



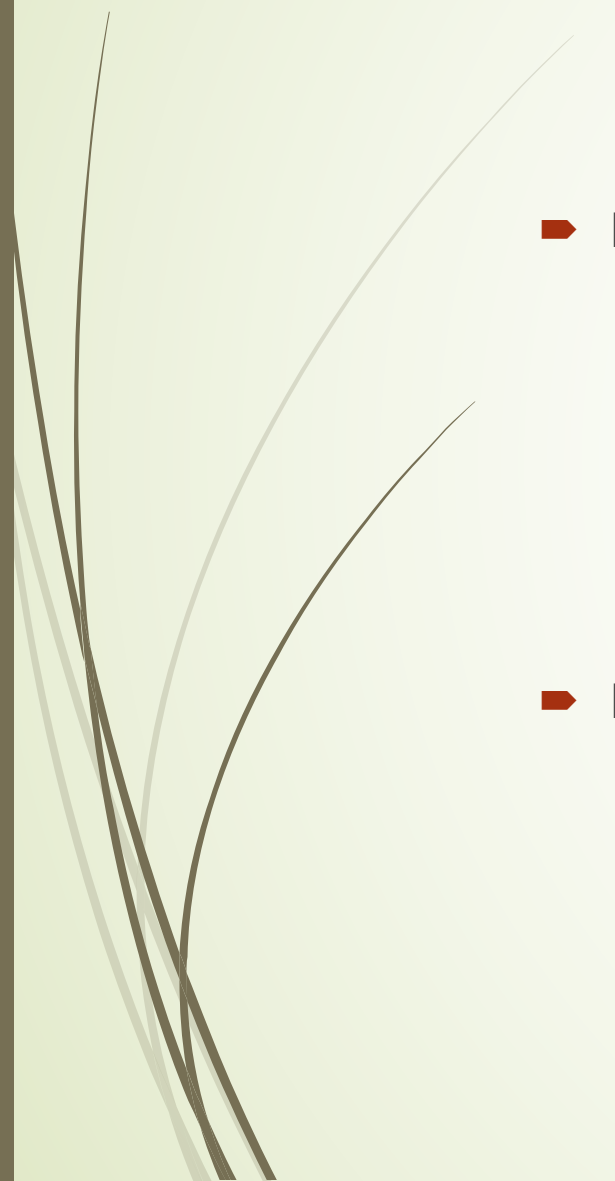
Farm Adaptation and Success

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Summer 2024



What we will cover

- Farm Adaptation
 - Environmental challenges
 - Weed pressure
 - Pest pressure
 - Practices for resilience
 - Hydroponics
 - Farm Success
 - Value Added items
 - Beekeeping
- 



Challenges will always be present

- Challenges
 - Access to farmable land
 - Access to water...volume, quality, duration
 - Access to equipment
 - Adverse weather events
 - Climate change
 - Competition
 - Marketing
 - Time and help
 - Discrimination
- 

Adverse Weather Events

■ Frost

- Last frost vs first frost
- Can cause tissue damage or death
- Plants that appear damaged can recover once temps warm...ex. salad mix

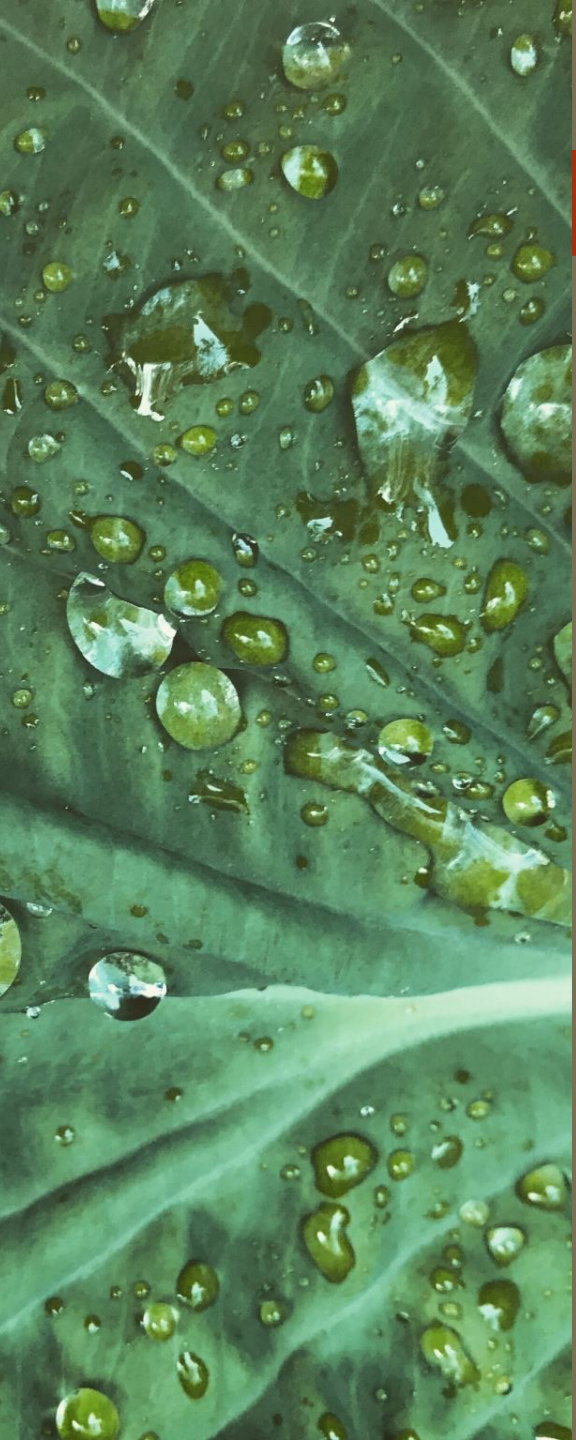
■ Wind

- Creates soil crust
- Reduce germination rate
- Cause plant damage

■ Hail

- June vs August
- Can reduce germination, cause tissue damage, cause damage to fruit





Adverse Weather Events

- Sun
 - Intensity of Colorado sun can cause sun scald on leaf tissue and fruits
 - ex. peppers
- Heat
 - Heat stressed plants cease metabolic functions
 - Stomata close thus halting water and nutrient uptake and photosynthesis
- Drought
 - May adversely effect quantity and duration of irrigation water access
 - Permanent wilting point will lead to necrosis of plant tissues
- Snow
 - Can collapse greenhouses
 - Delayed planting dates or early end of season

Adapting to Adverse Weather

■ Season extension

- Reduces vulnerability to frost, hail, insect damage, wind, sun
- Greenhouse
 - Can be fully climate controlled
 - Can use shade cloth or insect netting vs. plastic film
 - Con...can be costly to build and maintain

■ Row cover

- AKA spun bound fleece, Remay, floating row cover
- Thin weight for insect exclusion, moisture retention, and shade, thick weight for frost protection
- Cons
 - Wind!
 - Costly to set up
 - Must be suspended above plants...not effective if laying directly on plant tissue
 - Time consuming



Climate Change and Agriculture

- Tremendous threat to agricultural productivity and food security
- Extreme weather events
 - Droughts and floods
 - Wind and hail
- Erratic weather patterns
 - Changing habitat ranges
 - USDA Zone shift
 - In our area...temperature changes and unpredictable last frost and first frost dates can impact crop planting dates
- Reduced water availability
- Declining biodiversity
- Introduction of new pests and diseases due to warmer temperatures and less severe winters

Severe fires can stunt plant growth or destroy crops and farms



Eric Howard Weld County, CO 2013

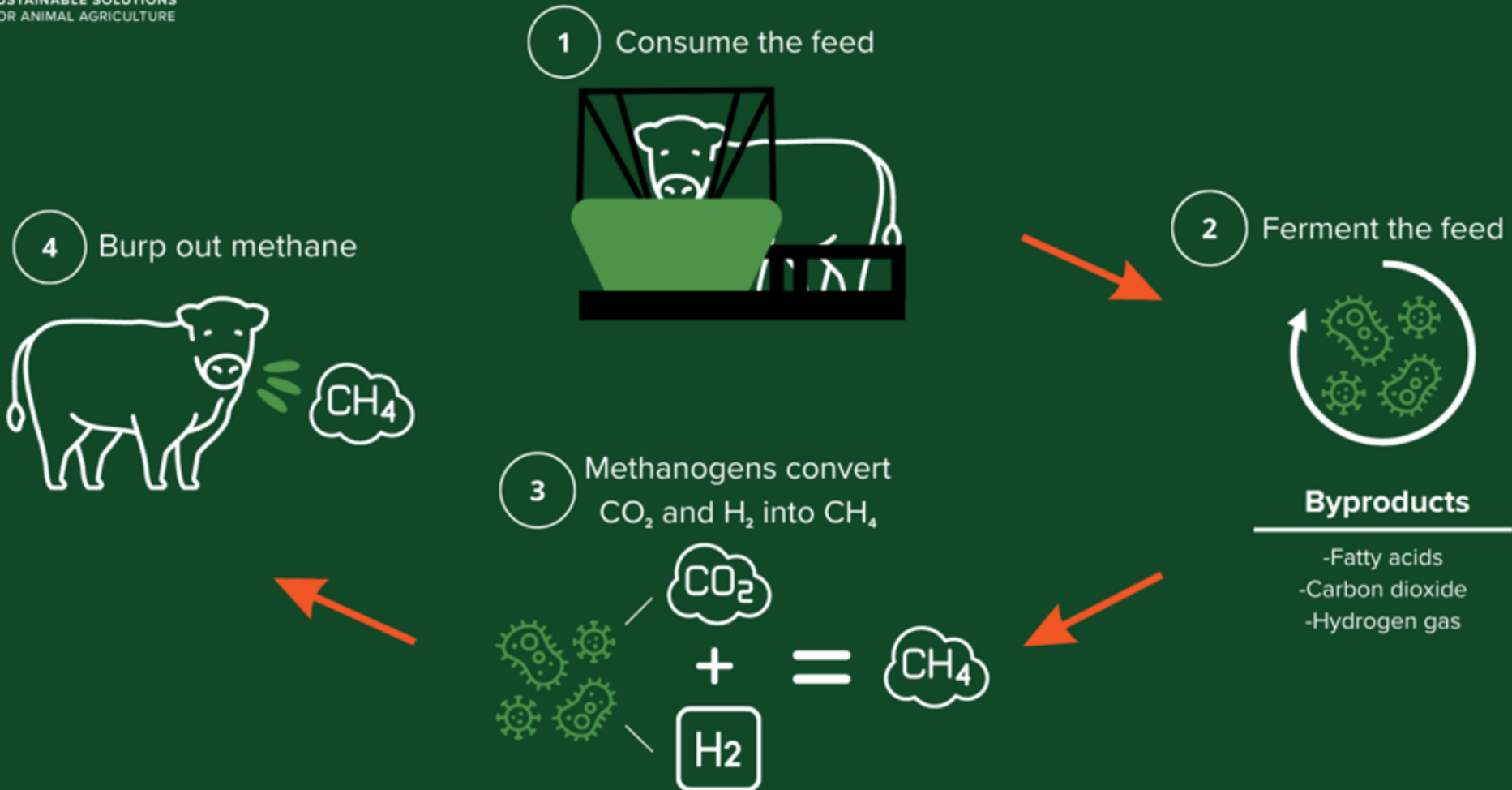


Climate Change and Agriculture



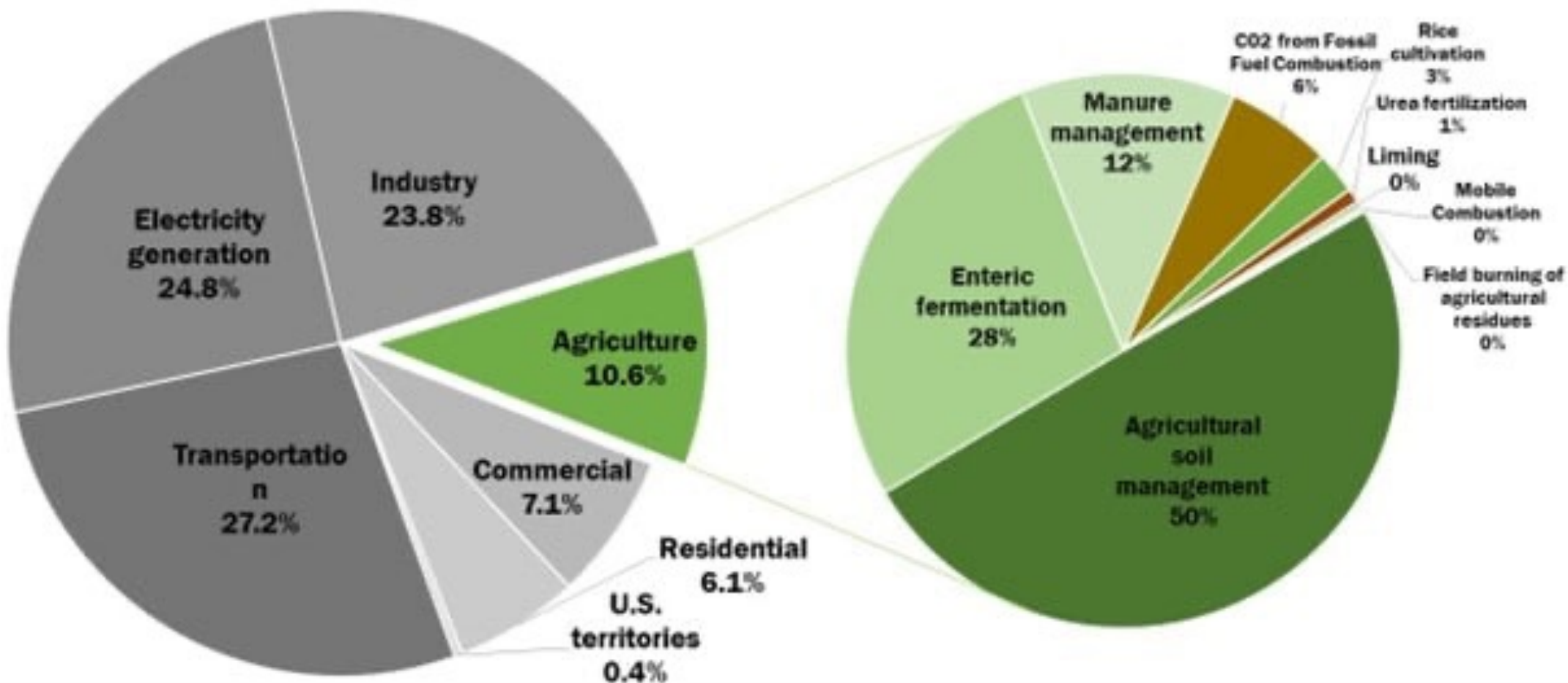
- Several agricultural practices contribute to greenhouse gas emissions
 - Soil practices
 - Decomposing matter and microbial activity generate CO₂
 - Soil has the ability to capture and hold carbon via carbon sequestration
 - Damaged or degraded soil releases CO₂ and methane into the atmosphere
 - Tillage releases sequestered carbon
 - Farm equipment emits CO₂ from fossil fuel combustion
 - Livestock management
 - Manure management... manure is often disposed of in piles, slurries, and lagoons releasing nitrous oxide and methane
 - Digestive process of ruminants... grain-based diet not conducive for digestive health
 - Industrial livestock facilities vs. pasture and grazing operations
 - Concentrations of manure and urine become toxic vs. a natural resource for soil health when spread out

The Enteric Fermentation Process



U.S. and Agricultural Emissions By Source, 2020

Agriculture continues to be just 10% of U.S. Greenhouse Gas Emissions



AMERICAN FARM BUREAU FEDERATION*

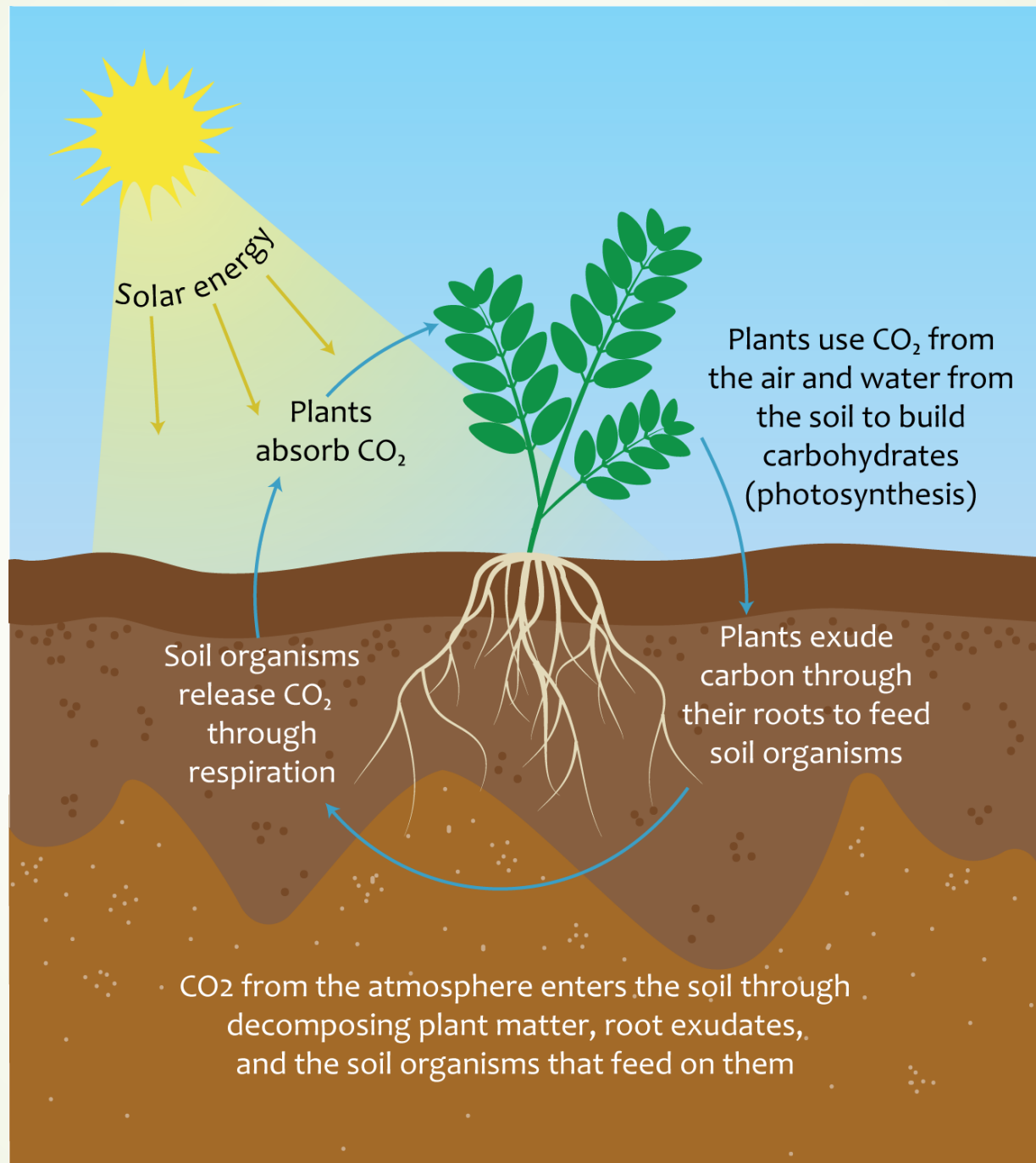
www.fb.org

Source: Environmental Protection Agency,
Farm Bureau Calculations



Resilience to Climate Change

- Soil management
 - Reduced tillage
 - Reduces need for equipment and fuel consumption
 - Reduce release of sequestered carbon in soil
 - Improve carbon sequestration by increasing crop residues left on field and organic matter stored in soil
 - Increase use of cover crops
 - Increase field residues, add additional organic matter to soil
 - Test soil regularly
 - Can reduce nitrogen applications, change in application timing to better match plant uptake of nutrients
 - Precision application of fertilizers, use slow-release fertilizers



Resilience to Climate Change



- Livestock management
 - Change feed
 - Use feed additives to reduce methane production
 - Install digesters to capture methane produced during manure storage
 - Captured methane can be used to generate electricity
 - Allow animals to graze
 - Better for digestion
 - Reduces concentration of manure requiring disposal
 - Reduce manure storage time



Resilience



- ▶ Variety selection
- ▶ Use ground covers and mulch to retain soil moisture
- ▶ Irrigation timing
 - ▶ Reduce evaporation by not watering in the heat of the day
 - ▶ Utilize drip irrigation vs. overhead systems
 - ▶ Proper water applications can reduce heat stress
- ▶ Apply for conservation programs that offer incentive payments for reducing greenhouse gas emissions
 - ▶ Conservation Reserve Program (CRP) CRP is a land conservation program administered by the Farm Service Agency (FSA). In exchange for a yearly rental payment, farmers enrolled in the program agree to remove environmentally sensitive land from agricultural production and plant species that will improve environmental health and quality. Contracts for land enrolled in CRP are from 10 to 15 years in length. The long-term goal of the program is to re-establish valuable land cover to help improve water quality, prevent soil erosion, and reduce loss of wildlife habitat
 - ▶ Programs that encourage ag producers to grow feedstocks used for biofuels or provide land for wind and solar power generation
- ▶ Plant more grasses and trees on farms

Environmental Quality Incentives Program (EQIP) Is EQIP Right for Me?



Can You Answer 'Yes' to the Following?

Then EQIP may be a good fit for your operation

- ☒ I own or rent, and manage land for agricultural or forest production, such as cropland, rangeland, grassland or forestland.
- ☒ I have control of the land such as through ownership or a lease.
- ☒ I can prove irrigation history if my conservation work involves water conservation with irrigation system improvements.
- ☒ My land complies with highly erodible land and wetland conservation determination provisions (if unsure, ask your local USDA Service Center).
- ☒ I established or updated farm records with the Farm Service Agency for me and my operation.
- ☒ I have a social security number or employer identification number issued by the IRS.
- ☒ My average gross income is less than \$900,000 (does not apply to Indian Tribes).
- ☒ If I am a member of an entity or joint operation, I have authority to make management decisions for the business.

What is EQIP?

The Environmental Quality Incentives Program (EQIP) offers technical and financial assistance for working lands, including field crops, specialty crops, organic, confined livestock and grazing, and non-industrial private forest land.

Rather than take land out of production, EQIP helps farmers maintain or improve production while conserving natural resources on working landscapes.

What Are the Benefits?

EQIP may provide many benefits, including improved water and air quality, conserved ground and surface water, increased soil health and reduced soil erosion and sedimentation, improved or created wildlife habitat, and mitigation against drought and increasing weather extremes.

For example, EQIP can help you:

- Reduce contamination from agricultural sources, such as animal feeding operations.
- Efficiently utilize nutrients, reduce input costs and reduce non-point source pollution.
- Increase soil health to help mitigate against increasing weather volatility and improved drought resiliency.

How Does EQIP Work?

EQIP supports producers who improve and sustain natural resources on their operation by implementing structural, vegetative, and management practices.

For example, if you want to use EQIP conservation practices to improve irrigation efficiency, renovate pastureland or nutrient and pest management on your eligible land,



Pest Pressure

- Pests can reduce a crops optimal performance, productivity, and growth
- Can reduce yields and cause damage to marketable portion of crop
- Reduced profitability
 - Insect damaged produce is less desirable to consumer
 - Crop may end up in secondary market for less value
 - Mitigating pest infestations can be costly and time consuming
 - Post-harvest processing can be time consuming---culling and sorting
- Can be vectors of viruses and diseases



Macro Pests

- Deer, rabbits, chipmunks, squirrels, gophers, prairie dogs, birds, mice
- Can cause substantial crop loss in a very short period of time
- Challenging to control or eliminate
- Costly and time consuming
 - Deer fencing
 - Traps
 - Wildlife mitigation services
- Repellents can be effective
 - Castor oil, cayenne, peppermint essential oil, dried blood, coyote urine, hair
- Barn cats and dogs can be helpful



Insect Pests

➤ Chewing insects

- Examples grasshoppers, caterpillars (imported cabbage moth), flea beetles, Colorado potato beetle, slugs, pill bugs
- Can cause severe damage, especially to marketable portion of plant
- Holes, shot holing, stem girdling, skeletonizing

➤ Piercing-Sucking Insects

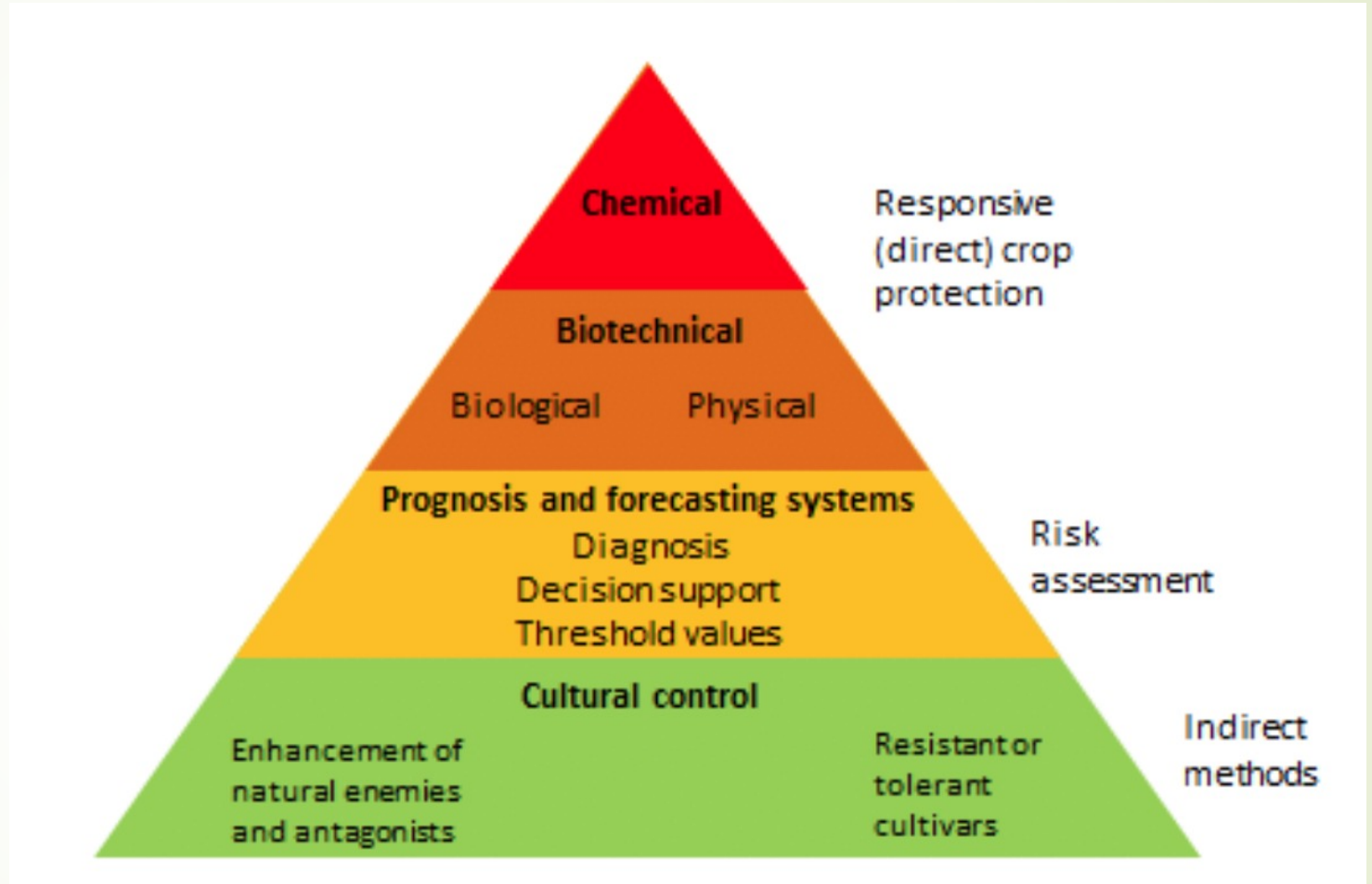
- Examples aphids, mites, squash bugs, weevils, thrips, leaf miners
- Suck carbohydrates directly from plant cells
- Weaken plants performance, can vector viruses and diseases
- Cause stippling, large amounts of sugary secretion from waste that can attract secondary pests such as ants and wasps....ants and carrot seeds



Integrated Pest Management (IPM)

➤ Basic Principles:

1. Identify pests and monitor progress
2. Set action thresholds
3. Prevent
4. Control





Insect Pest Management

Prevention

- Variety selection
- Healthy plants
- Plant spacing...allow air circulation
- Pruning...remove dead and dieing leaves, lower leaves
- Sanitation of tools and environment
- Insect cloth and lightweight row cover
- Plant companion plants that repel insects ie marigolds

Control

- Burn crop residues
- Solarization
- Trap crops
- Cover crops to create habitat for beneficial predators
- Crop rotation



Insect Pest Management

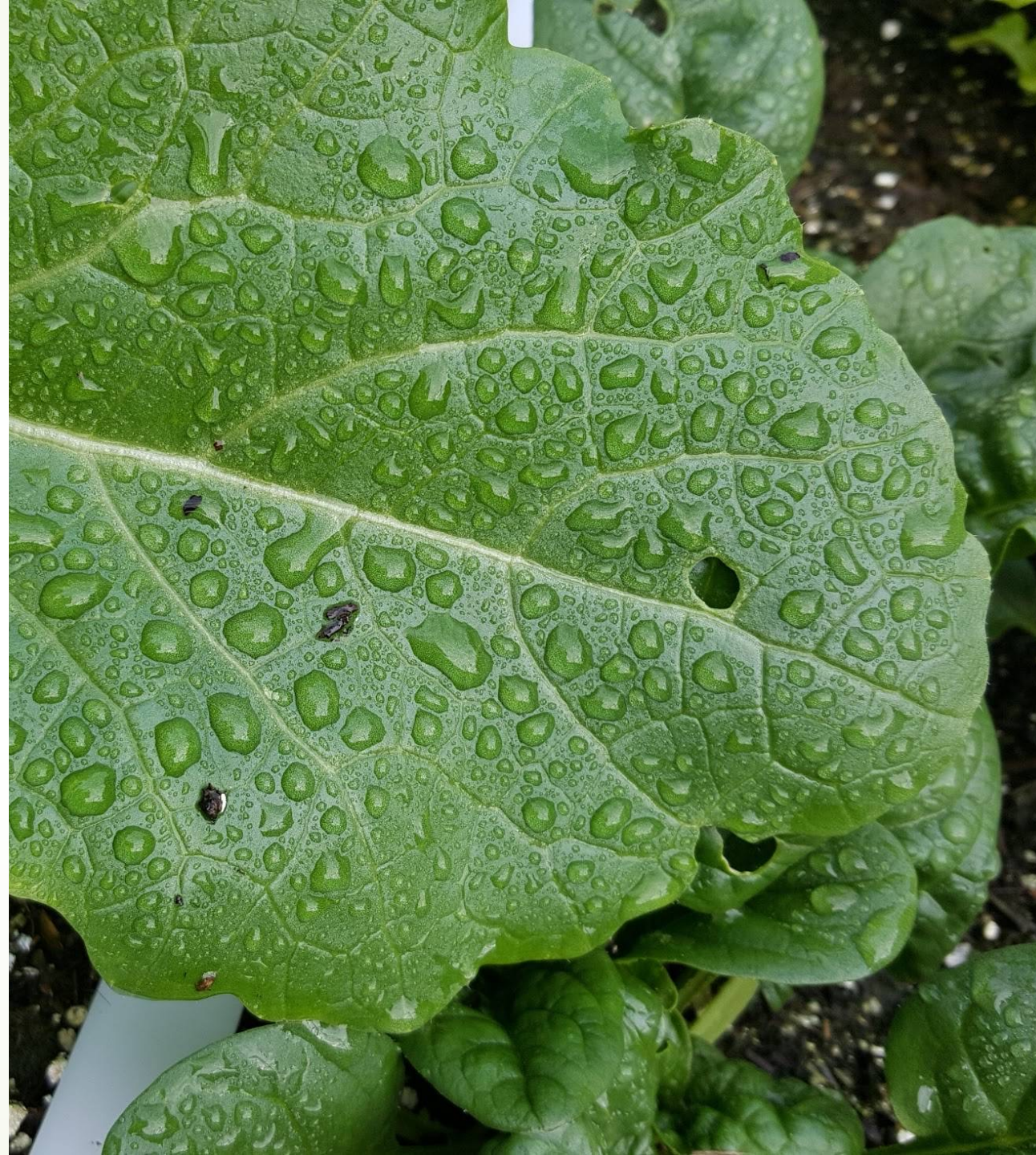
- Biological control
 - Utilizing predatory insects to control pests
 - Ladybugs, praying mantids, lacewings, predatory mites, minute pirate bugs, wasps, nematodes, Assassin bugs
 - Can be costly and timely
 - For many predatory insects...the larval stage is the most effective for control.
 - Time is essential to allow adult stage insects to mate and lay eggs before the larval stage can effectively control a pest
 - Outbreaks can become worse while waiting for biologicals to take effect
 - Biological pesticides...active ingredient is commonly beneficial bacteria or derived from natural materials
 - *Bacillus thuringiensis*
 - Spinosad

Natural Pest Control

- If you must use a pesticide there are many safe and effective natural options
- ALWAYS follow label directions, wear proper PPE (personal protective equipment), abide by re-entry intervals and communicate with employees
- Insecticidal soaps and oils smother soft bodied insects
 - Neem oil, canola oil, soybean oil, peppermint oil, cayenne, garlic oil, thyme oil, rosemary oil
 - Can cause burning/magnification if applied during direct sun
 - Can clog stomata, may require leaf rinse
- Diatomaceous earth is abrasive/dehydrates and can control many soil born insects
 - Slugs, ants, beetles, caterpillars, root aphids
- Sulfur, sodium bicarbonate (baking soda) can be effective for changing the pH of the leaf surface to control powdery mildew
 - Sulfur can be effective against some species of mites...no sulfur after oil
- Pyrethrin although naturally derived from chrysanthemums is a neurotoxin so be extremely careful to minimize contact

Economic Threshold

- Tolerable loss vs. Financial/time burden
- All agriculture production will result in some level of loss due to factors beyond the producer's control
- At what point will you end up spending more time and money to treat a problem than the actual level of loss you will experience from that problem?
- Not all produce needs to be perfect...industrialized food system has trained consumers to prefer "perfect" produce which is just not realistic
- Use imperfect produce as a teaching tool to educate customers of what real food looks like
- Everything in nature must eat so we can share a little even with the pests
- Suspiciously perfect food is often heavily treated food!



Not All Pests
are Insects!



Weed Pressure

- “A weed is any plant deemed undesirable by man” Dr. Newman
- Weeds are one of the largest challenges to control when using natural growing practices
- Many weeds are edible, have medicinal properties, and benefit soil health however they can compete with crops for space resources
- Weeds are evolutionary masters designed to survive in the most adverse conditions
 - Mimicry, weak breaking points, minimal inputs for growth
- Weeds can easily propagate and spread





Weed Management

- Reduce tillage
 - Thrive in disturbed soil
 - Tilling can also break roots into several small propagules that can all reproduce a new plant
- Cover crops
 - Can outgrow and compete/smother with weeds
- Solarizing
- Pre-irrigation
- Flame weeding
- Prevent seed production
- Crop rotation
 - Squash is easy to weed vs. salad mix
 - Use “smother crops” to clean up weedy areas
- Mulches and groundcovers
 - Weed barrier fabric, plastic mulch, cardboard and woodchips
- Horticultural vinegar and industrial strength hydrogen peroxide can be a helpful tools

Hydroponics 101

- 10th century Aztecs were using floating gardens in nearby lakes
- 13th century Chinese utilized hydroponics for rice fields devoid of soil
- 1924 Dr. Gericke of the University of CA created the word 'hydroponics' to describe growing in non-soil media and nutrient-enriched water indoors and outdoors
- Can be extremely water efficient and produce very rapid growth and high yields
- Could become more essential in the future due to declining soil health, scarcity of water and farmable land, erratic weather events



A photograph of a hydroponic greenhouse. The image shows long, parallel rows of tomato plants growing in white foam channels. The plants are lush green with many green and some ripening red tomatoes. A central aisle made of wooden planks runs down the middle of the greenhouse, flanked by the plant rows. The structure is covered with a translucent plastic or polyethylene film, and the perspective leads the eye down the length of the greenhouse.

Hydroponics

- Several styles
- Recirculating systems
 - Ebb & Flow
 - Aeroponics
 - Deep Water Culture (DWC)
 - Aquaponics
 - Nutrient Film Technology (NFT)
- Drain to Waste
 - Inherently less efficient and more wasteful



Hydroponics

- Most commonly grown crops: leafy greens, lettuce, tomatoes, peppers, cucumbers, strawberries, herbs
- Crops with fibrous root systems perform best, root crops not so much
- Vertical systems can be extremely efficient use of space
- Initial set up can be costly
 - Reservoirs, flood tables, net baskets, water pumps, oxygen pumps, cycle timers, water heaters/chillers, media, nutrients, pH/PPM meter, supplemental lighting may be necessary
- Possible to use organic nutrients but commonly utilizes synthetic nutrients

Hydroponics

- Factors must be regulated for optimal growth
 - Water quality...can require filtration to remove excess chlorine and particles that can clog irrigation emitters
 - Ozone or UV light can be used to sanitize water
 - Water temperature
 - 68 degrees is the magic number
 - Cold water loses dissolved oxygen, warmer water can cause root rot
 - Can require water heaters or chillers to maintain optimal temperature
 - Dissolved oxygen required in water for nutrient absorption and to help prevent water-borne diseases
 - Nutrient solution and strength
 - pH is critical for nutrient absorption 5.0-5.8 is ideal
 - Nutrient strength depends on crop and stage of growth
 - Often measured using PPM (Parts Per Million) or E.C. (Electrical Conductivity) scales



Hydroponics

■ Grow media

■ Expanded clay pebbles aka Hydroton

- Can be re-used indefinitely after cleaned and sanitized
- Holds little moisture and fertilizer in between watering events

■ Rockwool

- Spun bound basalt
- Can be commercially recycled...more and more facilities becoming available
- Stays more saturated with water and fertilizer in between watering events

■ Coconut coir

- By-product of coconut industry, can be high in sodium and potassium which can affect nutrient uptake
- Behaves similarly to peat-based mediums
- Retains some moisture and fertilizer in between watering events





NFT system at Zion Farm, Durango, CO

Beekeeping

- Can have many benefits to a farm beyond honey and beeswax
 - Pollination to enhance yield potential
 - Essential for orchards and enclosed greenhouse production
 - Uniformity on fruit set due to proper pollination
 - Summer squash, cucumbers, beans and more
- A honeybee can visit upwards of 1,000 flowers a day over a several mile radius
- It can require visiting 1 million flowers to make 1 TBSP of honey!
- Wax capped honey has been found in the tombs of ancient Egyptians...still edible after 5,000 years
- Beekeeping can be easy to become involved with
 - Most communities have local beekeeping groups
 - Four Corners Beekeeping Association

Beekeeping Basics

- ▶ 20,000 species of bees exist throughout the world
 - ▶ 3,600 native to North America
- ▶ *Apis mellifera* 'honey bee'
 - ▶ Several varieties within this genus and species
 - ▶ Carniolan is most common in N. America
 - ▶ Italian, Russian, Buckfast, Minnesota varieties all have various strengths and properties
- ▶ Within the colony..average of 60,000 bees
 - ▶ Queen...1 per hive, unique pheromone signature, mates once with up to 20 drones...can lay 3,000 eggs a day, viable for 2-3 seasons at most
 - ▶ Drone: males, 40 day lifecycle, do not have stingers, sole purpose is to mate
 - ▶ Worker: 40 day life cycle, foragers of water, nectar, pollen, clean hive, make hive products: wax, royal jelly, propolis, defend colony with barbed stinger
 - ▶ Fat Bees: 200 day lifecycle from fall to spring, maintain hive temperature throughout winter, feed queen, collect condensation from hive walls for water



Hive Basics

- Langstroth hive: stacking box style
 - deep boxes for brood can weigh upwards of 60-80lbs
 - Honey supers 60+lbs
- Top bar hive: long horizontal
 - Lighter and easier to move frames...8-10lbs
- Hive placement and orientation:
 - Entrance should face East
 - Don't obstruct "bee line"
 - Do not like wind or too much shade
 - Level, dry, flat ground with good ventilation
 - Need nearby water source
 - Electric fencing may be necessary to keep bears, skunks, out
 - Bear Smart Durango





Hive Maintenance

- Beekeeper's job is to perform tasks throughout the 4 seasons to ensure health of their colony
 - Spring:
 - Supplemental feeding in spring: sugar water, pollen patties
 - Inspect for signs of swarming and perform splits
 - Remove entrance reducers and install screened base boards when weather warms
 - Summer:
 - Varroa mite counts and treatments if necessary
 - Install queen excluder and honey supers...don't let colony fill brood chambers with honey or the queen doesn't have space to lay eggs
 - Clean up cross combing and trim grasses/foliage away from hives
 - Prevent robbing from wasps, ants, mice, etc
 - Fall:
 - Leave 70-80lbs of honey in hive for colony
 - Consume 1/3 during the winter and 2/3 in spring when Queen rebuild colony of drones and workers
 - Make candy boards for supplemental winter feeding/moisture control
 - Install solid base boards, add entrance reducers, other insulating measures
 - Winter:
 - Winter Solstice Oxalic vaporization
 - Keep snow cleared from entrance and hive body to maintain ventilation and reduce condensation and black mold

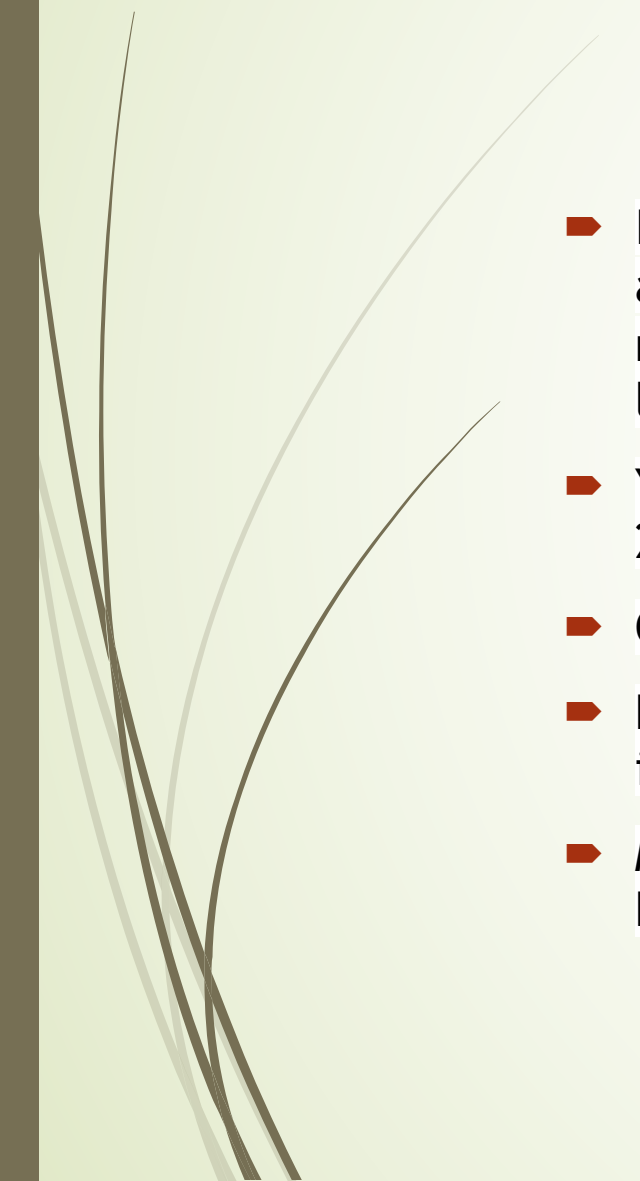
Value Added Revenue

- Your operation model may allow for the production of secondary products
- Depending on your market outlets, you can capture more profit by diversifying your offerings





Colorado Cottage Foods Act



- In 2012, the Colorado legislature enacted the Colorado Cottage Foods Act, allowing limited types of food products that are non-potentially hazardous (do not require refrigeration for safety) to be sold directly to consumers without licensing or inspections
- You are required to take their training course and renew your certification every 2 years
- Colorado State University extension service conducts the trainings
- Local health departments will require this certification if selling Cottage Foods items at a local farmer's market
- Must abide by labeling requirements for all products produced under Cottage Foods Law

Cottage Foods Certification

- Baked goods (that do not require refrigeration or contain meat products)
- Pickled vegetables
- Dehydrated vegetables
- Dehydrated herbs and spice blends
- Eggs
- Jams, jellies, and preserves



Value Added Product Ideas

- Plant starts for Spring and early summer markets or local nurseries and landscapers
- Compost tea
- Seed packets
- Cut or dried flower arrangements
- Honey
 - Beeswax, salves, lip balms
- Get creative!



Farm Success

- ❖ Time
- ❖ Be realistic with crop plans and farm development...may take several years to achieve your goals
- ❖ Observe!
- ❖ Conduct experiments and keep a scientific log
- ❖ Adapting, willingness to change
- ❖ Recordkeeping...handwritten will do, utilize technology if desired
 - ❖ We learn from our mistakes but we also want to replicate our success
- ❖ Set goals, have discipline and determination
- ❖ Adhere by boundaries
- ❖ Create a network with other farmers whom you can learn from and ask questions
- ❖ Be resourceful
- ❖ Utilize resources and apply for grants
- ❖ Seek funding if necessary











Sources for Organic Seeds

- FedCo Seeds
 - Peaceful Valley Farm Supply
 - High Mowing
 - Botanical Interests
 - Sandia Seeds
 - Baker's Creek Heirloom Seeds
 - Eden Brothers
 - Harris Seeds
 - Seed Calculator tools:
 - Johnny's Seed Supply
 - Osborn Quality Seeds
- 