Climate Smart Agriculture: What’s all the Buzz
Climate-smart Agriculture

• Integrated approach to managing landscapes
  – Cropland, livestock, forests, fisheries
• Addresses interlinked challenge of food security and climate change
• First defined in a 2010 by the Food and Agriculture Organization of the United Nations

Source: https://www.fao.org/3/i1881e/i1881e00.htm
Climate-smart Agriculture

• 3 main goals
  – Increase productivity
  – Enhance resilience
  – Reduce emissions
• Does not define any new farming practices
• Does include many of the things already being done
  – Nutrient management, conservation tillage, cover cropping, etc.

Why now?

• Growing global population
  – Changing diets
  – Increased demand for food

• Food production struggling to keep up
  – Crop yield leveling off globally
  – Stressing natural resources (soil, water, biodiversity)

• In 2020, 690 million people (8.9%) hungry

Agriculture and a Changing Climate

• Agriculture vulnerable to:
  – Increasing temperatures
  – Weather variability
  – Shifting agroecosystem boundaries
  – Invasive plants and insects
  – Increased frequency of extreme events

• Substantial investment in adaptation is needed to maintain and increase yields

Observed U.S. Temperature Changes

Source: Walsh et al. 2014, National Climate Assessment; SARE – Climate Change in Agriculture, 2015
Observed U.S. Precipitation Changes

Source: Walsh et al. 2014, National Climate Assessment; SARE – Climate Change in Agriculture, 2015
Observed U.S. Heavy Precipitation Changes

Source: Walsh et al. 2014, National Climate Assessment; SARE – Climate Change in Agriculture, 2015
Observed Increase in Frost-Free Season Length

Source: Walsh et al. 2014, National Climate Assessment; SARE – Climate Change in Agriculture, 2015
Causes of Climate Change

Natural causes

Human (anthropogenic) causes

Source: SARE – Climate Change and Sustainable Agriculture
Climate Change and Agriculture

• Agricultural generates 19 to 29% of total greenhouse gas emissions
• Food loss or wasted accounts for 1/3 of global production
• Opportunities
  – Lower emissions per unit produced
  – Sequester carbon

Many sources of GHGs

Agriculture, Forestry and Other Land Use (AFOLU)
Overview of U.S. Greenhouse Gas Emissions in 2019

- Carbon Dioxide: 80%
- Fluorinated Gases: 3%
- Nitrous Oxide: 7%
- Methane: 10%

Figure TS.30 | GHG emissions intensities of selected major AFOLU commodities for decades 1960s–2000s. (1) Cattle meat, defined as GHG (enteric fermentation + manure management of cattle, dairy and non-dairy)/meat produced; (2) pig meat, defined as GHG (enteric fermentation + manure management of swine, market and breeding)/meat produced; (3) chicken meat, defined as GHG (manure management of chickens)/meat produced; (4) milk, defined as GHG (enteric fermentation + manure management of cattle, dairy)/milk produced; (5) eggs, defined as GHG (manure management of chickens, layers)/egg produced; (6) rice, defined as GHG (rice cultivation)/rice produced; (7) cereals, defined as GHG (synthetic fertilizers)/cereals produced; (8) wood, defined as GHG (carbon loss from harvest)/roundwood produced. [Figure 11.15]
Resilient Soils Through Conservation Practices
Long-term Cropping System and Cover Crop Study - Cover Crops Between Wheat & Sorghum/Corn

On going since 2007

Cumulative N₂O emissions (lbs N₂O-N ac⁻¹)

Cover crop planting
SNL termination
DSB harvest
First frost

Soil nitrate concentration (ppm)

Cover crop treatment | Mean grain yield at 0 N rate (bu/ac) | Fertilizer N equivalent credit (lb N/ac) | Fertilizer N value @ $0.33/lb N ($/ac)
--- | --- | --- | ---
Chemical fallow | 88 b | - | -
Double-crop soybean | 91 b | 8 b | 2.64
Summer legume | 100 a | 30 a | 9.90
Summer non-legume | 64 c | -45 c | -14.85
Winter legume | 87 b | -1 b | -0.33
Winter non-legume | 87 b | -3 b | -0.99

K-STATE
Research and Extension
Kansas Agricultural Watershed Field Laboratory
On going since 2014
Cover Crop Research in Western Kansas

Augustine Obour and John Holman
Western Kansas Agricultural Research Centers

Objectives:

• Determine cover crop management options for dryland systems.

• Determine impacts of removing cover crops for forage on soil health.

• Evaluate flex-fallow as a strategy for sustainable integration of cover crops in semiarid environments.
On-going work in Kansas

• Kansas Corn Growers Association / Soil Health Partnership: 3 producer projects (Rice and others).

• USDA-AFRI Sustainable Agricultural Systems Projects
  – Increasing Water Productivity, Nutrient Efficiency and Soil Health in Rainfed Food Systems of Semi-Arid Southern Great Plains (Rice and others)
  – Enhancing the Sustainability of US Cropping Systems through Cover Crops and an Innovative Information and Technology Network (Tomlinson and Presley)
Sorghum + Sensors + Sustainability = SMARTFARM

SMARTFARM for Sorghum

Farmers planted 5.7 million acres and harvested 365 million bushels of sorghum in 2018.

Farmers harvested an average 72.1 bushels per acre.
Sorghum + Sensors + Sustainability = SMARTFARM

**Crop Management Drivers**
- Biomass, Crop, Tactical Decisions, Tillage, Crop residue, Fertilizer, Irrigation, Weeds

**Atmospheric Drivers**
- Net Radiation, Air Temperature, Precipitation, Wind, Air humidity

**Soil Drivers**
- Organic Carbon, pH, Texture, Nitrogen Content, Temperature, Moisture, Oxygen, Microbes

**Technology**
- Eddy Flux, Trace Gas Analyzer, Modeling, Remote sensing, High Resolution Spatial and Temporal Data collection, Data Communication, Data Analysis

**Innovation**
- “Gold Standard” (Quality and Reliability)
- \( \text{CO}_2, \text{N}_2\text{O}, \text{CH}_4, \text{H}_2\text{O} \)
- Emissions quantification

**Our Pitch**

Dr. Gopal Kakani
v.g.kakani@okstate.edu

Dr. Nitya Rajan
nrajan@tamu.edu

Dr. Peter Tomlinson
ptomlin@ksu.edu
Partnership for Climate-Smart Commodities

• USDA announced details in February 2022
  – Goal to finance partnerships to support production and marketing of climate smart commodities
  – Pilot projects to have a time frame of 1 to 5 years
  – Funding through USDA’s Commodity Credit Corporation
  – Two rounds of proposals
    • Round one large proposals $5 to $100 million
    • Round two small proposals $250,000 to 5 million
Partnership for Climate-Smart Commodities

- September 2022
  - USDA announced selection of 70 projects (investment of $2.8 billion)
- December 2022
  - USDA announced selection of an additional 71 projects (investment of $325 million)
- 24 projects identifying Kansas
Partnership for Climate-Smart Commodities - Goals

• Provide technical and financial assistance to producers to implement climate-smart production practices on a voluntary basis on working lands
• Pilot innovative and cost-effective methods for quantification, monitoring, reporting and verification of greenhouse gas benefits
• Develop markets and promote the resulting climate-smart commodities
National Sorghum Producers Partnerships for Climate-Smart Commodities Project

• Implement climate-smart production practices across US sorghum acres

• Goal of reducing carbon emissions and developing markets for sorghum as a climate-smart commodity
National Sorghum Producers Partnerships for Climate-Smart Commodities Project

• K-State leading Climate-smart sorghum nitrogen fertility
  – Partners Oklahoma State, Texas A&M and A&M Prairie view
• Modernize recommendations to reflect current:
  – tillage practices
  – enhanced efficiency fertilizer products
  – fertilizer application technology
• Optimizing nitrogen use has the potential to:
  – Reduce the nitrogen input requirements to produce a bushel of grain
  – Reduce fertilizer input costs
  – Reducing the risk potential for nitrogen loss through leaching, runoff, and denitrification.
Thank you

Peter Tomlinson - Environmental Quality
(ptomlin@ksu.edu)
Department of Agronomy, Kansas State University