SUSTAINABLE AGRICULTURE

This presentation is sponsored by the Beginning Farmer and Rancher Development Program.
Objectives

- Explain the differences and benefits of sustainable agriculture over traditional agriculture
- Understand the methods of soil and water protection
- Explore the purpose and application of integrated farming methods
- Gain an introductory knowledge of the benefits and methods of rational and multi-species grazing
“Consumers are increasingly demanding on the ethical dimension of food quality. This relates to the process of production and trade and its broad impacts on society and the environment. It includes a wide range of social, environmental or cultural issues such as the treatment of workers, a fair return to producers, environmental impacts and animal welfare.”

[Byers and Liu, 2008]
Farm as an Ecosystem: Energy Flow

Sustainable agriculture is the practice of farming using principles of ecology

- Some of the objectives of this type of farming are:
  - *Protect the soils from erosion and degradation*
  - *Increase soil fertility*
  - *Conserve water and natural habitats*
  - *Reduce emission of greenhouse gasses*
Sustainable Agriculture

This type of farming relies on and protects nature by taking advantage of natural goods and services, such as biodiversity, nutrient cycling, soil regeneration and integrated pest management.
Sustainable Agriculture

This type of agriculture is a clear contrast to traditional agriculture models characterized by:

- Traditional Agriculture
  - Use of non-renewable and synthetic resources (fossil fuels, chemicals and genetically engineered crops)
  - Intensive farming of monocultures (reduces diversity and damages soil structure and fertility)
  - Breaks mineral and nutrient cycles
  - Promotes erosion (intensive tillage and other agricultural practices)
<table>
<thead>
<tr>
<th>Conventional Farming</th>
<th>Sustainable Farming</th>
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<td>Fuel and input intensive</td>
<td>Information and labor intensive</td>
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<td>Linear process</td>
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<td>Farm as factory</td>
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<td>Enterprise separation</td>
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<td>Single enterprises</td>
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<td>Monoculture</td>
<td>Diversity of plants and animals</td>
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<td>Single-use equipment</td>
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<td>Passive marketing</td>
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Sustainable Agriculture

- Sustainable farmers limit the use of external inputs and work to maximize reliance on natural, renewable and on-farm inputs.

- They select alternatives that are the least toxic and least energy intensive. However, converting to sustainable practices does not mean simple input substitution. It requires planning ahead of time to employ preventative strategies to control potential problems before they develop:
  - For example, crop rotation protects the nutrient content in the soil without the need for fertilizers.
  - Introducing different animal species into the grazing rotation reduces the need for week killers (goat and sheep eat plants that cattle will not eat).
  - Rotational grazing helps to control parasites and pathogens in the animals by reducing the time that they are exposed to feces on the ground.
Sustainable Agriculture

By stimulating the health of the farm ecosystem, this type of practice will ensure the long term persistence of the farm.

- This will help to promote:
  - Social sustainability
  - Economic sustainability
Sustainable Agriculture

- There are many specific practices that can be incorporated into a sustainable farm, but the common thread is that these farmers embrace farming practices that mimic natural ecological processes.

- Beyond growing food, the philosophy of sustainability also encompasses broader principles that support the just treatment of farm workers and food pricing that provides the farmer with a livable income.

- Critics of sustainable agriculture claim that these methods result in lower crop yields, however studies have show that over time, sustainably farmed lands can be as productive as conventional farms.
Sustainable Agriculture

Some of the most common agricultural practices that are used in sustainable agriculture are:

- Soil and water protection
- Integrated pest management
- Rotational grazing
- Multi-species grazing programs
SOIL AND WATER PROTECTION
Soil Protection

- The soil consists of several layers that differ in texture, structure, consistency, color, chemical, biological and physical characteristics
  - These characteristics are affected by parent materials, climate, slope, organisms, temperature and time
  - An ideal soil would have:
    - 45% minerals (sand, silt, clay)
    - 25% water
    - 25% air
    - 5% organic matter
- The goal is to return nutrients and organic matter to soil, slow down effects of water and wind and reduce amount of damage done to the soil by tillage
Soil Protection

- There are several practices that are used in sustainable agriculture to protect and enhance soil quality:
  - **Cover Crops (also called green manure)**
    - Crops planted primarily to manage soil fertility, water, weeds, pests, disease and other problems – after a specific period, they are plowed under to improve soil fertility and quality
  - **Conservation Tillage (non or reduced tillage)**
    - By reducing tillage of the soil, it reduces soil compaction, protects soil from wind and water erosion and favors the establishment of a stable ecosystem in the soil (organisms, nutrients and pH)
  - **Composts**
    - Addition of organic matter and nutrients to the soil improves soil structure – by composing the organic matter, pathogens and unwanted seeds and weeds are destroyed in the process
Water Protection

- Agriculture use accounts for over 80% of the water used in the U.S.
- Because of its large share of the total consumption, agriculture is central to the challenge of balancing water demands among other uses, including urban, industrial and environmental uses.
Water Protection

There are different strategies that can be used to conserve water on the farm:

- **Improving water conservation and storage measures**
  - Use plants, cover crops, mulches and residues
  - Use buffers to capture snowmelt

- **Selection of plants adapted to the condition in your area**
  - Drought-tolerant plants
  - Native species
  - Plants with deep root systems survive better

- **Using reduced-volume irrigation systems**
  - Lining above ground ditches
  - Underground and portable piping systems
  - Drip systems

- **Preservation of waterways**
  - Streambank stabilization
  - Protection of riparian buffers
  - Grass waterway
  - Grade stabilizations
  - Wetland restoration
EXAMPLE
Farm as an Ecosystem: Water Cycle

- Management decisions on the farm that add to ground cover and soil organic matter enhance the natural water cycle

- Effective water use on the farm results in low surface runoff, low soil surface evaporation, low drought incidence, high transpiration by plants and high seepage of water to underground reservoirs
INTEGRATED PEST MANAGEMENT
Integrated Pest Management (IPM)

Integrated pest management (IPM) is an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices.

- It uses methods that control pests while reducing exposure to people, property and the environment.

- Some of the methods used are:
  - Biological controls
  - Organic chemical controls
  - Physical controls
How to Control Weeds Using IPM

- Do not allow weeds to form seed heads and/or perennial rooting structure in the cropping systems
- Thoroughly clean equipment before moving it from one farm or location to another to avoid transporting weed seeds from infested fields
- Thoroughly compost all imported manure to insure destruction of viable weed seed
- Improve soil structure, aeration, water infiltration and fertility to optimize crop growth and minimize weed pressure
- Work with neighbors to eliminate or minimize the potential for spread of noxious and problematic weeds from adjacent lands
How to Control Weeds Using IPM

- Some of the most common practices used in sustainable agriculture will help to control weeds in the field, such as:
  - *Crop rotation*
    - For example: crop rotations reduce weeds by eliminating the constant niche established by mono-cropping systems
  - *Strategic planting and cultivation*
  - *Rotational grazing*
  - *Mowing*
  - *Irrigation*
  - *Use of mulches*
Control of Pest Diseases

To control diseases in plants you should select pathogen-free planting materials, resistant cultivars and make a program of crop rotation

- Make sure not to allow plants from the same family as the ones before (like potatoes following tomatoes)
- By interrupting the cycle with a different crop (like corn or squash) you will prevent the persistence of the disease in the plot
- If you have a disease in the crop, you should try to clean all the crop residues to avoid contamination or spreading the disease to other parts of the farm
Plant Disease Management

Use crop rotation, diversity, resistant cultivars, clean seed and soil fertility measure to prevent plant diseases

- **Compost tea** is usually considered as one of the best methods to control fungal diseases in plants
  - It is made by steeping compost in water for 3–7 days. It is also used as a fertilizer
  - Because it is very concentrated it is usually diluted before using
    - It is usually sprayed on the leaves when it is used to control fungal diseases
    - Or, it is applied to the roots when it is used as a fertilizer
ROTATIONAL GRAZING
Rotational Grazing

In rotational grazing, animals graze on one portion of a pasture (called a paddock) while allowing the other portions of the pasture to recover.

- The length of time animals are in the paddock depends on the type of animal, the size of the herd, the paddock and the condition of the pasture.
<table>
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<tr>
<th>Grazing Method</th>
<th>Diagram</th>
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<td>Continuous grazing</td>
<td><img src="image1.png" alt="Continuous Grazing Diagram" /></td>
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<tr>
<td>Rotational grazing</td>
<td><img src="image2.png" alt="Rotational Grazing Diagram" /></td>
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<tr>
<td>Intensive grazing</td>
<td><img src="image3.png" alt="Intensive Grazing Diagram" /></td>
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Advantages to Rotational Grazing

- Resting periods allow pastures to recover and develop better root systems (which in turn improves soil structure and water retention) and helps control weeds in the paddock.

- As the animals graze the paddock they spread manure and return nutrients to the system. Moving the animals often ensures even distribution of the manure around the farm.

- Animals always get access to high quality forage and the resting period helps to reduce parasite and bacterial infections in the animal by reducing exposure of the animals to feces.

- Promoting the establishment of a diverse and dense pasture, farmers are able to extend the grazing season.

- Paddocks are usually more stable and resilient than intensively grazed paddocks. They are also more capable of responding to adverse environmental conditions, such as drought.
Multi-Species Grazing

- In addition to the rotational management, many sustainable farmers have discovered the advantages of having multiple species grazing on the same paddocks
  - *This management practice is based on the fact that cows and horses prefer grass, sheep prefer forbs and goats prefer trees and shrubs*
  - *There is no competition for resources and there is better use of the paddock*
  - *Studies have shown that by increasing the number of animal species in the paddock, you can increase meat production by 24% versus just grazing cattle*
  - *Also, because cows, sheep and goats have different internal parasites, there is no initial risk of disease transmission*
Multi-Species Grazing

- Multi-species grazing is flexible and can be done either simultaneously by putting all of the animals in the paddock together at once (called “mob grazing”) or in a “leader-follower” method, which places one flock or herd through a pasture for a grazing period, then immediately following with another flock or herd.

- One other method is to use the principles of rotational grazing and keep the animals in different paddocks and then rotate the species as part of the rotation.
Multi-Species Grazing

- Some people include pigs and chickens in the rotation
  - *In the case of chickens, it can be done by letting them loose in the paddock along with other animals*
  - *Or, moving the chicken portable pens as part of the grazing rotation*
    - Chickens will benefit from short pasture and will be able to eat the insects that are attracted to the feces of the larger animals
    - Also, by breaking up the feces, any parasite or bacteria present in them will die faster and reduce disease problems
    - Finally, by breaking up the feces, it acts as a natural fertilizer for the land and it is packed into the soil from the animals
Multi-Species Grazing

- However, there are some things to consider when grazing different animals in the same paddock:
  - **Copper toxicity in sheep**
    - Sheep can die of copper toxicity which is one of the important minerals in cattle feed. Keep the cattle feed higher so that cattle can reach it, but sheep cannot.
  - **Bullying problems**
    - Even though cattle can look impressive and scary due to size, it is the rams that end up causing most of the problems. If an animal doesn’t like sharing, remove it from the group.
  - **Fencing**
    - Goats in particular are hard to keep fenced in. Electric fencing is generally the best alternative when keeping a multi-species group.
Need more information?

- ATTRA. What is Sustainable Agriculture?
  - https://attra.ncat.org/fundamental.html

- SARE. Sustainable Agriculture Research & Education. What is Sustainable Agriculture?
  - http://www.sare.org/Learning-Center/SARE-Program-Materials/National-Program-Materials/What-is-Sustainable-Agriculture

- SARE. Sustainable Agriculture Research & Education. Online Curriculum on Sustainable Agriculture.
  - http://www.sare.org/Learning-Center/Courses-and-Curriculua/National-Continuing-Education-Program/Course-1-Sustainable-Agriculture

- National Sustainable Agriculture Coalition.
  - http://sustainableagriculture.net/publications/
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