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This presentation is part of an educational modular program designed to provide new and beginning farmers and ranchers with relevant information to initiate, improve and run their agricultural operations



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Sustainable Agriculture: WATER

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Sustainable agriculture is a social and ecological movement that evolved as a response to the multiple problems caused by irresponsible and unplanned intensive and extensive agriculture





Intensive and extensive unplanned production systems led to:

- Erosion
- Depletion of soil and water resources
- Contamination of soil and water resources
- Loss of biodiversity
- Deforestation
- Decline of rural areas and family farms





There are many basic strategies for sustainable agriculture, but in general they all are based on:

- Embracing farming practices that mimic natural ecological processes
- Promoting health and wellbeing of all the elements in the environmental (soil, water, plants, animals, humans)
- Providing a profitable and stable income for farm families and communities





Examples of practices of Sustainable agriculture:

- Reduces external inputs fuels, fertilizers, pesticides, feed
- Cycles nutrients back into the soil for fertility and conservation
- Smart water use strategies
- Grazing and pasture management
- Minimize tilling
- Promotes healthy soils by encouraging plant diversity and frequent rotation of the vegetation in each spot
- Avoid the use of chemical fertilizers and pesticides and instead implement practices of integrated pest and weed management and reintegration of on-farm resources, such as manure, litter, crops, etc.
- Waste management plans





Table 1. Comparison of the conventional and sustainable models of agriculture

<u>Conventional model</u>	<u>Sustainable model</u>
Fuel and input intensive	Information and labor intensive
Linear process	Cyclical process
Farm as factory	Farm as ecosystem
Enterprise separation	Enterprise integration
Single enterprises	Many enterprises
Monoculture	Diversity of plants and animals
	
Single-use equipment	Multiple-use equipment
Passive marketing	Active marketing



Elements in the Farm Ecosystem



- Soil
- Water
- Plants
- Animals
- Humans



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Sustainable Agriculture

A close-up photograph of a single, clear water droplet hanging from the tip of a green grass blade. The background is a soft, out-of-focus green field of grass.

WATER



Agricultural 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





In some areas, rainfall is available and sufficient for crop growth, but many other areas require irrigation

For irrigation to be sustainable, it requires proper management to avoid:

- salinization of the soil
- depleting water resources
- excessive use of fuels to obtain water





As part of a sustainable farming plan, it is important to include sustainable water usage and conservation strategies, including:

1. Improving water conservation and storage measures
2. Selection of drought-tolerant crop species
3. Using reduced-volume irrigation systems
4. Managing crops and land to reduce water loss
5. Preservation of waterways





Water conservation strategies

- Use conservation practices that promote water infiltration and minimize water loss
 - Protect the soil surface with plants, cover crops, mulches and residues
 - Use buffers to capture snowmelt, reduce runoff and prevent erosion
 - Use manure, cover crops and crop residues to increase organic matter and build soil quality



Cover crops help to manage water and soil loss in vineyards



Water conservation

Soil management is an important aspect of water availability and water conservation

- In many areas, crops do not use most of the water they receive because farm soils are unable to store this water and the water is lost as runoff
- Good soil structure improves water infiltration and decreases runoff and erosion
 - Strategies that help to increase organic matter in the soil such as reduced tillage, add compost or manure into the soil, cover crops, will help to improve soil structure
 - All these strategies are included in the presentation of Sustainable agriculture: SOIL, also in this program





Plant management for water conservation

Selecting plants adapted to the conditions on your area is an important water management strategy

- Consider drought-tolerant varieties
- Native species usually perform well
- Plants with deep root systems will be able to survive better during a drought (such as alfalfa)



Native grasses such as Virginia Wildrye (*Elymus*), Purpletop (*Tridens*) and broomsedge (*Andropogon*) are successful in Arkansas and the Southeast region



Plant management for water conservation

- Crop rotation
 - Traditionally farmers would leave the land fallow to conserve water for their crops
 - The fallow system relies on the tenet that leaving the land bare over a year or more allows water to accumulate in the soil
 - Numerous studies have shown that planting nitrogen building cover crops, improve the soil and water retention significantly more



Plant management for water conservation

Selection of plant species that need little water:

- Native grasses
- Sunflowers, sorghum, amaranth, pearl millet, foxtail millet, cowpeas and mung beans



Amaranth



Foxtail millet



Cowpeas



Smart Irrigation systems

- It is important to take into consideration your cropping and livestock systems, management constraints and water supplies before deciding on an irrigation system
 - Contact your local extension or USDA's Natural Resources Conservation Services (NRCS) office for assistance in your area





Smart Irrigation systems

- Water delivery systems
 - Lining above ground ditches with impermeable materials can decrease water loss by seepage and improve efficiency
 - Underground or portable piping systems
- Irrigation systems
 - With proper design and installation, a center pivot sprinkler can achieve high irrigation efficiency and uniform application
 - Other strategies such as furrow irrigation strategies, alternated irrigation can help save water
 - The USDA's NRCS offices have cost-share programs to encourage water saving systems



Problems with poorly planned irrigation systems

- Drip systems help to avoid increasing salinity downstream, a serious problem with flood irrigation in arid environments.
- Irrigation water discharging from furrows carries dissolved solids picked up from the soil
- Farmers near a river's headwaters who divert part of the water into furrows multiply the amounts of solids-and salinity-for each farm that follows



Soil salinization



Preservation of waterways

Streambank stabilization

Riparian buffers

Grass waterway

Grade stabilization structure

Wetland restoration





Streambank stabilization

Protecting a stream or other body of water by re-shaping and stabilizing the bank and excluding livestock

Stabilizing the streambank reduces erosion, protects water quality, improves fish habitat, and the vegetation provides habitat for birds and small animals.





Streambank stabilization

How it works

Streambanks can be re-shaped by adding some kind of structure to protect it, such as fences, rocks or lunkers (wood structures)



Streambank stabilization

Planning

- Remove large obstacles such as logs and stumps from the stream bed if they are causing turbulence along the banks
- For livestock, install an alternate watering system away from the stream, restrict access to only a part of the waterway or create a stream crossing that can also provide access to water
- In prone to flooding areas, single or double wire electric fences with flexible line posts may be more practical than a permanent fence



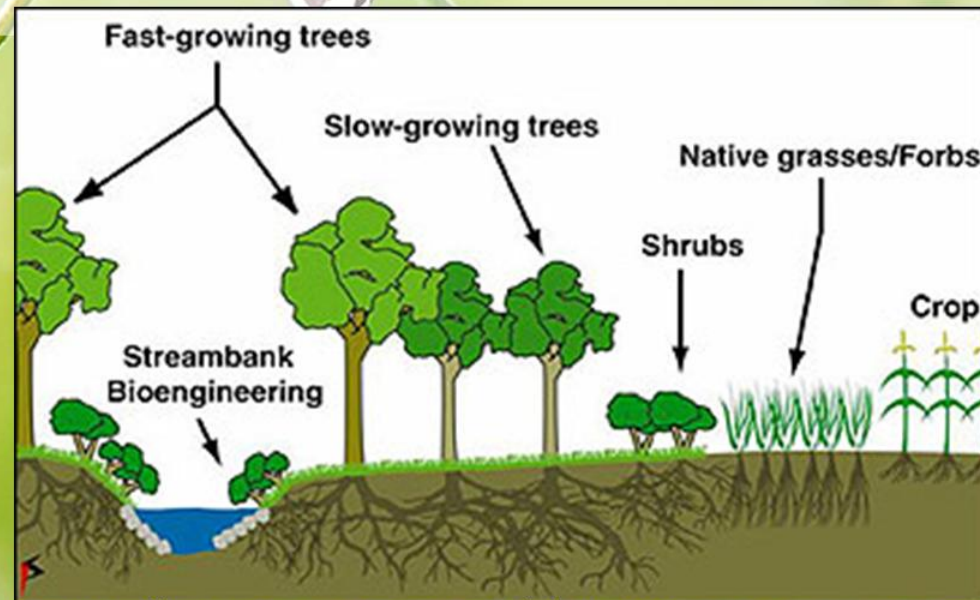
Allow access to the water from only certain areas that have been fenced and treated to prevent erosion

Riparian buffers

Riparian buffers are strips of grass, trees or shrubs established along streams, ditches, wetlands or other water bodies (buffer strip")

Riparian buffers trap sediment, filter nutrients, and provide habitat and corridors for fish and wildlife

They are a second step for bank stabilization





Buffers are designed to incorporate three different zones:

Zone 1: large native tree species

Zone 2: native shrubs

Zone 3: native grasses

Work with a conservationist to select plants for your buffer and determine its width





Riparian buffers

- This can increase land value, as people who purchase land for recreational use are willing to pay more if there is more wooded area on the land
- Use profitable crops such as black walnut and hazelnut
- Avoid grazing on buffer areas
- Delay mowing grass areas until after July 15 to protect nesting birds
- Remove sediment and reseed the buffer periodically



Grass waterway

- Shaping a natural drainage way and establishing grass to prevent gullies from forming in fields

The drainage way carries runoff water from the field and the grass prevents the water from forming a gully

The vegetation may also trap some sediment washed from cropland, absorb some chemicals and nutrients in the runoff water, and provide cover for small birds and animals



<http://plantandsoil.unl.edu/croptechology2005/pagesinclude/s/printModule.jsp?informationModuleId=1088801071>



<http://conservemyland.org/best-management-practices/grass-waterway>



Grass waterway

- A grade stabilization structure may be needed at the bottom of the waterway to prevent a gully from forming
- The width and depth of the waterway will depend on the nature of the fields it drains.

- Do not use the waterway as a roadway
- Fertilize and mow as needed, but wait until after July 15 when birds are done nesting to mow
- Be careful not to till into the edges of the waterway
- Avoid end rows planted along the waterway, because they may allow gullies to form on the waterway edge



<http://conservemyland.org/best-management-practices/grassed-waterway>



Grade stabilization structure

- An earthen, concrete or other structure built across a drainage way to prevent gully erosion



Grade stabilization structure

- A dam or embankment built across a gully or grass waterway drops water to a lower elevation while protecting the soil from gully erosion or scouring
- Structures are typically either a drop spillway or a small dam and basin with a pipe outlet.



Rock dam



Rock bowl



Worm ditch



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Grade stabilization
Log and fabric step falls



Wetland restoration

- Restoring a previously drained wetland by filling ditches or removing or breaking tile drains
- The wetland temporarily holds runoff (reducing flooding downstream), and filters sediment, nutrients and chemicals before the water recharges groundwater.





Wetland restoration

In places where wetlands have been drained and farmed, there are different strategies to try to recover the wetland:

- Create small dikes or embankments around the natural water body so that water can naturally refill the area
- Dig to form a shallow basin and install small dikes or embankments to establish and maintain water levels





Wetland restoration

- Exclude livestock from the area
- Control beavers and muskrats, and keep burrowing rodents out of dikes
- Establish and maintain vegetative cover embankments and spillways
- Existing natural seed banks will sometimes regenerate native vegetation in the wetland
- Adjacent upland nesting cover greatly improves the value of wetlands for wildlife (ducks, geese, native birds)
- Consider whether plugging drains or breaking tile lines will have adverse effects on other parts of your farm, neighboring farms or established drainage districts.





Balanced crop-livestock strategies

Multi species grazing can help to ensure better usage of crops and thus help to have better usage of the water resources

- Different livestock species favor different forages
- Different species have different grazing methods and behaviors
- You can increase or decrease the number of animals depending on the season
- Plus the manure is recycled into the soil and helps to improve soil structure and retain more water



Strategies for smart water usage are essential for sustainable farming

Including:

1. Improving water conservation and storage measures
2. Selection of drought-tolerant crop species
3. Using reduced-volume irrigation systems
4. Managing crops and land to reduce water loss
5. Preservation of waterways

Other topics related to sustainable agriculture are included in other modules in this program





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This presentation was prepared by:



Dale Bumpers College of Agricultural, Food and Life Sciences and
the Division of Agriculture; University of Arkansas, Fayetteville AR

Dan Donoghue

Ixchel Reyes-Herrera



USDA-ARS-Poultry Production and Product Safety
Research Unit, Fayetteville AR

Annie Donoghue

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