Enhancing environmental and financial performance on Midwestern farms
Real net farm income is projected to fall.
Agricultural export values projected to rise slightly in 2020, China share to remain down significantly

Data: USDA
Least U.S. Corn Harvested by November 10, 1995-2019

1. 2009 42%
2. 2019 66%
3. 2008 72%

Source: USDA NASS Crop Progress Data
Based on NASS crop progress data.
Fewest U.S. Soybeans Harvested by November 10, 1995-2019

1. 2009  79%
2. 2019  85%
3. 2018  87%

Source: USDA NASS Crop Progress Data
U.S. SOYBEANS: Percent Harvested

Based on NASS crop progress data.

Source: USDA NASS Crop Progress Data
Wheat, corn, and soybean prices
Dollars per bushel

Data: USDA
So, why focus on environmental performance now? First, most everyone cares a lot about farm and food production, and the environment.

**Farmers**
- Recreation
- Uses: clean air, water, clean water
- Profitability
- Liability

**Public**
- Recreation
- Uses: clean air, water, clean water

Americans farms created value added of roughly $400 billion in 2017.

Americans spent about $1.6 trillion on food at home and away from home in 2017.

“...Every year, American consumers spend more on outdoor recreation [$887 billion] than they do on pharmaceuticals and fuel, combined. In fact, the impact of outdoor recreation on America's economy is almost as big as that of hospital care…”

> Roughly $170 billion in the Midwest


But secondly, because we can focus on improving the financial performance of farms, and limiting their environmental impacts

1. Technology and innovation
2. USDA programs
3. Remaining challenges

https://oceanservice.noaa.gov/news/historical-hurricanes/
https://www.canr.msu.edu/resources/management_of_nitrogen_fertilizer_to_reduce_nitrous_oxide_emissions_from_fi
https://oceanservice.noaa.gov/facts/deadzone.html
Technological innovations have helped push up agricultural productivity

US, Index: Year 1929 = 1.00

- Rubber tires on tractors introduced
- Herbicide 2,4-D introduced; Widespread adoption of inorganic nitrogen fertilizer begins
- Anhydrous ammonia injection becomes predominant
- First automated irrigation system field tested
- No-till starts to become popular
- Satellites used for precision ag
- Robotic milking introduced
- Weed and pest resistant biotech
- Drought tolerant biotech
- Consumer-focused biotech traits
- Big data applications
- Widespread adoption of hybrid seed begins

Source: USDA-OCE using data from USDA-ERS and historic USDA data (pre-1948)
Technological innovations have helped push up agricultural productivity

Corn output has risen 435% since 1960, soybeans by 1,190%, rice by 225%, and wheat by 215%.

Beef output has risen 87% since 1960, pork by 143%, milk by 77%, and chicken by 1,050%.

Data: USDA, BLS
Example: Rising corn yields through technological innovation

Data: USDA ERS Agricultural Resources and Environmental Indicators, 2019:
Recent trends and policies have generally led to falling food prices and growth in trade

Productivity also can drive environmental performance

Example: Nitrogen Application Quantity: Corn

Productivity also can drive environmental performance

>>> increasing lbs per acre application

The quantity of nitrogen applied on corn acres are increasing

Example: Nitrogen Application Quantity: Corn

But declining excess nitrogen applications

>>> decreasing lbs per bushel

Nitrogen Application per Bushel: Corn

But declining excess nitrogen applications

>>> decreasing lbs per bushel

But nitrogen applications per bushel are decreasing. This demonstrates increasing efficiency of production.

New focus on intensification can improve productivity and environmental outcomes

Pounds Nitrogen Applied per Bushel Corn Produced in Illinois, 1990-2020

Source: USDA-NASS Quick Stats
Cow numbers have been falling since the mid-20th century, while milk per cow has increased steadily.

Data: USDA-NASS
**Focus: enhancing productivity and the environment**

Enteric methane emissions in dairy have dropped **55%** from 31 g methane/kg milk in 1924, to 14 g methane/kg milk in 2014.

Farming will generate externalities. How can we achieve MC = MB?

Voluntary Programs

Generally, there will be positive private benefits to conservation practices, but there could be underinvestment.

USDA and other similar programs can provide incentives to boost investments to achieve private and public benefits.
How can we promote conservation adoption?

**On-Farm Economic Benefits**
- Certain practices can have financial and environmental benefits.
  - Reduced tillage
  - Reduced N applications
  - Precision agriculture
  - Cover crops

**Incentive Programs**
- USDA offers a variety of programs to incentivize adoption of conservation practices.
  - CRP
  - EQIP
  - CSP
Break-even prices for conservation adoption

Range in incentive prices from $0-$100

Source: ICF and USDA, 2016
Break-even prices for conservation adoption

Reduced tillage, using precision ag and reducing N applications can pencil out for farmers

Range in incentive prices from $0-$100

Source: ICF and USDA, 2016
Conservation Tillage Benefits:

- Reduces soil erosion
- Reduces runoff
- Improves water management
- Improves soil health
- Reduced time/fuel use

Source: USDA NRCS
Mulch till and no-till adoption vary by region

More farmers are using mulch till than no-till in the Heartland.

Fewer farmers are using conservation tillage in the Northeast/Lake States.

No-Till Adoption: Corn

No-till adoption on corn acres in the Corn Belt is slightly decreasing, and is around 20% (2005-2016)

No-till adoption on soy acres in the Corn Belt is slightly decreasing, but relatively high—around 50% (2005-2016)

Source: USDA ERS based on ARMS data for 2006 and 2012. 
Cover Crop Benefits:

- Reduce soil erosion
- Reduce runoff
- Improve water management
- Improve soil health
- Provide additional nutrients
- Suppress weeds

Source: USDA NRCS
Cover crop adoption is increasing, but still low overall (about 5%)
Cover crop adoption is increasing, but still low overall (about 5%)

The Corn Belt and Lake States are at about 5% adoption, but the Northeast is much higher (around 20%)

Percent of acres using cover crops in 2012
Percent of acres using cover crops in 2017

Increased adoption in the Eastern and Midwestern States
Change in cover crop acreage 2012-2017

Bright green represents a 5-39% increase

Dark blue represents a 5-35% decrease

Source: USDA ERS analysis of 2017 Census of Agriculture Summary Data, USDA NASS
Cover crops can provide yield returns:

### TABLE 2. Percent increase in corn and soybean yields after one, three and five years of consecutive cover crop use on a field, based on a regression analysis of data for crop years 2015 and 2016

<table>
<thead>
<tr>
<th></th>
<th>ONE YEAR</th>
<th>THREE YEARS</th>
<th>FIVE YEARS</th>
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</thead>
<tbody>
<tr>
<td>Corn</td>
<td>0.52%</td>
<td>1.76%</td>
<td>3%</td>
</tr>
<tr>
<td>Soybeans</td>
<td>2.12%</td>
<td>3.54%</td>
<td>4.96%</td>
</tr>
</tbody>
</table>

Figures shown are an average of yields from the 2015 and 2016 growing seasons, with yield data obtained from about 500 farmers each year through the SARE/CTIC National Cover Crop Survey.

Source: SARE Cover Crop Economics, 2019
https://www.sare.org/Learning-Center/Bulletins/Cover-Crop-Economics
USDA encouraged cover crop planting on prevented plant acres this year:

Prevented or Delayed Planting

Did heavy rainfall, flooding, or other weather events prevent or delay planting on your farm? USDA is here to help farmers navigate challenges when it comes to prevented planting. USDA offers:

- Prevented planting coverage through USDA-administered crop insurance policies;
- Technical and financial assistance in planting cover crops, a practice common on lands unable to be planted to an insured crop.

Source: USDA
https://www.farmers.gov/management/prevented-planting
Precision Agriculture Benefits:

- Apply fertilizer and other inputs in the right place and right rate
- Maximize nutrient benefits while minimizing overapplication
- Financial benefits by reducing inputs

Variable Application Rate Technology Adoption (1998-2016)

VRT adoption, especially on corn (blue line), rapidly increased from 2005-2016

In 2005, around 5% of corn farmers used VRT in the Corn Belt.

By 2016, almost 40% of corn farmers used VRT in the Corn Belt.

USDA’s broadband programs support precision ag adoption

• USDA’s “A Case for Rural Broadband” report found that meeting rural broadband needs could provide $18 billion in additional economic benefits

• The USDA ReConnect Program offers grants and loans for broadband infrastructure

• USDA has invested over $51m to date
Targeting resources applies to both a farm level and a programmatic level.
New technologies will continue to drive efficiencies in production

Example: Enhanced Efficiency Fertilizers (EEFs)

• Reduce nitrogen losses to water and air
  • Nitrous oxide emissions from fertilizers are the largest source of greenhouse gas emissions from the ag sector (almost 50% of ag emissions)

• Improve nitrogen use efficiency and yield
Enhanced Efficiency Fertilizers:
- Coated fertilizers
- Double inhibitors (nitrification and urease inhibitors)
- Nitrification inhibitors
- Urease inhibitors

Impact of Enhanced Efficiency Fertilizers on Nitrous Oxide Reductions

Nitrogen inhibitors can reduce nitrous oxide emissions by over 40%

Enhanced Efficiency Fertilizers:
- Coated fertilizers
- Double inhibitors (nitrification and urease inhibitors)
- Nitrification inhibitors
- Urease inhibitors

Impact of Enhanced Efficiency Fertilizers on Nitrogen Use Efficiency

Enhanced Efficiency Fertilizers:
- Nitrification inhibitors
- Urease inhibitors
- Double inhibitors (nitrification and urease inhibitors)
- Coated fertilizers

Impact of Enhanced Efficiency Fertilizers on Nitrogen Use Efficiency

Nitrogen inhibitors can also increase nitrogen use efficiency by almost 50%

Enhanced Efficiency Fertilizers:
- Nitrification inhibitors
- Urease inhibitors
- Double inhibitors (nitrification and urease inhibitors)
- Coated fertilizers

USDA has a role to play in incentivizing conservation adoption

- USDA makes significant investments through Farm Bill programs (EQIP, CSP, CRP, etc.)

- These investments have led to reductions in soil loss, runoff, and sequestered carbon
USDA investments in conservation (2009-2018)

Note: Data expressed in 2018 dollars. Working lands includes: Environmental Quality Incentives Programs, Conservation Stewardship Program and Conservation Technology Assistance. Conservation Reserve Program, Agricultural Conservation Easement Program. All programs include these and their predecessors.
Expenditures on top 5 EQIP practices 1998-2015

Cover crops account for more of EQIP spending over time

Total US Spending 2018: 6,187 Million

Note: Data expressed in 2018 dollars. Includes these programs and predecessors: Environmental Quality Incentives Programs, Conservation Stewardship Program, Conservation Technology Assistance, Conservation Reserve Program, Agricultural Conservation Easement Program.

Source: NRCS RCA Reports
Distribution of USDA conservation spending by program, 2018

Total US Spending 2018: 6,187 Million

Working lands programs include: Environmental Quality Incentives Program, Conservation Stewardship Program.

Source: NRCS RCA Reports
Outcomes from USDA conservation investments:

Average Sediment Loss Reduction 2017–18
2.52 million tons

Average Wind Erosion Loss Reduction 2017–18
3.13 million tons

Source: USDA CEAP Data
Outcomes from USDA conservation investments:

Average nitrogen runoff 2017–18 down 53.5 million lbs.

Average phosphorus runoff 2017–18 down 8.91 million lbs.

Source: USDA CEAP Data
Comparing successful EQIP participation to additionality

Source: ERS, Working Lands Conservation Contract
Modifications: Patterns in Dropped Practices
Comparing successful EQIP participation to additionality

Structural practices are additional, but less likely to be completed as planned.

Conservation tillage probably pencils out for farmers.

Source: ERS, Working Lands Conservation Contract Modifications: Patterns in Dropped Practices
Current CRP Enrollment and Expirations

- Current CRP enrollment is at 22 million acres. The 2018 Farm Bill increased the cap to 27 million acres by 2023.

- Expiring CRP Acres
  - 5.36 million acres in FY 2020
  - 3.01 million acres in FY 2021
  - 4.01 million acres in FY 2022

Source: USDA.
Continuous Enrollment Has Expanded Relative to General Enrollment

CRP Enrollment at End of Fiscal Year (Acres)

Source: USDA.
Outcomes from CRP investments:

- 34 million metric tons CO2e stored
- Habitat for over 42 million ducks since 1992
- Over 9 billion tons of soil erosion reduced since 1986
- In 2017, CRP reduced Phosphorus reaching streams by over 100 million pounds, Nitrogen by over ½ billion pounds, and sediment by nearly 200 million tons

Source: USDA.
Despite these investments and improvements in efficiency, we still have externalities
Summary: U.S. agriculture must continue to be productive, while addressing environmental challenges

USDA has a role in continuing to incentivize conservation adoption.

Thinking about this in an “intensity” context can help achieve productivity and environmental improvements.

USDA Conservation Spending, 2018

Source: NRCS RCA Reports

Continuing to innovate, improve efficiency, and enhance bottom lines will help meet demand and improve the environment.

Total Factor Productivity grew 170% from 1948-2015. This trend must continue to meet global demand.

Total inputs only grew 7% during this time period. This efficiency is necessary to protect the environment.
Join us on February 20-21, 2020 for USDA’s 96th annual Agricultural Outlook Forum

Registration is now open

https://www.usda.gov/oce/forum/