Modern Farming Tools & Techniques

Abigail Copenhaver, RDN, CDN
Ivy Lakes Dairy & Farmstead Nutrition
Stanley, NY
@dairyfarmerRD

Photo credit: Jennie Schmidt

Abigail Copenhaver, RDN, CDN
@dairyfarmerRD
Disclosures

- Owner of Farmstead Nutrition & Consulting, LLC and Ivy Lakes Dairy, LLC
- Honorarium
- Presentation sponsor by National Dairy Council grant
- Consulting for the American Dairy Association Northeast
Session Objectives

1. Describe at least one modern farming tool or technique and how it is used to increase efficiency and reduce environmental impact.

2. Identify the main differences and similarities of current farming practices.

3. Communicate 2-3 facts and recommend 2-3 credible resources about innovative farming tools and techniques to colleagues and the public.
Future of Food Initiative
Academy of Nutrition and Dietetics Foundation

eat right. Academy of Nutrition and Dietetics Foundation
Future of Food Initiative
Future of Food Resources for Members

• **Toolkits** [www.eatrightfoundation.org/toolkits-webinars](http://www.eatrightfoundation.org/toolkits-webinars)
  - Hunger in Our Community. What We Can Do.
  - Smart Choices. For a Healthy Planet. *(English/Spanish!)*
  - Tossed Treasures. How We All Can Waste Less Food. *(English/Spanish!)*

• **Supervised Practice Concentrations:**
  - Food Insecurity and Food Banking—*available now!* [www.healthyfoodbankhub.org](http://www.healthyfoodbankhub.org)
  - Food Systems—*under development!*

• **Webinars and Infographics** [www.eatrightfoundation.org](http://www.eatrightfoundation.org)

• **Affiliate Presentations:**
  - “Changing the Way We Look at Agriculture” 32 affiliates/DPGs *(2015)*
  - Food waste, food additives, and GMO presentations 10 affiliates *(2016)*
  - Foods of future, farming tools, and food preservation presentations 10 affiliates *(2017)*
Last year our donors’ generosity helped us award:

$446,900 in student scholarships to 194 students

$14,000 in student stipends to help 140 students attend FNCE.

$40,000 through Home Food Safety Challenge grants to dietetics students.

www.eatrightfoundation.org
History of Farming in the U.S. ¹

Photo source: LivingHistoryFarm.org
Photo credit: Nebraska State Historical Society
A romanticized view of farming?

Photo source: www.thecanadianencyclopedia.ca
According to the 1920 USDA Census of Agriculture:

- US population = 105.7 million
- 48.6% of people lived in rural areas
- 6.45 million farms

The total number of farms in the U.S. peaked in 1935 at 6.8 million.

USDA Definition of a “Farm”

Any place from which $1,000 or more of agricultural products were produced and sold, or normally would have been sold, during the census year.

Artwork credit: Amy Myrdal Miller
As the U.S. population has grown, the number of farms has decreased.

In 1935 one farm fed approximately 19 people. Today one farm feeds approximately 149 people.

Figure 3-1
Farms, land in farms, and average acres per farm, 1850-1997
Most of the decline in farms occurred between 1935 and 1974

Source: Compiled by ERS from Census of Agriculture data.

The Homestead Act of 1862

![Homestead Certificate](https://www.archives.gov)

It is hereby certified, That pursuant to the provisions of the act of Congress, approved May 20, 1862, entitled “An act to secure homesteads to actual settlers on the public domain,”

Daniel Fryman has made payment in full for Section 26 of Township four of Range five containing 160 acres.

Now, therefore, be it known, That on presentation of this Certificate to the COMMISSIONER OF THE GENERAL LAND OFFICE, the said Daniel Fryman shall be entitled to a Patent for the Tract of Land above described.

Henry M. Atkinson

Photo source: www.archives.gov
Farmland & Railroads

In the ten-year period prior to 1880, some 40,000 miles of railroad were built, bringing the total network up to 93,267 miles. In 1880, every state and territory was provided with railway transportation. A second line of railroads to the Pacific was nearing completion, and other transcontinental railroads were under construction. Railway development was exerting a powerful influence upon immigration and agricultural and industrial growth throughout the country.

Source: Central Pacific Railroad Photographic History Museum http://cprr.org/Museum/RR_Development.html
Farmland & Railroads

Photo source: www.enjoyart.com
Wheat, An Important Food Crop

Photo credit: Archives of Gus Lohse and Rosemarie Lohse Myrdal, used with permission.
How Wheat is Harvested Today

Photo credit: Harold Myrdal
Wheat & Food Security\textsuperscript{9,10}

Photo credits: Archives of Gus Lohse and Rosemarie Lohse Myrdal, used with permission.
A 54-row corn planter

Photo credit: https://www.deere.com/en_US/products/equipment/planting_and_seeding_equipment/planters/db_planter_series/db120/db120.page
U.S. Corn Yield, 1935 to 2016

1930s: Hybrid corn becomes available

1996: Biotech corn seed becomes available

Source: USDA ERS, accessed online on October 10, 2016 at http://www.ers.usda.gov/media/521667/corndatatable.htm
Dairy Farming: Then & Now

Photo credit: permaculture.co.uk

Photo credit: Amy Myrdal Miller
Dairy Farming Today

Parallel Milking Parlors

Photo credit: http://www.siouxdairy.com/site/assets/galleries/11/roordaparlor2.jpg
Moving hay in North Dakota in 1950

Photo credit: Rosemarie Myrdal

Moving hay in North Dakota in 2010

Photo credit: Naomi Myrdal
Current Farming Practices

Photo credit: http://www.freeimages.com/photo/farm-land-1395655
Let’s Talk Farming Systems

Agriculture

CONVENTIONAL
- Uses modern technology and mechanization.
- Stems from green revolution.

BIOTECHNOLOGY
- Uses plant breeding techniques to develop or improve living organisms.
- “RoundUp/Bt/Stacked.”

ORGANIC
- Ecological production system minimizing off farm inputs;
- Uses only OMRI approved materials.
## Comparison of Practices

<table>
<thead>
<tr>
<th>Practice</th>
<th>Conventional</th>
<th>Biotech</th>
<th>Organic</th>
</tr>
</thead>
<tbody>
<tr>
<td>No-Till</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Crop Rotation</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Cover Crops</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Green Manure</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>IPM</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Fertilizers</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Pesticides</td>
<td>✓</td>
<td>✓</td>
<td>✓ OMRI</td>
</tr>
</tbody>
</table>
Challenges

- Global population growth: 8.3-10.9 billion by 2050.
- Most growth in developing countries.
- Increased demand for food, water, energy, employment.
- Wasted food.
- Global income growth: With affluence comes increasing demand for meat.
- Cropland loss.
- Soil erosion.
- Fertilizer costs.
- Market speculation.
- Aquifer depletion.
- Water pollution.
- And other climate change challenges...

World Bank World Development Indicators database
Increased Subsidy for Organic Ag

Mandatory spending on organic agriculture, 2002-2014 Farm Acts

$ million

- 2002 Farm Act
- 2008 Farm Act
- 2014 Farm Act

**Does not include intramural organic research funds in USDA, Agricultural Research Service.

How Crops Are Genetically Modified\textsuperscript{16,17}

<table>
<thead>
<tr>
<th>Traditional Breeding</th>
<th>Mutagenesis</th>
<th>RNA Interference</th>
<th>Transgenics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crossing plants and selecting offspring</td>
<td>Exposing seeds to chemicals or radiation</td>
<td>Switching off selected genes with RNA</td>
<td>Inserting selected genes using recombinant DNA methods</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Genes Affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>10K - &gt;300K</td>
</tr>
</tbody>
</table>

Desired gene(s) inserted with other genetic material. No safety testing requirements. 
Random changes in genome, usually unpredictable. No safety testing requirements. 
Targeted gene(s) switched off or ‘silenced’. Safety testing required. 
Desired gene(s) inserted only at known locations. Safety testing required.

Sources: Biotechnology Provides New Tools for Plant Breeding, University of California Davis Publication 8043; Plant Breeding: Induced Mutation Technology for Crop Improvement, FJ. Novak, H. Brunner; International Atomic Energy Agency, 1992; Atomic Gardening: Public Perceptions and Public Policy, B. Dick, M. Jones, Life Sciences Foundation Magazine; RNAi for Crop Improvement, International Service for the Acquisition of Agri-Biotech Applications Pocket K No. 34. Infographic by XiaoZhi Lim

Source: https://www.geneticliteracyproject.org/2014/04/22/glp-infographic-how-crops-are-modified-are-gmos-more-dangerous/
Farming Tools and Techniques

- Soil Health
- Water
- Data
“No-Till” (L) does not work up the ground before planting.
Planting on No Till Ground

Photo credit: Jennie Schmidt
Key Soil Health Practices

- **No-till:** Growing crops without tilling (e.g., plowing) the soil.
- **Reduced-till/mulch-till:** Tilling the soil in ways that minimize disturbance to the soil or maintain more residue cover than conventional tillage.
- **Mulching:** Adding plant residue (or other materials) to the surface of the soil.
- **Cover cropping:** Growing a crop, often over the winter, that will be left in place as residue or incorporated into the soil to increase organic matter.
- **Conservation crop rotation:** Choosing crop rotations to maximize crop diversity, build organic matter, and improve soil biodiversity.
- **Nutrient management:** Adjusting the type, location, rate, and timing of fertilizer or other nutrients to meet plant needs and minimize environmental impacts.
- **Prescribed/rotational grazing:** Managing where and when livestock graze in two or more pastures in order to prevent overgrazing and to optimize pasture growth.
Concern – Pesticides

Application

Tolerances

Glyphosate

EFSA

Photo source: http://agresearchmag.ars.usda.gov/2000/nov/insect
EPA Formula for Toxicity$^{24}$

\[ T = \text{Amount of Residue} + \text{Amount Consumed} + \text{Toxicity of Pesticide} \]
The Mississippi River/Gulf of Mexico Watershed Nutrient Task Force was established in 1997 to coordinate activities to reduce the size, severity and duration of hypoxia in the Gulf.

https://vimeo.com/58382888
A bioreactor is a medium of good carbon sources, wood chips, through which tile water is passed and nitrates are released as nitrogen gas into the atmosphere.

Practice Paper: Promoting Ecological Sustainability within the Food System

Miles from harvest to delivery/mpg = gallons fuel used × 19.5 lb. CO2 = lb. CO2 generated from transportation of food
Innovations in agriculture technology help to use fewer resources, including fertilizer, pesticides, water, etc.

Examples:
• Technology to maximize crop space
• Satellite imagery to survey soil
• Technology to increase drought tolerance
• Precision agriculture tools to reduce inputs and improve efficiency
The New Farmer has Choices

Photo credit: Dee Sandquist

Photo credit: Dee Sandquist
Communicating Farming Facts
FARMERS
- Less than 2% of the population are farmers, and only 1% farm as principal occupation.
- As of 2012, there are 3.2 million farmers in the U.S.
- Principal operators were on average 58.3 years old and were predominantly male.
- 11% of farmers are new farmers who have farmed 10 years or less.

FARMS & FARMLAND
- 2.1 million farms (14,093 are certified organic farms)
- 914.5 million acres of farmland across the U.S.
- 97% of all farms in the U.S. are family farms
- 474,028 farms covering 173.1 million acres were farmed with conservation tillage or no-till practices
Farm Production Facts

Farmers may choose from four types of production methods:
1. Conventional
2. Organic
3. Biotech
4. Indoor, vertical (requires no sun and no soil)

A farmer or rancher may choose to use multiple production methods based on factors including soil type(s), climate, availability of seed or machinery, access to irrigation, growing region, crop prices, and market access and demand.
## Farm Production Methods

### Similarities & Differences

<table>
<thead>
<tr>
<th></th>
<th>ORGANIC</th>
<th>CONVENTIONAL</th>
<th>BIOTECHNOLOGY</th>
<th>PROTECTED CULTURE &amp; INDOOR VERTICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Crop Rotation</strong></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td><strong>Cover Crops</strong></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td><strong>No-Till</strong></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td><strong>Fertilizer</strong></td>
<td>Compost</td>
<td>Natural or synthetic</td>
<td>Natural or synthetic</td>
<td>Natural or synthetic</td>
</tr>
<tr>
<td><strong>Crop Protection</strong></td>
<td>IPM</td>
<td>IPM</td>
<td>IPM</td>
<td>Need depends on how protected the growing conditions are.</td>
</tr>
<tr>
<td></td>
<td>Herbicides</td>
<td>Herbicides</td>
<td>Herbicides</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pesticides</td>
<td>Pesticides</td>
<td>Pesticides</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fungicides</td>
<td>Fungicides</td>
<td>Fungicides</td>
<td></td>
</tr>
<tr>
<td><strong>Fallow Land</strong></td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
The Pace of Change

- Technology Change
- Social Change
- Business Change
- Political Change

"The good thing about science is that it's true whether or not you believe in it."

Neil deGrasse Tyson

American astrophysicist, cosmologist, author, and science communicator

Frederick P. Rose Director, Hayden Planetarium
Rose Center for Earth and Space in New York City
Communication Resources

• Center for Science in the Public Interest Agricultural Biotechnology Project
  https://cspinet.org/protecting-our-health/biotechnology

• Centers for Disease Control and Prevention (CDC) Pesticides and Health
  http://ephtracking.cdc.gov/showPesticidesHealth.action

• Genetic Literacy Project
  https://www.geneticliteracyproject.org/

• National Academy of Sciences Genetically Engineered Crops Report
  https://nas-sites.org/ge-crops/

• Alliance for Food & Farming
  http://www.foodandfarming.info/
Communication Resources

- International Food Information Council (IFIC) Foundation’s *Understanding Our Food Communications Tool Kit*
  www.foodinsight.org/articles/understanding-our-food-communications-tool-kit

- IFIC Foundation’s *Food Biotechnology: A Communicator’s Guide to Improving Understanding, 3rd edition*
  www.foodinsight.org/education/food-biotechnology-communicators-guide-improving-understanding

- USDA National Organic Program
  http://www.ams.usda.gov/AM Sv1.0/getfile?dDocName=STELPRDC5101542

- Hunger and Environmental Nutrition (HEN) Dietetic Practice Group *Organic Talking Points*
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Donate online at [www.eatrightfoundation.org](http://www.eatrightfoundation.org)

**THANK YOU!**
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QUESTIONS?

Speaker Name
Title
Affiliation

Event
Location
Date
References

References


References


