An Introduction to Sustainable Farming

OSU Extension Small Farms
What is sustainability?

- “Leave the world better than you found it, take no more than you need, try not to harm life or the environment, make amends if you do.”
  –Paul Hawken

- “Sustainable design is the careful nesting of human purposes with the larger patterns and flows of the natural world...”
  –David Orr

- The word "sustain," from the Latin sustinere (sus-, from below and tenere, to hold), to keep in existence or maintain, implies long-term support or permanence.
What is sustainable agriculture?

- A farm system that mimics as closely as possible the complexity of a healthy and natural ecosystem.
- Goals include:
  - Providing a more profitable farm income.
  - Promoting environmental stewardship.
  - Promoting stable, prosperous farm families and communities.
Sustainable Agriculture:

- Reduces inputs.
- Uses ecological pest and weed management strategies.
- Cycles nutrients back into the soil for fertility and health.
- Strengthens rural and urban communities.
- Produces viable farm income.
- Promotes healthy family and social values.
- Brings the consumer back into agriculture.
Sustainable Agriculture

- Sustainable describes farming systems that are "capable of maintaining their productivity and usefulness to society indefinitely. Such systems... must be resource-conserving, socially supportive, commercially competitive, and environmentally sound." [John Ikerd, as quoted by Richard Duesterhaus in "Sustainability's Promise," *Journal of Soil and Water Conservation* (Jan.-Feb. 1990) 45(1).]
Types of Sustainable Farming

- Organic farming
- Biodynamic
- Permaculture
- Agroecological Systems
- Low-input
Why Sustainable Agriculture?

- Environmental Damage
Why Sustainable Agriculture?

- Economic concentration of agribusiness gives farmers little power or control over production, marketing and distribution.
- Loss of farms -- 155,000 farms were lost from 1987 to 1997 and 30 million acres have been lost to development.
Table 1. Comparison of the industrial and biological models of agriculture.

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<th>Industrial model</th>
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“The best way to communicate the meaning of sustainable agriculture is through real-life stories of farmers who are developing sustainable farming systems on their own farms.”

- John Ikerd
Environmental Sustainability

- Sustainable agriculture can be viewed as management of a production system where there is a multitude of complex interactions occurring between soil, water, plants, animals, climate and people.

- The GOAL is to integrate all these components into a solid production system that benefits all participants.

- Farms stay environmentally sustainable by mimicking natural processes and ecosystem function.

- Diversifying our farms with various enterprises, both animals and crops, we manage risks a whole lot better.
Cattail Creek Lamb, Junction City, Oregon
Energy flow is the pathway of sunlight through a biological system.

In relation to the farm, energy capture is enhanced by maximizing the leaf area available for photosynthesis and by cycling the stored energy through the food chain.

We make money in farming by capturing sunlight – in essence, we are farming the sun (and the soil).
Farm as an Ecosystem: Water Cycle

- An effective water cycle includes: no soil erosion, fast water entry into the soil and the soil’s ability to store water.

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

- Effective water use on the farm results in low surface runoff, low soil surface evaporation, low drought incidence, low flood incidence, high transpiration by plants and high seepage of water to underground reservoirs (Savory and Butterfield, 1999).
Farm as an Ecosystem: Mineral Cycle

- In nature, minerals needed for plant and animal growth are continuously being recycled through the ecosystem.
- An effective mineral cycle is one where there is a movement of nutrients from the soil to crops and animals and then back to the soil, basically a circle of nutrient renewal.
- Ways to enhance this cycle on the farm include: on-farm feeding of livestock, careful management of manure and crop residues, and practices that prevent erosion.
Source: ATTRA. Illustration by Andrea Fournet
Farm as an Ecosystem: Biodiversity

- A farm will be dynamic and healthy if it has a high diversity of plants and animals (above and below).

- GREATER DIVERSITY = GREATER STABILITY
Social Sustainability

- Buying farm supplies locally rather than from out-of-state.
- Educating your community about sustainable food production.
- Direct marketing through CSAs and farmers’ markets builds community and social sustainability.
- School tours and farm internships.
- Quality of life on the farm for everyone involved with clear communication and general happiness with farm work.
Economic Sustainability

- Selecting profitable enterprises.
- Sound financial planning.
- Direct marketing.
- Risk management.
Applying the Principles: Soil Fertility Management

- Goal is to sustain high crop productivity and crop quality in food and fiber production as well as in grass farming.
- Strive to keep the soil covered throughout the year, whether with permanent pasture or cover crops and green manures.
- Maintain or build soil organic matter levels through inputs of compost or cover cropping.
- Properly timed or limited tillage.
- Irrigation management to reduce erosion and runoff.
- Sound crop rotations, soil amending and organic fertilizing techniques.
- Balanced levels of available plant nutrients and balanced PH.
Soil Fertility: Cover Crops

- Perennial and biennial sod crops, annual green manures, and annual cover crops all build soil. Examples include vetch, rye, oats, fava beans, clover, buckwheat, sudangrass and sunnhemp.

- Increase nutrient availability.

- Temperature, moisture conditions, placement of the residue and quality of the cover crop influence nutrient release.
Soil Fertility: Cover Crops

- Cover crops improve the soil’s physical properties with carbon and nitrogen cycling.
- Some cover crops actually suppress certain parasitic nematodes and soil borne diseases, i.e. rye, triticale, mustards.
- Cover crops have superb weed suppressing effects by competing with weeds for light and smothering unwanted plants or through allelopathy.
- Reduce erosion and attract beneficial bugs.
Peas, Vetch & Oats
More Vetch, Bell Bean and Oats
Soil Fertility: Composts

- Use of compost in crop production and grass farming is beneficial to build soil organic matter, add nutrients to the soil and retain water.
- Nutrient contribution of manure-based compost is balanced between N-P-K. Have a compost nutrient assessment done.
- How much compost to apply and timing is different on each farm.
- Ease and economics of use, local availability and costs as well as variability of quality.
Animal Manure

- The use of fresh or undecomposed manure in agricultural systems is of great benefit to the farm.
- Integrate grazing animals or other livestock onto your farm to produce compost for your fields.
- There are variations in nutrient profiles of animal manures.
- If using raw manure, cannot apply to fields for organic certification less than 120 days before harvest.
Composting
On-Farm Composting
Soil Fertility: Tillage

- Prepares the ground for seedlings and transplants.
- Provides a range of residue incorporation options.
- Enables the incorporation of amendments.
- Improves soil aeration, and breaks up soil clods to form good seed and root beds.
- Improves water infiltration.
- Increases rate of microbial activity and mineralization.
- Deep tillage can break through compacted layers.
Tillage

- Accelerates the rate and extent of long-term declines in soil organic matter.
- May increase sub-soil compaction.
- High energy and labor costs.
- Loss of soil organic matter from excessive tillage can lead to crusting of bare soils.
Reduced and no-tillage systems

- Residue cover protects the soil from wind and water erosion.
- Allows for greater moisture retention in rain-fed systems.
- These systems build soil organic matter over a period of years, and reach a higher “steady state” level than tilled systems in the same environment.
Reduced and no-till systems

- Residue cover lowers soil temperature, which delays seed germination and slows seedling growth and may place growers at an economic disadvantage.
- Weed control is very difficult without the use of herbicides.
- Requires specialized equipment to plant through thick layer of residue.
- Increased leaching of nutrients and herbicides into the groundwater has been shown in some conventional reduced and no-till systems after many years of these practices.
Spader
Tilling with Row Markers
Rototiller Preparing Seed Beds
No-Till Roller
Deep Tillage Chisel Plow
And yes, farmers do still plow with horses!
Soil Fertility: Soil Amendments & Supplemental Fertilizers

- Organic amendments and fertilizers are useful as long as they are in balance with the rest of the system. Use soil test to find deficiencies.

- Balance nutrient inputs with nutrient outputs each year.

- Inputs>outputs=accumulation. Results in risk of excess nutrients creating nonpoint source pollution and enhancing disease and pest incidence.

- Inputs<outputs=soil depletion. Potential risk of plant nutrient deficiencies and stress, reduced yield, and increased susceptibility to pest and pathogens.
Soil Fertility: Crop Rotation

- Break weed and pest cycles.
- Provide complementary fertilization to crops in sequence with each other, i.e. legume crops preceding corn or tomatoes.
- Prevent buildup of pest insects and weeds.
- In some cases, yield increases follow from the “rotation effect.”
- Ideal rotation includes planning over the long-term with fields in rotation of crops, cover crops or sod, and livestock.
Crop Rotation Considerations

- Avoid rotation of crop species that share similar pests and diseases. Intersperse with different crops to break pest and disease cycles.

- Rotate crops to maximize use of nutrient inputs and distribute nutrient demand placed on soil.

- Think about fallow periods and perennial cover crops.

- Intercropping is the growing of two or more crops in proximity to promote interaction between them.
Various Crop Rotations

Year One:
Seed Crop

Years Four and Five:
Grass

Year Two:
Legume (Kale or Turnip)

Year Three:
Undersown Seed Crop (Myrtle oats or Bere)
Guidelines for Crop Rotations

- Follow a legume-sod crop with a high-nitrogen-demanding crop such as corn to take advantage of the nitrogen supply.
- Grow less-nitrogen-demanding crops such as oats, barley, or wheat in the second or third year after a legume sod.
- Grow the same annual crop for only one year if possible to decrease the likelihood of insects, diseases, and nematodes becoming a problem.
- Don't follow one crop with another closely related species, since insects, disease, and nematode problems are frequently shared by members of closely related crops.
- Use longer periods of perennial crops, such as legume sod, on sloping land and on highly erosive soils.
- Use crop rotations that promote healthier crops.
- Try to grow a deep-rooted crop, such as alfalfa, safflower, or sunflower as part of the rotation.
- Grow some crops that will leave a significant amount of residues, like sorghum or corn harvested for grain, to help maintain organic matter levels.
Ecological Weed Management

- Improve soil tilth, aeration, water infiltration, and fertility to optimize crop growth and minimize weed pressure.

- Thoroughly clean equipment before moving it from one farm or location to another to avoid transporting weed seeds from infested fields.

- Do not allow weeds to form seed heads and/or perennial rooting structure in the cropping systems.

- Thoroughly compost all imported animal manure to insure destruction of viable weed seed.

- Work with neighbors to eliminate or minimize the potential for spread of noxious and problematic weeds from adjacent lands.
Cultural Weed Practices

- Crop Rotations
- Tillage
- Planting and Cultivation
- Rotational Grazing
- Mowing
- Irrigation
- Flame Weeding
- Mulches
Allis Chalmers Basket Weeder
Ecological Pest Management

- Intercropping, diversity and cover cropping
- Crop rotation
- Farmscaping
- Use of resistant varieties
Ecological Pest Management

- Biological controls
- Organic chemical controls
- Physical controls
Integrated Pest Management (IPM)

- Basic framework used to decide when and how pests are controlled.
- Goal is to give growers management guidelines in order to make pest control economic and environmental.
- Integrates habitat modification and cultural, physical, biological and chemical practices to minimize crop losses.
- Monitoring, record keeping, and life-cycle information about pests and their natural enemies are used to determine which control measures are necessary.
Plant Disease Manipulations

- Environment manipulations include increasing plant spacing to reduce humidity, regulating irrigation, and choosing where crop is grown.
- Host manipulations include resistant cultivars, pathogen-free planting materials, crop rotation and intercropping.
- Pathogen manipulations include keeping them out of the field by removal of host tissue or organic chemical controls (neem, copper, sulfur etc.)
Plant Disease Management

- Use crop rotations, biodiversity, resistant cultivars, clean seed and soil fertility measures to prevent plant diseases.

- Compost teas can help control fungal diseases. Foliar sprays are also effective.
Rotational Grazing

- Skillfully using livestock to harvest forages leads to improved soil fertility, a diverse, dense, and useful pasture ecology, and an extended grazing season. Fertile soil and productive pastures, in turn, support healthy animals.

- In a system of controlled rotations, pastures are subdivided into paddocks – fenced acreage of any given size. Livestock is moved between paddocks at frequent intervals, giving animals access to a limited pasture area over a short period of time.

- As a result, the plants have time to recover, the roots maintain energy reserves, and the livestock always have high quality forage.

- A primary strategy of controlled grazing is to use fencing and livestock movement as tools to manage forage growth and protect it from overgrazing.
Sustainable Pasture Management

- Management is key to healthy and sustainable pastures.
- Lands most susceptible to erosion can be maintained as permanent sod.
- Land used for row crops benefits from a year or more in pasture as part of a crop rotation plan.
- Soil health improves as the content of organic matter increases under good grazing management.
- Soil structure improves over time as compaction and hardpan is reduced.
- Good pasture mixes include a variety of grasses, forbs and legumes.
Mixed Species Grazing

- Cattle prefer grass over other types of plants, and are less selective when grazing than sheep or goats. Sheep and goats, on the other hand, are much more likely to eat weeds.

- Mixed species grazing may also benefit pastures that are less diverse, by encouraging more even grazing.

- Parasite control.
Bringing It All Together: Integrated Farming Systems

- Goal is to find and adopt "integrated and resource-efficient crop and livestock systems that maintain productivity, that are profitable, and that protect the environment and the personal health of farmers and their families," as well as "overcoming the barriers to adoption of more sustainable agricultural systems so these systems can serve as a foundation upon which rural American communities will be revitalized."
Organic Certification

- All producers who would like to certify must follow organic standards set out by USDA.

- There are a number of rules to follow, but the principles laid out today should directly follow that of organic production.

- In general, organic rules do not allow synthetic fertilizers, pesticides or herbicides in crop production or the use of antibiotics, hormones and non-organic feed in livestock. Livestock must also have access to pasture.

- For more information on how to certify, go to http://www.ams.usda.gov/nop/ or talk with me individually. Oregon Tilth is also a source of information: www.tilth.org.
Case Studies

- Blue Fox Farm, Applegate, Oregon
- Six acres of over fifty different types of organic vegetables
- Active soil fertility program including using raw and pelleted chicken manure, winter and summer cover cropping, and active crop rotations.
- Weed management includes mechanical and hand cultivation and mowing.
- Use botanical sprays for disease and pest suppression as well as crop rotations.
Blue Fox Farm

- Direct market to a thirty-person CSA, two farmers’ markets, a number of restaurants and the local natural food groceries.
Larry Thompson—Boring, Oregon

- 43 fruit and vegetable crops on 140 acres.
- Direct markets through farm stand, farmers markets and pick-your-own.
- Dedicated advocate of crop rotations and planting a succession of flowering species to control pests without pesticides. He relies on cover crops to control weeds and provide habitat for beneficial insects.
More on Larry Thompson

- Thompson allows native grasses and dandelions to grow between his berry rows. The mixed vegetation provides an alluring habitat that, along with flowering fruit and vegetable plants, draws insects that prey on pests.
Bob Muth, Williamstown, New Jersey

- 11 acres in mixed vegetables and cut flowers
- Three-quarters of an acre in strawberries sold from a roadside stand
- 40 acres of hay
- The farm grosses between $150,000 and $300,000.
Muth Farm

- Muth designs long rotations and makes extensive use of cover crops. Only about 20 percent of his 80 acres is in vegetable crops at any one time. He also adds extra organic matter by spreading the leaves collected by local municipalities on some of his fields each autumn.

- In a typical rotation, after the vegetable crop is turned under in the fall, he covers the ground with up to six inches of leaves, about 20 tons per acre. The following spring, he works in the decomposing leaves. His soil-building program has now given him fields that test as high as 5 percent organic matter, unheard of for the mineral soils of southern New Jersey.
Richard and Peggy Sechrist
Fredericksburg, Texas

- 50-head beef cattle herd
- 750-1,000 pastured chickens per month
- Certified organic beef and poultry sold to "natural foods" outlets
- The Sechrists work within the dry cycles by maintaining their pastures in native grasses. They graze three herds of cattle - one-year-olds, two-year-olds and a cow-calf herd - in a planned rotational approach.
More on the Sechrists

- Rotating the herds is based on a fairly sophisticated system of monitoring plant growth and recovery. The cattle are grass-fed, with alfalfa hay as needed as a supplement. The cattle don't receive any antibiotics or synthetic treatments.

- Market beef and poultry through Homestead Healthy Foods, a direct marketing company that sells at farmers markets’, fairs, over the internet, and health food stores.

- "Our basic herd health is excellent," Peggy says, “…our pasture management is the most important factor."
Travis and Amy Forgues
Alburg Springs, Vermont

- 80 milking cows on 220-acre pasture-based, organic dairy farm

- Their property is split into 10-acre permanent paddocks, using movable fences to subdivide those into smaller areas. They move the herd to fresh ground twice a day.

- They are part of Organic Valley, a farmer-owned cooperative that accepts milk from farmers in 14 states, marketing the product by region.

- They strive to receive 23 cents a pound for milk, a strategy Travis calls "farm-gate" pricing, or fair compensation for their labor. By contrast, the industry average for milk produced and marketed conventionally is about half that.

- As a certified organic operation, the Forgues forego any chemical pesticides or fertilizers. They eschew hormones or antibiotics, and take a proactive approach to sick cows, culling them quickly if a homeopathic remedy doesn't work.
Sources of Information for New Farmers

- ATTRA – www.attra.org
- SARE – www.sare.org
- Oregon Small Farms – http://smallfarms.oregonstate.edu/
- OFRF – www.ofrf.org
- The New Farm – http://www.newfarm.org
Good Books

- *Sustainable Vegetable Production from Start-up to Market*, Vernon Grubinger
- *Small-Scale Livestock Farming: A Grass-Based Approach for Health, Sustainability, and Profit*, Carol Ekarius
- *Successful Small-Scale Farming: An Organic Approach*, Karl Schwenke
- *Pastured Poultry Profits*, Joel Salatin
- *Pests of the Garden and Small Farm*, Mary Louise Flint
Periodicals

- Small Farmer’s Journal
  http://www.smallfarmersjournal.com/

- Growing For Market
  http://www.growingformarket.com/

- In Good Tilth http://www.tilth.org/Newsletter.html

- Small Farm Today http://www.smallfarmtoday.com/

- Stockman Grass Farmer http://stockmangrassfarmer.net/

- ACRES USA http://www.acresusa.com

- Capital Press http://www.capitalpress.com