMES & BIOLOGICAL NITROGEN FIXATION

- Most legumes (e.g., soybean, cowpea, groundnut) can supply nitrogen to soil
- Under the right conditions, the biological N fixation reduces need for N fertilizer
  - Requires appropriate pH, phosphorus, nodulation
- A meta-analysis (i.e., review of lots of studies) in sub-Saharan Africa found:
  - maize yield increased in response to using legumes
  - response wasn’t as great as with fertilizer
    - didn’t consider treatment of legume + fertilizer
  - Data spans a range of varieties (traditional, OPV, hybrid) and soil conditions

A value greater than 0 shows positive response to treatment

Sileshi et al. (2008)
In animals, breeding can:
• increase feed efficiency
• improve resistance to disease and parasites
• increase reproductive success
• improve production and quality of product
  - e.g., milk, meat, eggs

In crops, breeding can:
• increase energy that goes into grain
• reduce time to maturity
• improve disease resistance
• enhance dual use (e.g., improve grain and fodder)
• increase heat tolerance
• and even increase drought and flood tolerance—at the same time!
Packages of technologies and practices are often needed to achieve benefits.

<table>
<thead>
<tr>
<th>Package component</th>
<th>Lead farmers (%)</th>
<th>Follower farmers (%)</th>
<th>Yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved seed only</td>
<td>-</td>
<td>7</td>
<td>720</td>
</tr>
<tr>
<td>Improved seed + insecticide only</td>
<td>-</td>
<td>18</td>
<td>1,007</td>
</tr>
<tr>
<td>Improved seed + insecticide + fertilizer only</td>
<td>13</td>
<td>70</td>
<td>1,032</td>
</tr>
<tr>
<td>Improved seed + insecticide + fertilizer + 2 rows cereal by 4 rows cowpea</td>
<td>87</td>
<td>5</td>
<td>2,149</td>
</tr>
</tbody>
</table>

Average yields of improved cowpea under package and partial adoption in Kano

PEST AND DISEASE MANAGEMENT

- Livestock losses due to diseases are estimated at 20–30%
- Crop losses are similar, but lots of variation around this
- Crop pests include weeds (e.g., competitive plants), pathogens (e.g., viruses, bacteria, fungi) and animal pests (e.g., insects, mites, nematodes, rodents, birds)
- One global study estimates highest potential loss of crop yield is from weeds (34%), followed by animal pests (18%) and pathogens (16%)
- Potential losses vary by region, crop and time
  - Fall armyworm is currently a huge concern in Africa
  - Estimates indicate 13.5 million tons of maize valued at $3 billion are at risk due to fall armyworm in 2017–2018
WEATHER

- Variation in rainfall and temperature explains a third of global yield variation from 1979–2008
  - In some areas, weather variation may explain >75% of yield variation
- The other two-thirds of yield variability includes the numerous agronomic challenges and decisions that farmers make each year:
  - availability and use of agronomic inputs
  - pest and pathogen infestations
  - soil management, irrigation
  - distribution of varied crop maturity types

Ray et al. 2015
Study of smallholders in Indo-Gangetic plains of India

- Farmers rely on multiple sources of information, including:
  - Other farmers ← most important source of information
  - Face-to-face with non-farmers: mainly ag input dealers, then cooperatives, state department of agriculture, etc.
  - Traditional media:
    TV, radio, newspaper
  - Modern ICT:
    mainly mobile phone, some kiosk/internet, landline

Mittal & Mehar (2013)
POST-HARVEST LOSS

Availability and adoption of improved technologies and practices can reduce loss. e.g., thresher in Senegal

VALUE CHAINS

South-South technology transfer allows rice farmers in Senegal to cut post-harvest losses.

MANUAL THRESHING
LOSSES OF UP TO 35%

AFRICAN THRESHER
DOES AWAY WITH THIS POST-HARVEST LOSS

About a third of all food produced is lost in the food supply chain.

100% OF FOOD SUPPLY

Agriculture | Storage | Transport | Possessing | Retail | Consumer

66.6% OF FOOD SUPPLY

Most food losses in low-income countries occur at storage, transport and processing levels.

Most food losses in high-income countries occur at retail and consumer levels.

Source: FAO, 2013

Big Facts
ccafs.cgiar.org/bigfacts
MARKETS

- Access to markets can reduce input costs and increase sale price
- Off-farm storage and intermediaries

Challenges of Access in RURAL KENYA

Smallholder farmers like Grace face one key challenge—access. One Acre Fund believes every farmer should have regular access to life-changing products.

- Grace’s Farm
- Hospital: 10 min. walk
- Electricity: 10 min. walk
- School: 20 min. walk
- One Acre Fund Distribution Site: 30 min. walk
- River: 30 min. walk
- Mpesa Shop: 40 min. walk
- Paved Road: 50 min. walk
- Church: 1 hr. walk
- Market: 1 hr. walk
- Webuye: 1.5 hr. drive

Nearest town Grace could purchase inputs before joining One Acre Fund.

Products graded & receipts issued: More flexibility & transparency to farmers.

Central point of purchase provides the buyer more transparency and choice.
VALUE ADDITION AND PROCESSING

Value addition and processing creates a pull for farm product and can increase smallholder income.

U.S.-funded Ethiopian abattoir hopes to help herders during drought.
GENDER

Women are a large percentage of farmers—sustainable agricultural productivity growth can’t happen without them.

Palacios-Lopez, Christiaensen, Kilic (2015)
Sustainable Agricultural Productivity Growth requires pushes, pulls and feedback loops among the components.

**Inputs and Input Markets**
- Labor
- Land
- Water
- Improved genetics (e.g., seeds or breeds)
- Fertilizer
- Finance and capital
- Information
- Risk reduction (e.g., index insurance)

**Environment**
- Soil
- Weather
- Topography
- Agro-ecological zone
- Ecosystem services

**Management**
- Integrated Pest Management
- Water harvesting
- Mechanization
- Increased nutrient use efficiency
- Biological nitrogen fixation

**Yields, off-take or equivalent**
- e.g., primary productivity of crops, animal off-take, on-farm production per unit area

**Production**
- i.e., Quantity available for sale or consumption
  - Harvest practices (e.g., sorting, handling)
  - Drying
  - On-farm storage
  - Post-harvest loss reduction

**Output markets**
- i.e., Determines the value of the production
  - Off-farm storage
  - Value addition & processing

\[
\text{Increased Output Value} \div \text{Input Costs} = \text{Sustainable Agricultural Productivity Growth}
\]
AGRICULTURAL PRODUCTIVITY
= value of outputs relative to inputs

This can be measured in a few different ways.

1. Gross Margins—it’s a measure of net income
   • This was how Feed the Future measured agricultural productivity from 2010–2017
AGRICULTURAL PRODUCTIVITY

= value of outputs relative to inputs

2. Total Factor Productivity—it’s a ratio of output to input value

Infographic from Global Harvest Initiative
AGRICULTURAL PRODUCTIVITY

= value of outputs relative to inputs

3. TFP is hard to measure so you can consider one component as proxy (with varying degrees of success):

4. Sometimes proxies are even more simplified. Yields can be used. But they are a proxy that has to be interpreted correctly. Efforts that only focus on short term on-farm yields will likely not increase ag productivity.
Figure 2. Designing interventions requires a system-wide assessment of the availability of needed inputs, markets and traders, and financial and knowledge capacity. Monitoring of measurable results based on desired outputs allows for mid-course corrections (Adapted from The Montpellier Panel, 2013).
DESIGNING INTERVENTIONS—CONSIDERATIONS

#1: Designing interventions requires a system-wide assessment of the environmental conditions (including the state of soil and water conditions), availability of improved technologies and practices, inputs, delivery pathways for those inputs, access to finance (including credit, savings, and insurance), markets, traders and relevant information.

#2: Look for multiple opportunities, synergies and tradeoffs beyond a single activity or value chain.

#3: Ensure that technologies, practices and information used in development projects are appropriate to the agro-ecological and socio-economic conditions.

#4: Prioritize productivity enhancing interventions likely to significantly benefit livelihoods at the household-level and that can reach large numbers of households.

#5: Projects should not provide critical inputs or serve as markets unless those responsibilities can be transferred to others by the end of the project.
LIFELONG LEARNERS ARE PEOPLE WILLING TO RELEARN WHAT THEY THINK THEY ALREADY KNOW.
EVALUATIONS
FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

www.feedthefuture.gov